IRAQ MARSHLANDS RESTORATION PROGRAM

ACTION PLAN

APRIL 2004

FORWARD Task Order
Water Indefinite Quantity Contract
U.S. Agency for International Development

Collaborating Entities

U.S. Agency for International Development
Coalition Provisional Authority
Ministry of Water Resources
Ministry of Agriculture
Ministry of Environment
Ministry of Public Works
Development Alternatives, Inc., *Prime Contractor*
AMAR International Charitable Foundation
AquaMatrix International, Inc.
Commonwealth Scientific and Industrial Research Organization
Duke University Wetland Center
ECO Consult
Iraq Foundation
MRAG Americas, Inc.
Royal Holloway Institute of Environmental Research, University of London
University of Basra College of Agriculture
University of Basra Marine Science Center
United States Army Corps of Engineers

Photographs

Boatmen inside Hammar Marsh

At a milk collection point along Prosperity River where small trucks travel through settlements

Along Prosperity River, a villager with his water buffalo

A fisherman in Hawizeh Marsh

TABLE OF CONTENTS

EXECUTIVE SUMMARY

Background

The Iraq Marshlands Restoration Program is funded by the U.S. Agency for International Development (USAID) through the FORWARD task order, contracted under the Development Alternatives, Inc. (DAI) Water Indefinite Quantity Contract (IQC). The program is a twelve-month effort which supports the restoration of the ecosystem through improved management and strategic reflooding and provides social and economic assistance to the local population. These two tracks – environmental and developmental – are necessarily integrated, reflecting the historic harmony of the marshlands and their indigenous population.

The Iraq Marshlands Program operates at both a national and a marshlands level. At the national level, it works directly with and under its lead government entity, the Ministry of Water Resources. The following efforts are designed to support the key decision-making by the government about marshlands management and restoration, generally, and the operations of the ministry, specifically:

- *Strategic planning for CRIM* – assisting the Center for the Restoration of the Iraqi Marshlands as a newly-formed entity to determine its vision, mandate, responsibilities, programs, and organization within the context of the Ministry of Water Resources and other involved ministries

- *Hydrologic basin modeling* – enabling a partnership between the U.S. Corps of Engineers and the Ministry of Water Resources to develop the first hydrologic model of the Tigris-Euphrates basin

- *Hydraulic modeling* – focusing on one major marsh in the South to develop a profile for understanding the dynamics of reflooding and assisting in the designation of the marsh as a World Heritage site

- *Database development* – developing a database within CRIM to house water, soil, vegetation, social, and economic information about the marshlands for ongoing analysis and decision-making

- *Water and soil laboratory* – developing laboratory facilities and a capacities for soil and water analysis

- *International study tours and short courses* – building capacity in and commitment to wetland management and marsh restoration through study tours to the Everglades, Louisiana, and the Danube for officials from different ministries and from the research and university communities

- *Comprehensive donor strategy* – preparing a consensus-driven plan for long-term marsh restoration that reflects national and international views and commitments

In the marshlands, the program proposes to implement six discrete, but closely related, activities focusing on:

- *Integrated marsh management* – assessing the nature and distribution of reflooding and develop management options for future actions

- *Agricultural production and agribusiness* – diversifying agricultural production in the marshlands with higher value crops through demonstrations and nurseries

- *Livestock and dairy production* – addressing major sector constraints with veterinary services and the introduction of a new forage crop and supporting women and girls through education and income-generation initiatives

- *Capture fishing and fish farming* – increasing the population of high-valued fish in the marsh waters and encouraging aquaculture to increase incomes

- *Primary health care* – extending health care and related educational services to the marshlands populations, given that few clinics operate and that medical services are rarely available

- *Constructed wetlands* – building engineered wetlands to dramatically improve wastewater systems, public health, and overall water quality in the marshlands using low technology and natural processes

Program Objectives

The overall objectives of the program are the following:

- Improve the social and economic lives of marsh dwellers;

- Assess the success of wetland restoration and help guide government policies and decisions;

- Strengthen Iraqi commitment to marshland management; and

- Reach national and international consensus on long-term restoration strategies.

Program Guidelines

The program will be implemented using the following guidelines:

- Work in close implementation with the Government of Iraq and the Coalition Provisional Authority.

- Design and carry out activities using collaborative planning with our Iraqi partners.

- Place the views, concerns, and perspectives of the marsh dwellers at the center of the program and ensure that they guide decisions about marsh restoration and economic development.

- Adopt integrated economic development and ecosystem management as the framework for the program.

- Work to ensure the sustainability of program initiatives.

- Develop local capacity in wetland management and improved governance.

- Emphasize income generation.

Implementation Approach

The following are key components of the program's implementation approach for the activities in the marshlands:

- *Collaboration.* Reaching consensus among national ministries in Baghdad, governorate offices in the South, the marsh dwellers, and the program in a four-way partnership on the vision of the range of services to be provided and on commitments for each's contribution.

- *Advocacy.* Ensuring that the voice of the marsh dwellers is heard and incorporated into decisions made about the restoration of the ecosystem and their social and economic future.

- *Income generation.* Providing critical services and technologies to stimulate production and improve livelihoods of the poorest and most under-served people in Iraq.

- *Governance.* Working with government institutions and NGOs to develop effective and reasonably-priced strategies to provide help to under-served areas and build local entities in the process.

- *Capacity-building.* Harnessing underutilized, but talented, Iraqi expertise in the government and private sector to make an important contribution to rural welfare and boost the skills and pride of the country's labor force.

- *Physical presence.* Establishing on-the-ground initiatives which integrate and build on different activities to enhance program impact and increase the trust and confidence of the government and local population in the program.

Action Plan Design

In February 2004, a diverse team of 71 experts from six countries[1] joined together to design an action plan focusing on integrated marshlands management through ecosystem management and restoration and social and economic assistance for the local population of largely displaced and widely persecuted marsh dwellers. The team included international consultants; officials from the Ministries of Water Resources, Agriculture, and Environment and governorate offices in Misan, Nasiriyah, and Basra; university faculty and research center staff of the College of Agriculture and Marine Science Center of the University of Basra; and representatives of the non-governmental organizations Iraq Foundation and AMAR International Charitable Foundation.

During the month, the team divided into six operational units exploring the status of and opportunities for marsh management, agriculture, livestock, fishing, public health, and constructed wetlands. The team made extensive visits throughout Misan and Thi-Qar governorates in Hawizeh, Hammar, Central and smaller adjacent marshes. Working as technically focused units, they interviewed and explored on-the-ground activities of the former marsh dwellers, who comprise most of the population, and the few people who now live inside Hammar marsh on islands resembling a lifestyle all but terminated by the drainage of the marshes in the 1980s and 1990s. The team met with tribal sheikhs, leaders, farmers, fishermen, women herders, local service providers, and market agents and operators in marsh settlements, in mudhifs, in fields and pastures, on boats, in clinics, and in markets. The team has developed a detailed analysis which together is the most comprehensive account of the marsh ecosystem and socioeconomic situation to date. It was also charged with preparing an action plan which identified major constraints, defined objectives for an action program, and designed specific tasks for implementation. This volume contains those analyses and action plans.

Program Activities

The Iraq Marshlands Restoration Program operates at both the national and regional levels.

Activities at the National Level

Although the design efforts in February and this volume largely focus on local implementation in the marshlands, the Iraq Marshlands Restoration Program has a robust initiative at the national level. It will work closely with the Ministry of Water Resources as its lead Government of Iraq counterpart.

1. Hydrologic and Hydraulic Modeling

- Hydrologic model of the Tigris-Euphrates basin by US Army Corps of Engineers
- Hydraulic model of Hawizeh marsh in cooperation with Italian government

[1] Team members were from the following countries: Iraq, the United States, the United Kingdom, Jordan, Australia, and the Czech Republic.

2. Capacity-building in Marshland Management and Restoration

- Water and soil laboratory in Ministry of Water Resources in Baghdad
- Upgraded laboratory capacity at University of Basra
- Integrated marshlands database in the Ministry of Water Resources with GIS functions
- Short courses and study tours to Everglades and Danube

3. Strategic and Comprehensive Marshlands Planning

- Strategic plan for involved national ministries and regional offices related to marsh restoration
- Comprehensive restoration strategy for GOI and donors

Marshlands Program Activities

1. Develop an Integrated Marshlands Management Plan

Marsh restoration must be part of an integrated plan for the region, which takes account of other land use sectors and economic activities. The plan for integrated marshland management will achieve this objective. The extent and impact of the reflooding remain largely unknown. This activity seeks to provide an assessment of where the reflooding occurred, how it shifts over time, and what are the ecological responses, which result from newly increased flows in terms of water, soil, vegetation, wildlife, society, and economy. It also serves as the basis for the identification of monitoring sites for development of protocols for assessment of ecosystem functions, criteria for selection of sites for future reflooding, characterization of immediate and long-term affects on water, soil and biotic/resources, assessment of the impact of reflooding on local populations as well as the development of a plan for integrated marshlands management.

Objectives

The objectives of this integrated marsh management activity are to:

- Assess the nature and distribution of reflooding on the landscape;
- Determine the ecological and environmental effects over time of reflooding on biodiversity and ecosystem functioning;
- Determine the impact of reflooding on the local stakeholders; and
- Assist in the development of an integrated management plan for marshlands: land-water-living resources.

Marsh Management Tasks

- **Task 1: Assess the Nature and Distribution of Flooding on the Landscape and Hydrologic Conditions Using Satellite Imagery and Hydrologic Records**

Satellite imagery provides a unique perspective for both short-term and long-term monitoring of wetland ecosystems and in changes in adjacent land cover, which affect them. Visible and near-infrared imagery, such as that collected by Landsat, Quickbird, and Ikonos, is an excellent tool for monitoring marsh vegetation cover and changes to vegetation associated with land use activities, as well as the effects of longer-term changes in the hydrologic regime. In addition, under certain conditions, the spatial extent of flooding or inundation in wetlands can be directly monitored using these systems if: the ground is not obscured by cloud cover; and wetland vegetation is of low density. Imaging radar systems provide another means for remote monitoring of wetland systems. The wavelengths of the electromagnetic energy transmitted and received by imaging radars are not influenced by cloud cover or rain at the time of collection. Also, the levels of biomass typically found in marshes that do not have woody vegetation do not impede direct sensing of the water and ground surface by these systems. Thus, imaging radar systems can be used to directly detect flooded versus unflooded surfaces in marshes and monitor variations in soil moisture. Because these systems are not influenced by cloud cover and rainfall, they can be used to continuously monitor wetlands that are periodically flooded due to seasonal precipitation patterns, a capability that is not available using visible/near infrared systems.

- **Task 2: Develop Protocols for Assessing Ecosystem Functioning**

A quantitative description of wetland species or a complete listing of flora and fauna present at a site only provides a superficial understanding of ecosystem health. In order to gain the most comprehensive understanding of wetland health and of the success of wetland restoration, Task 2 will examine organisms as bio-indicators and as indicators of ecosystem functioning. In wetland ecosystems, this involves a range of techniques from the use of algal indicator species to the use of indicators of ecosystem level responses. Indicators need to be selected at various trophic levels including algal, plant, macroinvertebrates, fish, and, birds. Indicators of ecosystem structure and function, such as productivity, community habitat, biodiversity, biogeochemistry, and hydrologic dynamics, will also be monitored. In addition, the technical team will develop a comprehensive plan for sampling and monitoring prior to any field sampling. This will determine if there are any population shifts along salinity, nutrient, water or elevation gradients. To aid in the location of representative stands, it is recommended (although it may not be presently possible) that aerial photos or low level flights be used to determine the number of communities in each study area. . Once the scale of testing is determined, the team will determine the size, number, and location of the permanent plots with the monitored wetland.

- **Task 3: Develop an Integrated Marsh Management Plan**

Marshland restoration is only one of the elements necessary to improve human welfare and strengthen economic conditions in a sustainable way in southern Iraq. It cannot be achieved in isolation from other social and economic activities, and neither is it possible to separate it

from technical questions related to overall water availability and the needs of competing water demands. Within the areas of the restored marshlands, there are other sectors which require consideration within an overall integrated approach – particularly agriculture, livestock, oil and other economic activities. Task 4 seeks to integrate these different pieces of the marshlands puzzle into a comprehensive plan for use by the Government of Iraq as it develops policies and procedures concerning long-term marsh management and economic development in the southern wetlands.

2. Encourage Agriculture and Agribusiness

Constraints

Agriculture in the marshlands is poor, even in the areas where former marsh dwellers have been cultivating for more than a decade. The major reasons for the low level of success in agriculture are the following:

- *Low levels of productivity enhancing inputs, especially fertilizer*. Access to inputs is difficult given the remote locations of many former marsh dwellers, and costs are sometimes prohibitive.

- *Poor or unknown resource base*. The condition of the soil is dependent on how quickly the marsh was dried, the number of years it has been dry, and whether the area was burnt after desiccation occurred, all of which are generally unknown.

- *Lack of knowledge*. Few former marsh dwellers have access to extension services or other means of acquiring knowledge of production techniques or technologies.

- *Lack of or prohibitive distance from markets*. Former marsh dwellers lack knowledge of markets, and many have transportation problems.

Despite these many difficulties, the agriculture team saw enough good agriculture in the marshes to believe that program interventions designed to tackle some of the main issues noted above can help former marsh dwellers to succeed in agriculture. The program of five activities presented below has the following objective:

Objective

The objective of the agriculture activity is to jumpstart agriculture production and agribusiness in the desiccated marshes and identify opportunities for and prepare former marsh dwellers to participate fully in a growing and more profitable Iraqi agricultural economy in the future.

Agriculture Tasks

- **Task 1 – Carry Out Large-Scale Crop Demonstrations for Field Crops and Horticulture**

Former mash dwellers have had little or no training or extension in how to grow, manage, or harvest crops. The agriculture team proposes a set of large-scale demonstrations in four locations in the drained areas of the Hawizeh, Central, and Hammar marshes to overcome the knowledge constraint in agriculture. The task coincides with a large-scale crop demonstration program conducted by the Ministry of Agriculture and supported by the Agriculture Reconstruction and Development for Iraq Program (ARDI). In consultation with the local population, the program will select five hectare sites in three locations which have good soil and water characteristics. Sites will be selected using the soil and water indicators to be developed. Working with communities, a technical team will demonstrate proper cultivation methods for commonly grown and easily marketed crops in the region. For summer, the agriculture team is proposing sorghum and maize, and for winter, wheat, barley, tomato under plastic, and broad bean. Other crops may be introduced as more information is gathered. Farmers will be encouraged to use simple farm record keeping sheets to track expenses and labor utilization. Dissemination will be supported by farmer field days for other former marsh dwellers to show agricultural techniques aimed at creating profitable cultivation and the use of the soil and water indicators kits.

- **Task 2 – Establish Date Palm Nurseries for Growing and Distributing Off-Shoots**

Date palms have the potential of earning significant export revenues for Iraq. The country is blessed with 629 varieties of date palms, many of which qualify as high-end export varieties capable of generating substantial revenues for individual farmers and for exporters. Dates are mainly exported to the Arab Gulf, but with the fall of the former regime, Iraqis, in both the public and private sectors, intend to put great efforts in expanding their market for dates to Europe, North America, and Japan. There is also a large internal market for dates. Date palms have cultural value as the symbol of Iraq, and recovery of this sector is viewed as more than an economic goal. It symbolizes the recovery of the nation.

Date palms were traditionally important in southern Iraq. To punish the people of the region, the former regime destroyed many palm orchards through either cutting the trees or starving them of water. The result is that nationwide, the number of date palm trees has decreased to about 50 percent of the total 20 years ago, and the percentage loss is higher in the south than any other part of the country.

The Ministry of Agriculture with the assistance of ARDI, has embarked on a program to establish nurseries in every date-growing governorate in Iraq, and in Basra, because of the importance of date palms the program envisions establishing three nurseries in this governorate. The purpose of this task is to develop a source of supply of off-shoots for farmers wishing to grow dates and to protect the country's rich genetic resources of this crop. The agriculture team for the Iraq Marshlands Restoration Program proposes to work with the MOA and the ARDI team to establish two additional date palm nurseries in desiccated marshlands.

The Marshlands Program proposes to begin with two date palm nurseries, each 10 dunum or 2.5 hectares in size, one each in the Hammar Marsh and in Hawizeh Marsh. Each dunum (2,500 square meters) will support 1,000 date palm offshoots, and this in turn will provide after about one year's time an additional 28 dunum (assuming the usual 70 percent survival rate) of date palms. Thus, two 10-dunum nurseries will supply enough off-shoots after one year to plant 560 dunums of date palms, after one year alone. The team and the MOA governorate offices in Nasiriyah and Al-Amarah will work together to determine the appropriate means of distributing off-shoots to the marsh dwellers.

This task will initiate a long-term program of development for the marsh dwellers. Date palms require between three and four years before fruit production begins, and full production commences only after eight or ten years. None the less, this effort, when it reaches full production levels, has the potential to provide significant and long-term stable income for the local population. In addition, the task has the opportunity to provide incomes to an increasing number of families as time goes on. The date palms off-shoots in the first year will continue to produce off-shoots in years to come. A well-established program of supply and distribution has the potential to have an effect for a long time to come.

3. Re-establish Livestock and Dairy Production

Livestock have always been an important part of the marsh economy, but with the drainage of the area, the traditional means of production were eroded and disrupted. In response to the drainage and to their general inaccessibility to water, people in the marshes made a dramatic shift to different livestock management patterns – from water buffalo to sheep. Livestock herding remains a critical endeavor in the marshes, both as a source of basic nutrition and income for families, but serious constraints exist.

Despite the evident dedication of people to their livestock, production, animal health, dairy processing, and marketing are all poor, even as the people have developed strategies to adjust to their newly imposed conditions. The main reasons for the poor performance of the livestock sector include the following:

Inadequate food supply for the animals. Animals are generally underfed, leading to low production levels. Foraging is restricted and herders do not have the resources to purchase feed. They do not cultivate forage crops like alfalfa or clover for the animals.

Unreliable and unavailable veterinary services. Although herders make occasional use of veterinary services, particularly for vaccinations, there is no veterinary service in the marshes, or likely in much of the rest of the south. Apparently, there are more than 200 unemployed veterinarians in the region. The inadequate services reflect the general rural malaise in the country. Poor animal health was consistently cited by people as one of the two most important constraints on production.

Poor Animal Stock. A serious constraint on production is the existing breeds found in the marshes. This is particularly true of cattle which are a cross between Friesian and local Al-Jenoubi (literally “southern”) breeds. The local variety is a low milk producer, but pure Friesian cattle could not survive the hot climate.

Poor or nonexistent collection and processing services. Milk collections are made in the settlements, but conditions are elementary, at best. Unrefrigerated trucks collect milk unhygienically. There are virtually no processing services available in the marshes; no plants exist in the south. People make cream and cheese in their homes using the most basic techniques. With low production, few milk and dairy products appear to reach the outside markets, in any event.

Inaccessible market infrastructure. Livestock and dairy markets in the south are characterized by poor standards for cleanliness, a lack of support services including cooling and weighing equipment, low quantities for sale which do not meet the local demand, and an absence of market information about pricing and market movement.

Objectives

The objectives of the livestock and dairy activity are to:

- Increase livestock and dairy production in the drained marshes by addressing major constraints related to animal health and nutrition;
- Improve household incomes by increasing production;
- Provide income-generating and educational opportunities to women and girls who are the animal tenders and herders and dairy marketers; and
- Provide meaningful employment to Iraqi unemployed or under-utilized professionals in the livestock sector.

Livestock Tasks

- **Task 1 – Extend Veterinary Services to Marsh Communities**

Veterinary services are essentially non-existent in the marshlands, although many talented, trained people are available and in need of work. Nationwide, statistics suggest that at least 500-600 veterinarian graduates are presently unemployed. People working in government entities in the South believe that 200 veterinarians may be seeking employment now. Those are in addition to the veterinarians already on the government lists who are underutilized and lack equipment, medicine, transport, and motivation. On the other side are the livestock owners who have little or no access to services and usually limit care to irregular vaccinations, at best. This task seeks to bring together the service providers and the service users under the umbrella of the Ministry of Agriculture as a model for collaboration with the program and effective assistance. Clearly, the most sensitive and challenging part of the task will be reaching agreement on the contributions of the parties and having those agreements honored. With the support of the government, the program will establish initially a small number of veterinary service centers which will share space with public health clinics so that together they can build momentum and interest and increase the program's impact. Veterinarian staff will make regular visits to identified areas. A monitoring effort will determine if the services do indeed boost production and income and justify continuation.

- **Task 2 – Introduce Forage Crop Cultivation to Improve Livestock Nutrition**

Throughout the marshes, animal herders uniformly identified inadequate food supply as the leading problem they face. This program is not designed to distribute animal fodder, but it can develop approaches to increase food for animals as part of an agricultural production effort. To that end, the program suggested carrying about a task to introduce alfalfa cultivation in the marshes in areas with high livestock concentrations, such as along Prosperity River.

- **Task 3 – Provide Educational and Income-Generating Opportunities for Marsh Dwelling Women and Girls**

If marsh dwellers are the poorest and most under-served people in Iraq, as seems to be the case, then marsh women and girls are clearly in the worst position. In addition to their household chores as wives and mothers, usually going from one pregnancy and childbirth immediately into another, women are responsible for many of the income-generating activities in their households. They play an important role in agriculture and post-harvest work and are essentially the exclusive managers of livestock and the sole dairy processors and marketers. Only fishing is a largely male domain. While the educational system in the marsh region is barely operating, it is boys who largely attend school. Most women and girls are illiterate. Nor are they able to retain some share of the income for themselves, despite its being almost entirely of their making. There is effectively no existing service directed specifically at women and girls, save the work of AMAR which provides midwifery services in their three clinics. This task seeks to provide women and girls with opportunities for education, albeit very limited, and income-generation, using their livestock chores as a possible point of entry in the communities.

4. Support Capture Fishing and Fish Farming

The recommendations of UNEP (2001) to promote an international agreement for the sharing of Tigris and Euphrates waters, restore and maintain the flooding regime, improve water quality, and remove river engineering works where possible would all contribute significantly to the potential recovery and production of the Mesopotamian fish stocks.

Keeping in mind the preference of some communities to keep some drained lands dry for agriculture and the limited availability of water for reflooding, the maximum fish production opportunities will be achieved by reflooding the maximum possible area reasonable. Recovery of the fish stocks will be further enhanced by keeping sluice gates open whenever possible, within flood control and agricultural constraints, to maintain fish migration routes and spawning stimuli. The natural diversity and productivity of the fishery will surely take some years to return, but there are encouraging signs that it can recover.

Objective

The objective of the fishing and fishing system activity is to increase the speed of recovery of the priority *Barbus* fish populations and encourage the sustainable management of the recovering fish stocks.

Capture Fishing and Fish Farming Tasks

- **Task 1 – Produce *Barbus Spp.* for Stocking into the Marshlands**

The recent reflooding of the marshlands has caused the less desirable asynchronous spawners such as the crucean and common carps to aggressively reproduce. The high value *Barbus* species have not reproduced yet, as they are annual spawners and have not had the opportunity and are naturally less fecund, in any case. The marshland fishery would be greatly enhanced and more balanced with more of the prime species. Task 1 utilizes available labor and upgraded existing facilities, combined with new Chemotherapeutants and technologies, to artificially spawn the *Barbus sharpeyi* for the first time. The task will immediately culture high-value and highly prized *Barbus* fingerlings through advanced fingerling stage and to stock the advanced fingerlings at select sites in the marshlands to boost overall fishing.

- **Task 2 – Co-manage Activities with Fishermen to Protect Local Stocks**

The national rules for fishing, designed to protect the Barbus fish species, are currently almost un-enforced within the marshes. Even after the June 31 hand-over of power to the Iraqi government, it is likely that mesh size and species size limits will be hard for government to enforce in most remote marsh communities. Such rules may also be sub-optimal for the exploitation of other, now-dominant species in the marshes. This activity would combine the skills, knowledge and capacities of the Department of Fisheries authorities and the local fishers and village chiefs to develop locally appropriate rules for managing fishing in 12 to 15 villages spread around the marshes.

Such rules are likely to focus on dry season refuges and migration routes. Indonesian river fish stocks that were partly protected over the dry season in community-managed reserves were 5 to 21 times more abundant, comprised up to 31 more species and were five to six times larger by weight, than in villages that used poison-fishing in the dry season. Discussions with villagers would attempt to determine the main spawning and dry season survival locations of the *Barbus* species and promote conservative actions in a selection of such areas. While protecting some areas, attention would also be paid to keeping open the maximum possible area of fishing grounds to promote catches and fishing livelihoods. Recognizing the constraints imposed by the high levels of poverty in some villages, emphasis would also be paid to the trade-offs between long term benefits and short term sacrifices.

This activity would be coordinated with the release of fish from Task 1, to specifically encourage the wise exploitation of the stocked fish in their release areas. Fishing communities may be encouraged to cooperate with the program by the lure of possible

stocking of much larger numbers of fish in 2005-2007, especially for the best collaborating villages.

- **Task 3 – Develop Aquaculture Enterprises**

The Marsh Arabs have undergone a seminal shift in their way of living, from reed based floating to terrestrial based habitation. This has resulted in an agronomic model that includes, even embraces, terrestrial agriculture. The growth of wheat, sheep and cows are now seen as a standard part of their culture. We were impressed in every village we visited, without exception, by the enthusiasm expressed for the concept of terrestrial based culture of fish. The Model Fish Farm will culture Chinese carps initially, as the culture technologies and the fingerlings of these species are readily available within the country. The *Barbus* species should be cultured in this system as they become available and protocol is developed for their culture.

- **Task 4 – Monitor Fishing Systems**

Given the ecological and physical complexity of floodplain river systems and the complex interactions between different stakeholders in specific local situations, the impact of different management interventions are very hard to predict. In the unusual situation of the Iraq marshes, where the waters have been almost completely drained, and are now being partly reflooded, the uncertainties are even greater. Where knowledge of the fishery is limited as in this case (and most others), an adaptive management strategy is recommended to guide future actions according to analyses of the results achieved in a series of management cycles.

The 1995 FAO Code of Conduct for Responsible Fisheries also requires states to adopt a precautionary approach to management. This involves setting targets and initial management strategies on the basis of the 'best available knowledge', but also collecting appropriate data to confirm that goals are being achieved and to guide future adjustments to management strategies as required.

The Ministry of Agriculture's Department of Fisheries has collected catch data for the marsh lands for many years, but not at a spatial resolution or in adequate detail to assess the impacts of this program or the other factors affecting outcomes. This task would address these constraints to knowledge about the fish populations and fishing activities in the marshes. Other data likely to affect fishery productivity (water quality, quantity, and timing) are being collected under the Integrated Marshland Management activity and should be integrated into an annual analysis of the status of the fishery.

5. Extend Primary Health Care Services

The marshlands have always been one of the most remote areas in Iraq, historically outside the general control of the government and with a record of the fewest and least developed services provided. During the 1990s, medical services were virtually non-existent in much of the region, largely the consequence of a deliberate national policy to persecute the local population. Nowadays, throughout the marshes, the situation has not dramatically

improved. Medical services are very limited, with only a few hospitals in the surrounding area and clinics offering no more than the most basic health care. Demanding cases have to be taken to the cities. Most clinic buildings are abandoned or in a state of bad disrepair. Only clinics in the marshes are still operational, but they provide only the most basic medicines and with few qualified personnel. They are likely to have a doctor's assistant and/or male nurse. As a result, women are likely to shun the clinics.

The most effective public health centers are those in Al-Chibayish between Central and Hammar marshes, Al-Turaba near Hawizeh marsh, and Al-Hassan near Hammar marsh. The first clinic is in the largest town in the marshes, serving about 12,000 people. The latter two were refurbished and re-established by the AMAR International Charitable Foundation, opening in June or later. The Al-Chibayish clinic has a doctor, dentist, nurses, and assistants. The AMAR clinics are staffed with a variety of medical specialists, including doctors, nurses, midwives, and assistants. However, all have problems being able to secure medicine. The three facilities are supplied from government warehouses, finding the medicine from private sources to be too costly. All lack the medicine most in demand: antibiotics. The stock in the pharmacy in AMAR's clinic in Al-Turaba was noticeably reduced between June 2003 and February 2004.

Objectives

Objectives of the public health activity are to:

- Initiate a sustainable healthcare service in collaboration with MoH, NGOs and local people;
- Provide immediate curative and preventive care for the most unserved or under-served population groups;
- Initiate health education activities;
- Monitor the impact of reflooding on the health of the local population, particularly with respect to re-emerging diseases like malaria and schistosomiasis; and
- Support currently available health care services in selected sites (population aggregations).

Public Health Tasks

- **Task 1 – Establish Primary Health Care Clinics in the Marshes**

Medical services throughout the country have suffered from an absence of attention and resources for more than a decade. Today the situation is in disarray as supplies are short, equipment unavailable, and qualified personnel absent. The conditions are even worse in the marshlands where neglect was more passive than deliberately destructive. Although the major focus of the Iraq Marshlands Restoration Program is both ecosystem management and economic development, it would be unrealistic not to include an activity specifically targeted at one of the greatest problems facing Marsh Arabs: substance or non-

existent primary health care. It is necessarily an essential element of this assistance program. Efforts of the program will concentrate on re-establishing three to four primary health clinics in the marshlands to help as many underserved or unserved people as people, finding the present funding constraints.

- **Task 2 – Introduce Health Education Activities**

As part of the health services provided in the clinics, the program will develop and extend a limited preventative health care effort for people in the area.

6. Develop Constructed Wetlands for Domestic Wastewater Treatment

Towns and villages in the marshlands lack wastewater treatment facilities. In the larger towns of Al-Chibayish and Hammar City, people have small outdoor toilets with pipes that directly go into cesspools or covered pits adjacent to the houses. During periods of rain or high use, the pits back up and sewage can enter the house. Cesspools offer little better advantage since they are filled with raw sewage. The small ponds were filled with common reeds (*Phragmites australis*), which is predominantly used as fodder for animals. These ponds apparently receive high amounts of wastes produced in the village through runoff. However, these ponds may be only temporary during winter and most probably would dry during the dry season. Therefore, the use of these ponds as treatment units is not possible.

The conditions in villages are worse. Several sites in the marshlands were visited and assessed for placement of a constructed wetland for wastewater treatment. There is no public water supply. As a result, production of wastewater is low and in some cases practically zero. The water for day-by-day use from bathing and washing dishes is taken directly from the marshes and is released there, as well. In addition, houses do not have toilets. People go away from their houses to defecate.

Objectives

The objectives of the activity are to:

- Improve public health in the marshes through the use of low-cost constructed wetland technologies; and

- Reduce the overall level of pollutants entering the marsh waters by treating the wastewater on site.

Constructed Wetlands Tasks

- **Task 1 – Design and Build Constructed Wetlands for Wastewater Treatment**

The task will identify sites within the marshlands for placement of constructed wetlands for wastewater treatment. The program will work closely with the governorate offices of the Ministry of Public Works and with the local population to select appropriate sites that meet the basic engineering requirements. It will begin by building a demonstration constructed

wetlands in Al-Chabayish, the largest town in the marshlands. The site will be able to serve all of its 5,000 residents. The area is conveniently located next to the Euphrates riverbank and is the lowest part of the village.

- **Task 2 – Train Iraqi scientists and engineers in the design, operation, maintenance, sampling, and evaluation of constructed wetlands**

The constructed wetlands technology for wastewater treatment is likely appropriate throughout Iraq. Therefore, more detailed information about the construction, operation and maintenance of these systems will be required. The program will prepare training materials, schedule training courses, help select participants, and conduct the short courses.

Present Timeframe and Proposed Extension

At present, the program's timeframe is 1 October 2003 - 30 September 2004. Given delays in program implementation caused by security concerns, required contracting approvals, and team mobilization, we request a program extension to 31 December 2004. All tasks are designed with this new termination date in mind.

Proposed Funded Budget

The following table is a list of proposed tasks using existing program funding.

Proposed Iraq Marshlands Restoration Program Budget (Funded)

Program Management	USD
• Program Management and Design	415,000
• Security Arrangements	325,000
National-Level Activities	
Strategic and Comprehensive Marshlands Planning	
• Strategic Plan for CRIM	100,000
• Comprehensive Restoration Strategy for GOI and Donors	250,000
Hydrologic and Hydraulic Modeling	
• Hydrologic Model of the Tigris-Euphrates Basin	450,000
• Hydraulic Model of Hawizeh Marsh	50,000
Capacity-building in Marshland Management and Restoration	
• Water and Soil Laboratory in Ministry of Water Resources in Baghdad	250,000
• Upgraded Laboratory Capacity at University of Basra	50,000
• Integrated Marshlands Database	100,000
• Short Courses and International Study Tours	280,000
Marshlands Activities	
Integrated Marshland Management	
• Assess the Nature and Distribution of Flooding on the Landscape and Hydrologic Conditions Using Satellite Imagery and Hydrologic Records	135,000
• Develop Protocols for Assessing Ecosystem Functioning and Monitor Reflooding	285,000
• Develop an Integrated Marsh Management Plan	100,00
Agricultural Production and Agribusiness	
• Carry Out Large-Scale Crop Demonstrations for Field Crops and Horticulture	100,000
• Establish Date Palm Nurseries for Growing and Distributing Off-Shoots	100,000

Livestock and Dairy Production	
• Extend Veterinary Services to Marsh Communities	100,000
• Introduce Forage Crop Cultivation to Improve Livestock Nutrition	50,000
• Provide Educational and Income-Generating Opportunities for Marsh Dwelling Women and Girls	50,000
Capture Fishing and Fish Farming	
• Produce *Barbus Spp.* for Stocking into the Marshlands	75,000
• Co-manage Activities with Fishermen to Protect Local Stocks	65,000
• Develop Aquaculture Enterprises	125,000
• Monitor Fishing Systems	60,000
Public Health	
• Establish Primary Health Clinics in the Marshes	200,000
• Introduce Health Education Activities	10,000
Constructed Wetlands	
• Design and Build Constructed Wetlands for Wastewater Treatment	260,000
• Train Iraqi Scientists and Engineers in the Design, Operation, Maintenance, Sampling, and Evaluation of Constructed Wetlands	15,000
Total	**$4,000,000**

Additional Year 1 Unfunded Tasks

The following table is a list of proposed tasks that could be implemented, if additional funding is provided to the program.

Proposed Additional Marshlands Tasks for Year 1
(Presently Unfunded)

National-level Activities	
• Master Plan for Water Resources in Iraq	$3,500,000
• Soil and Water Laboratory in the Ministry of Water Resources	$250,000
Integrated Marshland Management	
• Monitoring Additional Reflooded Marsh Sites	$450,000
Agricultural Production and Agribusiness	
• Restoration of the Date Orchards	$300,000
• Rural Finance Program	$1,000,000
Livestock and Dairy Production	
• Expand the Number of Veterinary Service Centers	$250,000
• Expand Alfalfa Demonstration Plots	$100,000
• Expand Efforts to Assist Women and Girls in Education and Income-Generation	$100,000
Capture Fishing and Fish Farming	
• Development and Operation of Fish Marketing Coops Promoting the Export of *juri*	$100,000
• Promotion of Sustainable Fishing Gears	$50,000
• Educational Materials to Support Co-Management	$50,000
• Design and Construction of a Hatchery at the Marine Science Center, University of Basra	$250,000
• Training Course and Study Tour in the United States on the Latest Aquaculture Techniques	$125,000
Public Health	
• Expand the Number of Primary Health Clinics in the Marshes	$500,000
• Expand Efforts to Provide Health Education	$25,000

Constructed Wetlands	
• Increase the Number of Constructed Wetlands for Wastewater Treatment in the Marshes	$250,000
Total for Additional Marshlands Tasks in Year 1	**$7,100,000**

Additional Unfunded Tasks for Years 2-3

The following table is a list of proposed tasks that could be implemented, if additional funding is provided to the program.

Proposed Marshlands Tasks for Years 2 and 3

National-level Activities	
• Water Resources Planning Support	$500,000
• Hydrologic Modeling	$250,000
• Integrated Database Management and GIS Facilities	$200,000
• Short Courses and International Study Tours	$300,000
National-level Subtotal	*$1,250,000*
Integrated Marshland Management	
• Monitoring Reflooded Marsh Sites	$500,000
• Evaluation of the Impact of Marsh Restoration on the Local Population	$200,000
• Eco-tourism Ventures Based on Marsh Wildlife and Cultural Importance	$1,000,000
Marshland Management Subtotal	*$1,700,000*
Agricultural Production and Agribusiness	
• Expanded Demonstration Field Crop and Horticulture Program for More Villages and More Types of Crops	$400,000
• Cooperatives or Business Associations for Production and Marketing Date Palm or Other Horticultural Crops	$200,000
• Marketing Information System to Improve Decision Making Regarding Production and Marketing	$100,000
• Extension Materials Based on the Demonstration Programs to Transfer New Technologies or Crops Introduced by the Program	$200,000
• Training Courses Targeting Farmers, Extension Personnel, and MOA District Managers	$200,000
• Comprehensive Analysis of Irrigation and Drainage in Hawizeh and Hammar Marshes Following Reflooding	$500,000
• Investment in Cold Storage or Other Post Harvest Facilities Targeting Former Marsh Dwellers	$250,000
• Marketing Research and Training Program	$300,000
Agriculture Subtotal	*$2,150,000*
Livestock and Dairy Production	
• Stimulating Private Sector Provisions of Veterinarian Services	$200,000
• Expanded Efforts to Assist Women and Girls in Education and Income-	$500,000

Generation	
• New Technologies for Household Dairy Processing	$250,000
• Strengthening Burgeoning Private Sector Initiatives in Dairy Processing	$500,000
• Livestock and Dairy Market Operations Improvements	$500,000
Livestock Sub-total	*$1,950,000*
Capture Fishing and Fish Farming	
• Rehabilitation of Marshland Fish Habitats	$1,000,000
• Upgrading he Design of Fish Culture Facilities	$12,000
• Construction of Eleven More Model Fish Farms	$900,000
• Design and Construction of Three New Large-Scale Hatcheries	$850,000
• Training Fish Farmers and Extension Agents	$75,000
• Purchase of Fish Transport Vehicles	$240,000
• Securing Necessary Chemotherapeutants for the Longer Term Program	$12,000
• Construction of a Small Feed Milling and Pelleting System	$120,000
• Applied Fish Culture Research	$120,000
• Implementation of Fishery Co-management Efforts	$100,000
• Monitoring Changes in the Fishing Systems	$300,000
Fishing Subtotal	*$3,729,000*
Public Health	
• Additional Health Clinics in the Marshes	$2,000,000
• Expanded Efforts to Provide Health Education	$100,000
Public Health Subtotal	*$2,100,000*
Constructed Wetlands	
• Additional Constructed Wetland Sites	$1,000,000
Total for Marshlands Tasks for Years 2-3	**$13,879,000**

SETTING AND APPROACH

Photographs

Interviewing a tribal sheikh in Hammar City on constructed wetlands with Eng. Ali Shaheen, director of the Ministry of Water Resources office in Al- Nasiriyah governorate

Faculty of the University of Basra interviewing fishermen on the edge of Hawizeh Marsh

Dr. Mohamed Ghazi, Ministry of Agriculture in Baghdad with villagers along Prosperity River discussing livestock management

Dr. Omran Sukkur Habib, chair of the Department of Community Medicine at the University of Basra Medical College, at the Al-Chibayish public clinic

SETTING AND APPROACH

Iraq Marshlands Restoration Program

The Iraq Marshlands Restoration Program is funded by the U.S. Agency for International Development (USAID) through the FORWARD task order, contracted under the Development Alternatives, Inc. (DAI) Water Indefinite Quantity Contract (IQC). The program is a twelve-month effort which supports the restoration of the ecosystem through improved management and strategic reflooding and provides social and economic assistance to the local population. These two tracks – environmental and developmental – are necessarily integrated, reflecting the historic harmony of the marshlands and their indigenous population.

The Iraq Marshlands Program operates at both a national and a marshlands level. At the national level, it works directly with and under its lead government entity, the Ministry of Water Resources. The following efforts are designed to support the key decision-making by the government about marshlands management and restoration, generally, and the operations of the ministry, specifically:

- *Strategic planning for CRIM* – assisting the Center for the Restoration of the Iraqi Marshlands as a newly-formed entity to determine its vision, mandate, responsibilities, programs, and organization within the context of the Ministry of Water Resources and other involved ministries

- *Hydrologic basin modeling* – enabling a partnership between the U.S. Corps of Engineers and the Ministry of Water Resources to develop the first hydrologic model of the Tigris-Euphrates basin

- *Hydraulic modeling* – focusing on one major marsh in the South to develop a profile for understanding the dynamics of reflooding and assisting in the designation of the marsh as a World Heritage site

- *Database development* – developing a database within CRIM to house water, soil, vegetation, social, and economic information about the marshlands for ongoing analysis and decision-making

- *Water and soil laboratory* – developing laboratory facilities and a capacities for soil and water analysis

- *International study tours and short courses* – building capacity in and commitment to wetland management and marsh restoration through study tours to the Everglades and other locations for officials are different ministries and from the research and university communities

- *Comprehensive donor strategy* – preparing a consensus-driven plan for long-term marsh restoration that reflects national and international views and commitments

In the marshlands, the program proposed to implement six discrete, but closely related, activities focusing on:

- *Integrated marsh management* – assessing the nature and distribution of reflooding and develop management options for future actions

- *Agricultural production and agribusiness* – diversifying agricultural production in the marshlands with higher value crops through demonstrations and nurseries

- *Livestock and dairy production* – addressing major sector constraints with veterinary services and the introduction of a new forage crop and supporting women and girls through education and income-generation initiatives

- *Capture fishing and fish farming* – increasing the population of high-valued fish in the marsh waters and encouraging aquaculture to increase incomes

Integrated Marsh Management Approach

The intellectual framework for the program is the integrated marsh management approach which recognizes that people are at the heart of the ecosystem and that marshland restoration is not only compatible with, but can indeed support, a wide range of economic activities contributing to human welfare and sustainable development. The approach also recognizes the limitations imposed by the water available and the importance of achieving ecological, environmental, and human interactions. Healthy restored marshland ecosystems support biodiversity, improve environmental quality, such as through natural water purification, and generate goods and services, such as fisheries and grazing, providing benefits to communities living inside, adjacent to, and outside their boundaries. The integration of different uses of the marsh and adjacent land needs to take account of the ecosystem's capacity to function and not exceed that capacity which would lead to change and degradation.

- *Primary health care* – extending health care and related educational services to the marshlands populations, given that few clinics operate and that medical services are rarely available

- *Constructed wetlands* – building engineered wetlands to dramatically improve wastewater systems, public health, and overall water quality in the marshlands using low technology and natural processes

Program Objectives

The overall objectives of the program are the following:

- Improve the social and economic lives of marsh dwellers;
- Assess the success of wetland restoration and help guide government policies and decisions;
- Strengthen Iraqi commitment to marshland management; and
- Reach national and international consensus on long-term restoration strategies.

Program Guidelines

The program will be implemented using the following guidelines:

- Work in close implementation with GOI and CPA.
- Design and carry out activities using collaborative planning with our Iraqi partners.
- Place the views, concerns, and perspectives of the marsh dwellers at the center of the program and ensure that they guide decisions about marsh restoration and economic development.
- Adopt integrated economic development and ecosystem management as the framework for the program.
- Work to ensure the sustainability of program initiatives.
- Develop local capacity in wetland management and improved governance.
- Emphasize income generation.

FORWARD's Approach to the Marshlands Restoration Program

The restoration of Iraq's marshlands has been treated by some as a largely technical problem which can be addressed by specialized expertise. FORWARD's perspective is that the resolution of this complex set of issues, like other water-related issues, requires an exploration and vetting of the diverse views of a broad range of parties, which would otherwise impede reaching and honoring agreements over implementation. Even the development of a wetlands database, which some treat as a straightforward effort, involves competing and entrenched interests which can discourage cooperation and collaboration by the many stakeholders. Traditional technical efforts rarely seek to build consensus among these competing interests and instead try to persuade on the basis of the technical solution's logic. As a result, they too often fail or are unsustainable.

FORWARD, a collaborative planning and consensus building program for USAID's Bureau for Asia and the Near East, has over the past seven years addressed longstanding water policy and implementation issues in the Middle East. It brings to this marshlands restoration

program experience with successful interventions in demanding situations in Lebanon, West Bank/Gaza, Jordan, Egypt, and Morocco and an awareness of the need for reaching agreement among the stakeholders who will be most affected. In Iraq, they include new ministries emerging from the ruins of old institutions, new local government entities that will be operating in an uncharted civil setting, universities and research centers that were perversely politicized and denied resources, local stakeholders who were the victims of persecution and genocide and remain scattered across many countries, and a general population with whom they must compete for scarce water resources. Outside Iraq, there are various international donors and agencies, humanitarian groups, environmental organizations, and an oil industry, all seeking to advance their own agendas.

The successful design and implementation of the Iraq Marshlands Restoration Program must incorporate:

- An understanding of the core parties involved;
- A description of their interests and goals that need to be satisfied if agreements are to be reached;
- An identification of current positions;
- An assessment of the parties' willingness to take part constructively;
- The identification of how all parties can profit;
- A characterization of where there is already agreement or "common ground";
- A reframing of the remaining differences needing resolution to make the terms of engagement acceptable to all parties;
- Institutionally and politically appropriate ways of integrating these considerations with the technical approach; and
- Regular monitoring to permit constant revision and improvement of plans as interests change and new information emerges.

The marshlands restoration is a complicated multi-party collaborative planning effort requiring stakeholders to articulate their individual interests and concerns as a first step in reaching consensus around common goals and strategies. This approach, which merges technical expertise with a collaborative process, has a far greater likelihood of success than one which is primarily technically driven.

Implementation Approach for the Marshlands Activities

The following are key components of the program's implementation approach for the activities in the marshlands:

- *Collaboration.* Reaching consensus among national ministries in Baghdad, governorate offices in the South, the marsh dwellers, and the program in a four-way partnership on the vision of the range of services to be provided and on commitments for each's contribution.

- *Advocacy.* Ensuring that the voice of the marsh dwellers is heard and incorporated into decisions made about the restoration of the ecosystem and their social and economic future.

- *Income generation.* Providing critical services and technologies to stimulate production and improve livelihoods of the poorest and most under-served people in Iraq.

- *Governance.* Working with government institutions and NGOs to develop effective and reasonably-priced strategies to provide help to under-served areas and build local entities in the process.

- *Capacity-building.* Harnessing underutilized, but talented, Iraqi expertise in the government and private sector to make an important contribution to rural welfare and boost the skills and pride of the country's labor force.

- *Physical presence.* Establishing on-the-ground initiatives which integrate and build on different activities to enhance program impact and increase the trust and confidence of the government and local population in the program.

Action Plan Design

In February 2004, a diverse team of 71 experts from six countries[1] joined together to design an action plan focusing on integrated marshlands management through ecosystem management and restoration and social and economic assistance for the local population of largely displaced and widely persecuted marsh dwellers. The team included international consultants; officials from the Ministries of Water Resources, Agriculture, and Environment and governorate offices in Misan, Nasiriyah, and Basra; university faculty and research center staff of the College of Agriculture and Marine Science Center of the University of Basra; and representatives of the non-governmental organizations Iraq Foundation and AMAR International Charitable Foundation.

During the month, the team divided into six operational units exploring the status of and opportunities for marsh management, agriculture, livestock, fishing, public health, and constructed wetlands. The team made extensive visits throughout Misan and Thi-Qar governorates in Hawizeh, Hammar, Central and smaller adjacent marshes. Working as technically focused units, they interviewed and explored on-the-ground activities of the former marsh dwellers, who comprise most of the population, and the few people who now live inside Hammar marsh on islands resembling a lifestyle all but terminated by the drainage of the marshes in the 1980s and 1990s. The team met with tribal sheikhs,

[1] Team members were from the following countries: Iraq, the United States, the United Kingdom, Jordan, Australia, and the Czech Republic.

leaders, farmers, fishermen, women herders, local service providers, and market agents and operators in marsh settlements, mudhifs, in fields and pastures, on boats, in clinics, and in markets. The team has developed a detailed analysis which together is the most comprehensive account of the marsh ecosystem and socioeconomic situation to date. It was also charged with preparing an action plan which identified major constraints, defined objectives for an action program, and designed specific tasks for implementation. This volume contains those analyses and action plans.

Action Plan Design Team Members

Members of the February action plan design team included the following experts. They are jointly responsible for analyses and action plans.

Name	Team	Entity
Dr. Peter Reiss	Program Management Livestock, Public Health	Development Alternatives, Inc.
Dr. Ali Farhan	Program Management Marsh Monitoring	Development Alternatives, Inc.
Ms. Anna Presswell	Program Management Constructed Wetland	Development Alternatives, Inc.
Mr. Gabriel Bayram	Program Management	Development Alternatives, Inc.
Dr. Curtis Richardson	Marsh Management Constructed Wetlands	Duke University Wetland Center
Dr. Edward Maltby	Marsh Management	Royal Holloway Institute for Environmental Research (UK)
Dr. Hassan Janabi	Marsh Management	Ministry of Water Resources, Baghdad
Eng. Jassim Mohammed Dowage	Marsh Management	Ministry of Water Resources, Baghdad
Eng. Samira Abed Al Shebeb	Marsh Management	Ministry of Water Resources, Baghdad
Mr. Ossama Witwit	Marsh Management	Ministry of Water Resources, Nasiriyah
Eng. Nazim Ahmed Emam Fa'es	Marsh Management	Ministry of Water Resources, Basra
Mr. Hazim Ahmed Al-Delli	Marsh Management Agriculture	Ministry of Environment, Baghdad
Dr. Azzam Alwash	Marsh Management	Iraq Foundation
Dr. Najah Abood Hussein	Marsh Management Fishing	University of Basra
Mr. Salah Abdel Kader Al-Essa	Marsh Management	University of Basra
Mr. Mujtaba Abdulwahab Tahir	Marsh Management	University of Basra
Mr. Adel Kassim Jessim	Marsh Management	University of Basra
Dr. Jane Gleason	Agriculture	Development Alternatives, Inc.
Dr. Amer Jabarin	Agriculture	ECOConsult (Jordan)
Dr. Robert Fitzpatrick	Agriculture	Commonwealth Scientific and Industrial Research Organization (Australia)
Dr. Faraoun Ahmed Hussain	Agriculture	Ministry of Agriculture, Baghdad
Dr. Aqeel Abbas	Agriculture	Ministry of Agriculture, Baghdad
Mr. Fawzi	Agriculture	Ministry of Agriculture, Basra
Mr. Mustafa Ali	Agriculture	Ministry of Agriculture, Al-Medinah
Mr. Ali Hussein Hassan	Agriculture	Ministry of Environment, Basra
Mr. Salah Mehdi Sultan	Agriculture	University of Basra
Mr. Mohamed Malik Yassen	Agriculture	University of Basra
Dr. Abdul Jabbar Hassan	Agriculture	University of Basra

Dr. Ali Farhood Nassar	Agriculture	University of Basra
Dr. Dakhil Radi Al-Nedawi	Agriculture	University of Basra
Dr. Ali Hussein Attaha	Agriculture	University of Basra
Dr. Alaa Sabeeh Jabbar	Agriculture	University of Basra
Dr. Haitham Abdel-Salam Ali	Agriculture	University of Basra
Dr. Ali Hamdi Theiab	Agriculture	University of Basra
Mr. Wisam Jaba'a	Agriculture	AMAR International Charitable Foundation
Dr. Khalid Al-Zubaidi	Livestock	ECOConsult (Jordan)
Dr. Mohamed Ghazi	Livestock	Ministry of Agriculture, Baghdad
Eng. Tareq Khadem	Livestock	Ministry of Agriculture, Misan Province
Eng. Hussein Abed Al Hassan	Livestock	Ministry of Agriculture, Misan Province
Eng. Hadi Hussein	Livestock	Ministry of Agriculture, Misan Province
Eng. Ali Hadi	Livestock	Ministry of Agriculture, Basra Province
Eng. Shaker Eisa	Livestock	Ministry of Agriculture, Basra Province
Mr. Natham Kadhem	Livestock	Ministry of Agriculture, Al-Nasiriyah
Dr. Ghayeth Hameed Majeed	Livestock	University of Basra
Dr. Asaad Yheia Ayied	Livestock	University of Basra
Dr. Amad Falah Hassan	Livestock	University of Basra
Dr. Riyhad Kadheem Mossa	Livestock	University of Basra
Dr. Amera Kadhum Nasser	Livestock	University of Basra
Dr. Samir Stephan Hanna	Livestock	University of Basra
Ms. Khawla Rashige Hassan	Livestock	University of Basra
Mr. Ali Mohsine Al-Maraashi	Livestock	University of Basra
Dr. Daniel Hoggarth	Fishing	MRAG Americas, Inc.
Dr. John Woiwode	Fishing	AquaMatrix International, Inc.
Mr. Mohamed Mohamed Halous	Fishing	Ministry of Agriculture, Baghdad
Mr. Mustapha Al-Muchtar	Fishing	University of Basra
Mr. Adel Kassim Jassim	Fishing	University of Basra
Dr. Amina Ali Hashim	Fishing	University of Basra
Dr. Basim Jasim	Fishing	University of Basra
Dr. Adel Yacop Al-Dubakel	Fishing	University of Basra
Mr. Riyadh Adnan Al-Tameme	Fishing	University of Basra
Dr. Sadek Ali Hussein	Fishing	University of Basra
Dr. Sumaya Mohamed Ahmed	Fishing	University of Basra
Dr. Saged Saad Al-Noor	Fishing	University of Basra
Dr. Najim Rajab Khamees	Fishing	University of Basra
Mr. Muhammad Jasim	Fishing	AMAR International Charitable Foundation
Dr. Ali Nasir Muthanna	Public Health Livestock	AMAR International Charitable Foundation
Dr. Omran Sukkur Habib	Public Health	AMAR International Charitable Foundation
Dr. Alaa Hussain Abd	Public Health	AMAR International Charitable Foundation
Dr. Muhannad Saheb	Agriculture	AMAR International Charitable Foundation
Dr. Jan Vymazal	Constructed Wetlands Marsh Management	Duke Wetland Center (Czech Republic)
Dr. Azhar Ali Al-Saboonchi	Constructed Wetlands Marsh Management	University of Basra

Program Activities

The Iraq Marshlands Restoration Program operates at both the national and regional levels.

Activities at the National Level

Although the design efforts in February and this volume largely focus on local implementation in the marshlands, the Iraq Marshlands Restoration Program has a robust initiative at the national level. It will work closely with the Ministry of Water Resources, Ministry of Agriculture, and Ministry of Environment and is a permanent member of the Inter-Ministerial Marshlands Committee. Through its lead implementation partner, the program is carrying out efforts which fall into three broad categories: planning, modeling, and capacity-building. Specific tasks already underway or to be initiated shortly include the following:

1. Hydrologic and Hydraulic Modeling

- Hydrologic model of the Tigris-Euphrates basin by US Army Corps of Engineers
- Hydraulic model of Hawizeh marsh in cooperation with Italians

2. Capacity-building in Marshland Management and Restoration

- Water and soil laboratory in Ministry of Water Resources in Baghdad
- Upgraded laboratory capacity at University of Basra
- Integrated marshlands database in CRIM with GIS functions
- Short courses and study tours to Everglades and Danube

3. Strategic and Comprehensive Marshlands Planning

- Strategic plan for Center for Restoration of the Iraq Marshlands (CRIM)
- Comprehensive restoration strategy for GOI and donors

Activities in the Marshlands

The proposed tasks are targeted at stimulating opportunities for former marsh dwellers who have witnessed the near destruction of their society. The proposed tasks are designed to address the most common constraints mentioned by them and confirmed by technical experts both inside and outside the government. Funding and time will not permit the program to implement these tasks across the marshes. Broad dissemination depends on additional funding from the donor community. Instead, these tasks are designed as pilot projects which will inform:

- Stakeholders about successful technologies and approaches in their communities that can be adopted practically and sustainably;

- The national government and provincial offices about programs that can be expanded and institutionalized to support their growing governance objectives;

- International donors about attractive investment options to make in the marshlands.

Proposed Activity for Years 1-2
Master Planning for the Water Sector of Iraq

Although the program's immediate focus is on the restoration of the southern marshlands, its widest context is the state of water resources of Iraq. To that end, the program is presently developing a hydrologic model of the Tigris and Euphrates river basin in partnership with the Ministry of Water Resources and the U.S. Army Corps of Engineers. Beyond this effort, the program is prepared to carry out a major master planning effort of the water sector in Iraq. Any serious strategy for the restoration of the marshlands will require an understanding of the overall water resources of the country and the competition among the different sectors and regions for the scarce resource.

The proposed master plan would, among other things:

- Clarify the current state of water resources in Iraq
- Identify the sources, quantity, and quality of surface and ground waters
- Quantify present and projected water requirements for different sectors
- Assess the current physical infrastructure of the water system
- Review any existing plans for water resources development and management
- Examine transboundary issues and options for international negotiation
- Design and prioritize projects for implementation
- Identify investment sources

The development of the master plan will require the following support components:

- Strategic planning
- Water resources database development and management
- Geographical information systems

The addition of this master planning activity has the strong support of the Minister of Water Resources, Abdel Latif Rachid, and the CPA Senior Advisor, Edwin Theriot. The planning timeframe for the two-year effort is 10-15 years.

Proposed cost: $3,500,000

The following is a list of the tasks proposed for implementation for each of the six marshlands activities:

1. Develop an Integrated Marshland Management Plan

- Assess landscape flooding using remote sensing and ground-truthing
- Explore the hydrologic management of the marshlands
- Design ecosystem assessment protocols and identify criteria for site selection
- Characterize the immediate and long-term affect of reflooding on biodiversity, ecosystem functioning, and sustainable human use
- Develop a plan for integrated marshlands management

2. Encourage Agriculture and Agribusiness

- Develop a soil and water kit to improve land and irrigation planning
- Carry out large-scale crop demonstrations for field crops and horticulture
- Establish date palm nurseries

3. Re-establish Livestock and Dairy Production

- Extend veterinary services to marsh communities
- Introduce forage crop cultivation to improve livestock nutrition
- Provide educational and income-generation opportunities to marsh dwelling women and girls

4. Support Capture Fishing and Fish Farming

- Restore wild stocks of high-value *bunn*i by stocking cultured fingerlings
- Implement co-management activities with marsh fishermen to protect and enhance local fish stocks
- Establish a model fish farm for grass and silver carp
- Monitor fishing systems

5. Extend Primary Health Care Services

- Establish primary health clinics in the marshes as centers for medical services and related educational outreach

6. Develop Constructed Wetlands for Domestic Wastewater Treatment

- Design and develop demonstration constructed wetlands in the marshes for wastewater treatment
- Assess constructed wetlands for water quality improvement
- Train government and university staff to design, operate, and maintain, and monitor the performance of constructed wetlands

Present Timeframe and Proposed Extension

At present, the program's timeframe is 1 October 2003 - 30 September 2004. Given delays in program implementation caused by security concerns, required contracting approvals, and team mobilization, we request a program extension to 30 September 2005. All tasks are designed with this new termination date in mind.

1 DEVELOP AN INTEGRATED MARSH MANAGEMENT PLAN

Photographs

Along Prosperity River

Reeds growing in Hawizeh Marsh

An area of burned soil in Hammar Marsh near Al-Chibayish town

A settlement in southern Central Marsh which has been reflooded in the past two months

1 DEVELOP AN INTEGRATED MARSHLAND MANAGEMENT PLAN

Background

In little more than a decade, the regime of Saddam Hussein nearly destroyed one of the largest and most important wetlands in the world. Massive drainage structures, built in the 1990s, diverted water from the Tigris and Euphrates rivers from the marshlands in the south of the country. These actions were deliberately targeted at the Marsh Arabs who were seen to be disloyal and unmanageable after the Shi'a insurrection of 1991. The military raided settlements, killed tens of thousands of people – although the exact number is a likely higher – burned their houses, and killed their animals. Virtually all of the remaining people were either exiled or internally displaced. The period from 1991 to 1997 was marked by engineering programs, which drained the marshes through the construction of manmade rivers and canals of massive proportions. They diverted water from the marshes to irrigate vast areas for uneconomical and unsustainable wheat production, fill huge depressions or ponds to evaporate, or drain into the Shatt Al Arab. Despite an international trade embargo, a disproportionate share of the country's limited resources was channeled into these works.

By 1999, the drainage of the marshes was largely over. The only remaining marsh of any note was the northern portion of Hawizeh, which straddles the Iran-Iraq border. The other two marshes, Hammar and Central to the west, were totally desiccated. A 2001 seminal report by the United Nations Environment Program *The Mesopotamian Marshlands: Demise of an Ecosystem* for example indicated that only six percent of Hammar and three percent of the original central marshes remained. Since then, the marshlands went into even more rapid decline, and most experts predicted that those marshes would completely disappear in the following few years. The March 2003 war allowed for a reversal of the situation. There has been some recent re-flooding in small enclaves throughout the marshes. Excess water in 2004 has allowed for the random destruction of structures by people in the area after the war, and the opening of gates by local government officers.

Euphrates and the Tigris Rivers

Most of the Iraq water resources originate from outside Iraq where 88 percent of the natural runoff of the Euphrates comes from Turkey, 9 percent from Syria and the remainder from Iraq. As for the Tigris, 56 percent of its natural runoff comes from Turkey, 12 percent from Iran (especially for the two tributaries, lower Zab and Diyala rivers), while source of the remaining water is from within Iraq.

Tigris River

The total length of the river is about 1900 kilometers, of which 1415 are located inside Iraq. The average annual runoff, recorded for many years at the Turkish borders, is about 16.8 billion cubic meters (BCM). Other tributaries flow into the Tigris inside Iraq's territory, of which Khabor, Upper Zab, Lower Zab, Adhaim and Diyala are the most important. The average inflow of the Tigris River, both from inside and outside Iraq, is around 44 BCM.

Euphrates River

The total length of the river is 2940 kilometers, of which 1160 are situated inside Iraq. The average annual runoff of the river at the Turkish-Syrian border, before the building of the dams for irrigation projects in Turkey, was 30.4 BCM. The river has no tributaries inside Iraq.

Both the Tigris and Euphrates rivers are controlled by a series of dams and barrages. They were built to control the flood season where the inflow water exceeds the need for water in the country and to maintain reasonable water storage for summer when the requirements may exceed the inflow within the river and their tributaries. The annual distribution of the inflow of water resources in Iraq is as follows:

- February - June 7 percent
- July - October 10 percent
- November - January 15 percent

The two rivers and their tributaries are controlled by 25 dams and dikes in addition to 275 irrigation-pumping stations. Water released from the dams is justified mainly by the total requirements down stream. However, some water releases are adjusted according to the needs of hydropower generation.

Water Quality

In general, the water quality of the Tigris River is much better than that of the Euphrates. Baghdad normally has water with salinity of 500-600 parts per million (ppm) for the Tigris, and it increases to around 800 ppm as it reaches the city of Kut which is 170kilometers to the south of Baghdad. The Garraf River, a branch of the Tigris at the city of Kut, is the water feeder to Abu Siriq marsh, which is within acceptable quality of 800-1000 ppm.

Within the reach of the Tigris River between Kut and Al-Amara, the quality of water deteriorates, salinity changes significantly according to season, due to the volume of water released and pollutants coming from the Hor Al-Shewacha, the Al Chabab seasonal river, and the entering drainage water.

The salinity levels in the Euphrates are generally higher than in the Tigris. Evaporation from Hadith dam reservoir and Tharthar Lake, the main contributors to the Euphrates, normally raise the salinity levels of the water starting in Faluga Barrage. The increase in salinity becomes significant between the governorates of Samawa and Nasariya. It is believed that

salty ground water from the desert area contributes to a rise in salinity. Accordingly, it was expected that the salinity of Hammar marsh is higher than that of Abu-Zarag or Central marshes.

As for Hawizeh marsh, the quality of water is highly affected by the share of water that flows annually into it from Iran. The three rivers that originate in Iran and contribute to Hawizeh marsh are the Karkheh, Teeb, and Dewaireg. The last two are seasonal rivers, while the flow of the first is controlled by a new dam in Iran. The increased activities of agriculture may have resulted in an increase of the drainage water downstream of the dam towards Hawizeh. Within Iraq, the main contributors to the Hawizeh marsh are the rivers of Al-Kahla, Al-Mesharah, and sometimes the Crown-of-Battles Canal. They are all branches of the Tigris in Misan governorate. The quality of these rivers changes between summer and winter and depends also upon the levels of release in the Tigris River.

Constraints on Marsh Restoration

The restoration of the marshes is particularly challenging for several reasons:

The available water can restore only a proportion of the marshlands.

The current amount of water delivered to northern Iraq via the Tigris is 40-44 BCM and via the Euphrates 13-14 BCM. The principal additional supply from Iran is the Karkheh, but this has now diminished as a result of dam construction, which stores about 8 BCM, and may be reduced further as a result of dike construction along the Iran-Iraq border.

Restoring half of the original marsh would require roughly 25 BCM to meet the evaporation loss in southern Iraq, not accounting for the amount of water required to maintain through flow and permanent water bodies in the marshlands. That level of restoration would consume nearly half of the total available supply in the catchments and would represent an unrealistic allocation given other sector needs in the country.

Clearly, there are decisions to be made by the Government of Iraq regarding the priority locations and extent of areas to be restored.

Reflooding in itself does not guarantee marsh restoration.

The team visited a recently reflooded area in South Hawizeh, which was surrounded by straight embankments with no natural slopes or ecological gradients. The configuration resembled a reservoir with no through flow and probably little variation in depth of floodwater.

Summer drying will inevitably leave a salt crust. The development of a freshwater marsh will not take place under these conditions. Even brackish water or salt marshes are unlikely to form because of these impounded hydrological conditions. Criteria need to be developed which will take in to account the likelihood of successful long-term and sustainable restoration to meet desired outcomes.

Lack of knowledge of the nature and speed of recovery/change of the marsh ecosystem.

Reflooding is very recent. Although there has been a return of aquatic and emergent plants, fish, and wildlife adapted to the wetland environment in some areas, it is unknown how the ecosystem will change over time. It is essential to assess whether the direction of change is consistent with desirable states of ecosystem recovery and with the provision of the goods and services on which local populations depend for sustainable economic development. Some reflooded areas like the eastern Hammar marsh have not recovered and the reason for this lack of recovery are unknown.

The population returning to the area want improvements beyond the traditional resources of the marshlands.

Interviews by the various teams confirmed that while many people were pleased to see reflooding in the marshes, they were also eager to pursue economic activities such as more intensive agriculture which could yield higher returns than the traditional lifestyle. Additionally they want electricity, roads, new jobs, and improved social services, particularly health care and education.

Objectives

The objectives of the activity are to:

- Gain an accurate understanding of the present restoration of the marshlands;
- Develop protocols for monitoring marsh restoration which can be institutionalized by the Ministry of Water Resources;
- Assist the Ministry of Water Resources in determining the best areas for reflooding and restoration in the future.

Team Members

Members of the Integrated Marshlands Management team included:
Dr. Curtis Richardson, Duke University Wetland Center
Dr. Edward Maltby, Royal Holloway Institute of Environmental Research
Mr. Hazim Ahmed Al Dalli, Ministry of Environment
Eng. Samira Abed Al Shebeb, Ministry of Water Resources, CRIM
Eng. Jassim Mohammed Dawage, Ministry of Water Resources, CRIM
Dr. Najah Aboud Hussain, Department of Biology, University of Basra
Dr. Saleh Abdul Kader Al-Essa, Department of Fisheries, University of Basra
Dr. Azhar Al-Saboonchi, Department of Fisheries, University of Basra
Mr. Adel Kassim Jassim, Department of Fisheries, University of Basra
Mr. Mujtaba Abdul Wahab Tahir, Department of Fisheries, University of Basra
Dr. Azzam Alwash, Iraq Foundation

Appendix 1
Interviews

The following are summaries of two significant Interviews that were conducted with villagers in two locations: Upper Hammar and Hawizeh.

- Upper Hawizeh: 30 degrees 51 mins 49.1 seconds N
  46 degrees 40 mins 39.8 seconds E

The inhabitants had been settled in their present location for eight years, although originally they had lived just a few kilometers away for some 50 years. In 1991/2 the area was drained and they had relocated to west Iraq at Najaf. They returned in 1996 when the government initiated an irrigation project.

The immediate area had been reflooded for 18 months. Before drainage they used to fish, collect reed, manage buffalo and cows and hunted birds. Life is hard at present and much more difficult than before drainage. People would be happy to see a return to those original conditions but would also place a priority on the provision of electricity and roads. They would like the water to be a little higher than present but not so deep that it flooded their homes on the raised platforms. In 1982, the government had helped to increase the elevation of these platforms with the use of French excavators.

Under the predrainage conditions, there were always some permanent areas of deeper waters, while the edge of the marsh had dried out. Rice had been grown around the margins, but this was no longer done around the edges. Previously they had been able to sell fish from the marsh, but now the fish were very small, although they were using electro-fishing to catch whatever possible. One boat owner indicated that he punted or paddled often more than four hours to catch fish.

The local marsh materials including *Phragmites*, *Scirpus* and papyrus (though none of the latter was seen) were very important, and a large pile of freshly cut reed was being used to feed tethered cows on the island. Livestock was extremely important to the households, generating milk and dung pies were dried and burned as fuel.

The water enabled ready movement around the marsh to seek and exploit a wide range of opportunities as well as providing a basic transport route. Our own presence and interest confirmed with the people an opportunity to exploit tourism and there was considerable enthusiasm for this activity in the future. There was awareness of the diversity of birds found in the marshes but no sense of their wider conservation relevance – the use of ‘chicken bird’ was indicated but no reference to duck or other species. The community was compromised of 700-1000 people in about 50 houses; there was no educational facility and no interaction with the town except for the sale of fish. Drinking water was taken directly from the marsh.

- Hammar: 31 degrees 37 mins 18 secs N
  47 degrees 31 mins 14 secs E

By their account, this community was displaced roughly twenty times before ending up at their present location one year ago. They had originally lived in the marshes and depended on farming fishing and livestock. Before the Iraq-Iran War, they had dwellings on islands surrounded by water, but they used adjacent land for the cultivation of rice that was sold to the government. Currently they have no land suitable for agriculture.

They would like to have access to agricultural land, but otherwise their priority is for more water and associated marshland, from which to obtain a wide range of products. One traditional practice had been to farm rice when the floodwaters receded. They would welcome floodwater from winter to summer, the historic hydrological regime. The adjacent marsh area was re-flooded in April 2003. It supported only small fish currently, but the people would be very interested in activities which promoted/improved fish stocks.

The people are exceptionally poor and their other priorities are electricity, roads, hospital access, medicine and new houses. The community is large, comprising of about 4000 people in 500-600 houses.

Expectations had been raised recently in the construction of a water purification facility under a USAID project, but the distribution system did not reach the numerous standpipes alongside the road in the village. Local contractors were accused of inadequately meeting their obligations.

One of the key problems identified was a lack of jobs, and there was a strong interest in the possibilities of ecotourism for which boats with engines would be a key requirement. There is a healthy supply of *Phragmites* in the area and no need to extend further its production. Previously, they used to spray the marsh to control insects, especially mosquitoes. The hazard of mosquitoes close to homes was emphasized and linked to the occurrence of black fever. Drinking water was taken directly from the canal.

A number of extensive areas of previously drained land have been reflooded within the last year as a result of MoWR decisions and/or local actions. This had been facilitated by an unusually wet winter and the availability of water from central Iraq. Such conditions are unlikely to persist in future years with more normal rainfall regimes. In addition the team noted many areas of shallow flooding, often in and around settlements, which were not obviously connected with specific breaches in levees or openings of control structures.

Appendix 2

Conceptual Framework of Actions Underpinning the Program

1. Assess the Nature and Distribution of Flooding on the Landscape By Remote Sensing And Ground-truthing

Tasks

- Seasonal scenes
- Match to ground truth observations
- Data interpretation (including water regime, vegetation and land use)

Actions

- Select external contractor
- Identify Iraqi partner (e.g. MoWR/CRIM) and collaborating organizations

2. Characterize the Hydrological Context

- Current status
- Future options
- Probability of sustainability of water supply

Tasks

- Apply available information from historic and current hydrological records to assess the present extent of flooding in the marshes
- Link to USCOE model to predict marsh flooding regimes
- Evaluate specific marsh models e.g. Italian initiative

Actions

- Encourage CRIM to identify and review all available data files/sources
- Link marsh hydrological dynamics to the regional data set and modeling for one or two of the marsh sites

3. Develop Protocols for Assessment of Ecosystem Functioning

Tasks

- Development of indicators of ecosystem functioning
- Characterization of ecosystem structure
- Recognition of distinct biophysical units at landscape scale (allows extrapolation from monitoring sites to wider marshland area)

Actions

- Ensure that all essential aspects of ecosystem functioning are included in the biophysical assessment protocol/methodology
- Provide training support to the Iraqi team
- Develop appropriate sampling protocols
- Develop appropriate criteria for recognition and separation of biophysical units

4. Determine Criteria for Selection of Reflooding Sites

Proposed Criteria

- Population size/support
- Soil suitability/unsuitability for other uses
- Water quality for re-establishment
- Cost/Size
- Connectivity
- Sustainability of water supply
- Sufficient depth and duration
- Degree/pattern of impoundment
- Original landscape configuration/diversity
- Likelihood of success in meeting key objectives such as biodiversity, fisheries and other specific uses

Actions

- Develop guidelines for the implementation of the criteria to assist in decision making
- Assist CRIM to prioritize areas for sustainable marshland restoration based on theses criteria

5. Characterize the Immediate and Long-term Affects of Reflooding on Water, Soil, and Biotic Resources

- Biodiversity
- Ecosystem functioning
- Sustainable human use

Tasks

- Assess the changes in biodiversity, ecosystem structure, functioning and human use
- Quantify to the extent possible long term restoration sustainability

Actions

- Development of a long term database
- Characterize and define the properties of a sustainable marshland ecosystem

6. Assess the Impact of Reflooding on Local Populations

Tasks

- Establish how households/villages are using restored marsh at the monitoring locations (outside/adjacent/within)
- Assess ways in which benefits can be increased within the functional capacity of the ecosystem

Actions

- Define livelihood units for households/villages at monitoring locations
- Compare livelihood units with biophysical units to match resource use against capacity
- Determine economic and social costs and benefits of marsh activities

7. Develop an Integrated Plan for Marshlands In the Management of Land, Water and Living Resources

Tasks

- Assist MoWR and CRIM to apply the integrated plan for marshlands in the landscape to implement the overall restoration strategy
- Devise water management schedules to sustain wetland ecosystem restoration
- Assist MoWR and CRIM to formulate water allocations which will support sustainable marsh restoration in conjunction with the water needs of other sectors
- Develop an agreed minimum allocation for the restored marshes

Actions

- Assist CRIM to coordinate an integrated plan for marsh restoration
- Link the integrated marsh plan to the overall water plan for Iraq
- Assess the significance of trans-boundary water delivery issues to the integrated marsh plan
- Train senior level staff in the principle of integrated management planning and tools for implementation
- Utilize study tours to provide first hand experience of integrated management and planning in relation to wetland restoration

Appendix 3
Sites Visited by the Integrated Marshlands Management Team

Date		Site	Sampling
16 Feb.	1	Drained marsh close to MOD near Basra 30 degrees 36' 05" N 47 degrees 38' 46" E	Soil Core
	2	MOD Bridge 30 degrees 35' 05" N 47 degrees 39' 30" E	Water Samples
17 Feb.	1	Abu Zarag 31 degrees 07' 37.2" N 46 degrees 37' 42.2" E Re-flooded marsh (open water)	Water Samples
	2	31 degrees 08' 18.1" N 46 degrees 37' 25.2" E Slightly elevated marsh feature alongside main channel	Soil Cores Water Samples
	3	31 degrees 02' 33" N 46 degrees 39' 7" E Abu Jiri; culvert between north and south marsh	Water Samples
	4	30 degrees 58' 59" N 46 degrees 42' 30" E Farhut, near garage	Water Samples
	5	30 degrees 58' 08" N 47 degrees 02' 17" E Bridge, new breach in Euphrates bank	Water Samples
18 Feb.	1	Al Awdeh marsh 31 degrees 34' 13" N 46 degrees 53' 32" E	Water Samples Soil Sample
	2	31 degrees 34' 16" N 46 degrees 53' 32" E Adjacent canal	Water Sample
	3	31 degrees 34' 08" N	Water Sample

		46 degrees 52’ 36” E Flooded site closer to “intact” marsh	Soil Sample
	4	31 degrees 34’ 14” N 46 degrees 53’ 57” E Drained land adjacent re-flooded area	Soil Cores
	5	Prosperity River 31 degrees 27’ 01” N 47 degrees 06’ 27” E	Water Sample
19 Feb.	1	S. Hawizeh canal impoundment 31 degrees 07’ 00.1” N 47 degrees 40’ 17” E	Water Sample
	2	Adjacent drained marsh 37 degrees 07’ 00” N 47 degrees 40’ 16” E	Soil Cores
	3	S. Hawizeh flooded impoundment 31 degrees 10’ 45” N 47 degrees 39’ 47” E	Water Sample
	4	S. Hawizeh drained marsh 31 degrees 10’ 42” N 47 degrees 39’ 48” E	Soil Cores and profile samples
22 Feb.	1	Suq Al-Shayoukh – AMAR Clinic 30 degrees 50’ 38.9” N 46 degrees 35’ 46.8” E	Water Sample
	2	Boat departure point 30 degrees 51’ 51.9” N 46 degrees 38’ 19.9” E	Soil Core
	3	House on platform 30 degrees 51’ 49.1” N 46 degrees 40’ 39.8” E	Soil Cores Water Sample
	4	Channel between house and boat departure point and various intermediate locations.	Water Samples
	5	Re-flooded field (originally marsh)	Soil Samples

23 Feb.	1	Hawizeh – Re-flooded original marsh 31 degrees 36’ 55” N 47 degrees 33’ 14” E	 Water samples Soil Cores

Appendix 4
Summary Ramsar Criteria

Criteria for declaration of a wetland as a Ramsar site are as follows:

- Representative, rare or unique example of wetland type
- Supports endangered species
- Species important for biodiversity
- Supports species in critical stages of life cycle or refugia
- One percent of the population of the world's waterbird species
- Significant indigenous fish species
- Important source of food and completion of life cycle for fish

Action Plan 1

Develop an Integrated Marsh Management Plan

Marsh restoration must be part of an integrated plan for the region, which takes account of other land use sectors and economic activities. The plan for integrated marshland management will achieve this objective. The extent and impact of the reflooding remain largely unknown. This plan seeks to provide an assessment of where the reflooding occurred, how it has changed over time, and what are the ecological responses, which result from newly increased flows in terms of hydrologic conditions, water quality, soil, vegetation, wildlife, society, and economy. It also serves as the basis for the identification of monitoring sites for development of protocols for assessment of ecosystem structure and functions, criteria for selection of sites for future reflooding, characterization of immediate and long-term affects on water, soil and biotic/resources, assessment of the impact of reflooding on local populations as well as the development of a plan for integrated marshlands management.

Objectives

The objectives of this integrated marsh management activity are to:

- Assess the nature and distribution of reflooding on the landscape;
- Determine the ecological and environmental effects over time of reflooding on biodiversity and ecosystem functioning;
- Determine the impact of reflooding on the local stakeholders; and
- Assist in the development of an integrated management plan for marshlands: land-water-living resources.

Tasks

The proposed tasks are:

1. Assess the Nature and Distribution of Flooding on the Landscape and Hydrologic Conditions Using Satellite Imagery and Hydrologic Records

2. Develop Protocols for Assessing Ecosystem Functioning
3. Evaluate the Impact of Marsh Restoration on Local Populations
4. Develop the Marsh Management Plan

Task 1: Assess the Nature and Distribution of Flooding on the Landscape and Hydrologic Conditions Using Satellite Imagery and Hydrologic Records

Satellite imagery provides a unique perspective for both short-term and long-term monitoring of wetland ecosystems and in changes in adjacent land cover, which affect them. Visible and near-infrared imagery, such as that collected by Landsat, Quickbird, and Ikonos, is an excellent tool for monitoring marsh vegetation cover and changes to vegetation associated with land use activities, as well as the effects of longer-term changes in the hydrologic regime. In addition, under certain conditions, the spatial extent of flooding or inundation in wetlands can be directly monitored using these systems if: the ground is not obscured by cloud cover; and wetland vegetation is of low density. Imaging radar systems provide another means for remote monitoring of wetland systems. The wavelengths of the electromagnetic energy transmitted and received by imaging radars are not influenced by cloud cover or rain at the time of collection. Also, the levels of biomass typically found in marshes that do not have woody vegetation do not impede direct sensing of the water and ground surface by these systems. Thus, imaging radar systems can be used to directly detect flooded versus unflooded surfaces in marshes and monitor variations in soil moisture. Because these systems are not influenced by cloud cover and rainfall, they can be used to continuously monitor wetlands that are periodically flooded due to seasonal precipitation patterns, a capability that is not available using visible/near infrared systems.

Implementation Steps

Scientists will aid in the development and implementation of a program to monitor the hydrologic conditions and changes in vegetation cover in the marsh ecosystems found in southwest Iraq. The proposed major implementation steps for Task 1 are as follows:

1. Review past satellite imagery efforts to develop a plan

A quick systematic review of past efforts to utilize satellite imagery to monitor changes in marsh cover in this region and to assess the availability of satellite data sets for this study. Satellite data will be used to systematically monitor changes to marsh conditions and serve as a basis for effective stratification of the field sampling efforts. This program will build upon past efforts undertaken by such organizations as the United Nations Environmental Program which has already used Landsat imagery to map changes to the marshes. However, the utility of the past efforts needs to be clearly focused in terms of the goals of the present program, with the pathway for the exploitation of past efforts clearly identified.

Data will be requested from the European Space Agency to determine the availability of high-resolution satellite imagery – Ikonos and Quickbird – for the selected monitoring sites. The outcome of this task will be a written plan containing the review of past efforts and recommended Tasks for 2 to 4 below.

2. Assess high resolution imagery

The launching of the Ikonos and Quickbird satellite systems has initiated a new era in terms of satellite-based remote sensing systems. The four meter resolution, multi-spectral satellite imagery collected by these systems presents an opportunity to analyze land cover at a much finer spatial scale than the 30 meter resolution Landsat imagery, particularly if the one meter resolution panchromatic band is used to "sharpen" the imagery. For design of field collection campaigns, the use of these high-resolution data is invaluable. Under this task, these data will be used and up to two scenes of imagery will be analyzed each covering an area of 10 by 10 kilometers. Monitoring sites will be the areas of focus. Analyses of changes to marsh conditions in the context of the current program goals will be based on using a time series of satellite imagery. The team will focus on two epochs: 2002 to present and seasonal scenes (winter, spring, summer, and fall) during 2004. These periods will cover the most recent changes and ongoing changes in 2004. Under this task, image classification and change detection analyses will be carried out as well. Focus will be on identifying areas of similar vegetation cover and hydrologic regimes in the most recent imagery as a basis for aiding in identification of areas for intensive field sampling and biophysical units by scientists.

3. Analyze radar imagery

Detailed analyses of available imaging radar data from the best available sources will be carried out at Abu Zarag. This site was chosen since it will have the most intensive hydrologic data including models of flow. This site will be used to ground-truth the radar data. The model developed from this will be tested at two other sites in Hawizeh and Suq Al-Shayukh. Data from seasonal scenes throughout the year will be used to assess hydrological variations associated with seasonal flow and precipitation patterns. Data from the 2004 time period will be assessed in order to determine the hydrologic patterns in other reflooded marsh systems in southern Iraq. Data will be collected over the 2004 time period that are associated with specific water level manipulation events. This effort also includes one two-week (including days to travel to and from the site) field trip in order to collect surface soil moisture and water level data at selected test sites. These data will be used as a basis for calibration and validation of the satellite data sets.

4. Analyze current hydrologic conditions and preparation of an integrated hydrologic report

During implementation, an analysis of the current hydrologic releases will need to be carried out by the Ministry of Water Resources to aid in the verification of the remote sensing data, as well as link to USACE model to predict marsh flooding regimes. This effort will be done in partnership with CRIM. Efforts will be made to link marsh hydrological dynamics to the regional data set and modeling for one or two of the monitored marsh sites. A written report will be prepared that documents the results of all analyses carried out under this effort. A model will be presented to CRIM that will allow predictions of water levels from satellite imagery.

Technical Assistance

The task requires experts in remote sensing techniques who can develop models tying ground-truth marsh flooding data to remote sensing imagery. Their ability to develop models to predict soil moisture and water level via imagery is essential.

Deliverables

The deliverables for Task 1 include:

- Review of previous satellite imagery efforts to monitor marsh drainage and reflooding and recommendations for planning Steps 2-4
- Assessment report based on high-resolution imagery
- Report based on radar imagery
- Integrated hydrological report, which includes a model of predictions of water levels from satellite imagery

Proposed cost: $135,000.

Task 2: Develop Protocols for Assessing Ecosystem Functioning

A quantitative description of wetland species or a complete listing of flora and fauna present at a site only provides a superficial understanding of ecosystem health. In order to gain the most comprehensive understanding of wetland health and of the success of wetland restoration, Task 2 will examine organisms as bio-indicators and as indicators of ecosystem functioning. In wetland ecosystems, this involves a range of techniques from the use of algal indicator species to the use of indicators of ecosystem level responses. Indicators need to be selected at various trophic levels including algal, plant, macroinvertebrates, fish, and, birds. Indicators of ecosystem structure and function, such as productivity, community habitat, biodiversity, biogeochemistry, and hydrologic dynamics, will also be monitored. In addition, the technical team will develop a comprehensive plan for sampling and monitoring prior to any field sampling. This will determine if there are any population shifts along salinity, nutrient, water or elevation gradients.

To aid in the location of representative stands, it is recommended (although it may not be presently possible) that aerial photos or low level flights be used to determine the number of communities in each study area. For example, a general listing of the steps that need to be taken for plants at both the landscape level and site specific assessments are shown in Tables 1-4. Once the scale of testing is determined, the team will determine the size, number, and location of the permanent plots within the monitored wetland.

Implementation Steps

A technical team which includes the Ministry of Water Resources and the Center for Restoration of the Iraq Marshlands, the Ministry of the Environment, will develop and implement an initiative to monitor the ecological status of the marshes, water quality, hydrologic conditions, and changes in biota in three marsh ecosystems. Major implementation steps are as follows:

1. Develop a sampling protocol for marshlands assessment

The technical team has developed a draft protocol to assess indicator species and measures of ecosystem functioning: productivity, biogeochemistry, water quality, and hydrology and community habitat. The following year will be dedicated to the collection of data in the three selected marshes to refine the restoration criteria for successful marsh restoration. Of importance will be the development of a uniform sampling protocol that will be consistent in terms of parameters and units of measurement. Most of the data will be

collected from permanent sampling locations within the selected marshes. Example sampling protocols that need to be further refined are shown in the tables below.

Technical Assistance

Experts from the University of Basra, supported by wetland specialists from the US, will complete the draft protocols and test them in the field for accuracy and usefulness.

Proposed cost: $25,000

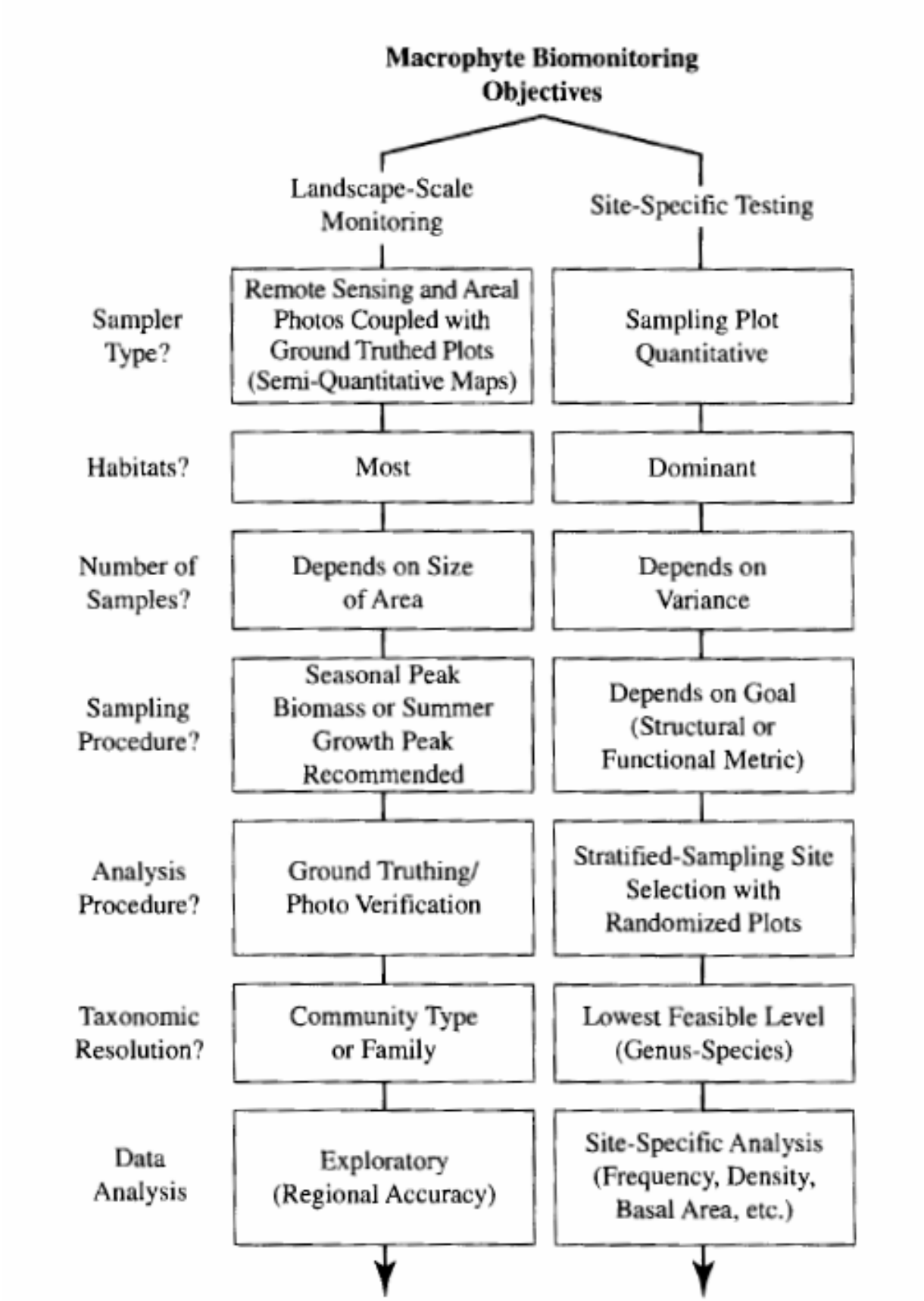


FIGURE 14.2. General guideline for macrophyte sampling in wetland communities

Table 1
Indicators of Ecosystem Functioning

Species Indicators	Nutrients Oligo-trophic	Nutrients Meso-trophic	Nutrients eutrophic	Salinity fresh	Salinity brackish	Salinity Saline	Hydro-period	Terrestrial
Algae								
Oedogonium			—	—				
Cladophora			—					
Rhizoclonium								
Spirogyra			—					
Vaucheria			—					
Enteromorpha						—	—	
Submerged Aquatics								
Potamogeton lucens	—							
P. perfoliatus	—							
P. crispus	—							
P. pectinatus		—	—					
Ceratophyllu m demersum		—	—					
Emergent plants								
Typha domengensis		—	—	—	—			
Phragmites australis	—	—	—	—	—			
Scripus littoralis							—	
Salicornia spp.						—		
Floating Aquatics								
Salvinia natanns			—					
Terrestrial								
Arundo donax								—

Table 2
Productivity Indicators

Indicators	Unit	Site	Location	Sample size/number	Schedule	Importance
Aquatic		Monitoring areas	Permanent stations			Productivity
Chlorophyll a	$\mu g/cm^3$				quarterly	
Standing crop	g/m^3				annual	
Fish						
Emergent Plants						
Major species	g/m^2					
Phragmites Typha etc.				$0.25m^2$	annual	

Table 3
Water Quality and Soil Indicators

Indicators	Units	Site	Location	Sample number	Schedule	Importance
			Permanent plots	2 per/plot		biogeochemistry
Water						Nutrient status
Conductivity	µs/cm				monthly	
Salinity	ppt				monthly	
TDS					monthly	
PH					monthly	
Temperature	C				monthly	
Dissolved oxygen	mg/L				monthly	
Total N					quarterly	
Total P					quarterly	
NO_3-N					quarterly	
NH_4-N					quarterly	
Na					quarterly	
SO_4-S					quarterly	
HCO_3					quarterly	
Soil						
Soil salinity	ds/cm				annually	
Depth of Organic Matter	cm				annually	
Soil organic Matter (0-15cm)	%				annually	
Redoxomorphic features					annually	
redox	mv				annually	
Nutrients (to be determined)					annually	
N, P, Na, H_2S						

Table 4
Hydrologic Dynamics, Bird Count, and Ramsar Criteria

Indicators	Units	Site	Location	Sample Number	Schedule	Importance
			Permanent plots	1 per/plot		Hydrologic dynamics
Water						
Depth	cm				monthly	
Spatial extent	m				monthly	
Flow	Cu/m/sec				monthly	
Bird Count					winter	biodiversity
Mammals					annual	
Characterization of the Ramsar Criteria	See table listing of 8 criteria	Whole Area			annual	

2. Assess ecosystem health and marsh restoration success

Three sites have been selected as the initial location of the marsh-monitoring program: Abu Zarag, Suq Al-Shayukh, and the remaining natural marsh in Hawizeh. Once the sampling protocol has been finalized, the technical team will compile and analyze the data quarterly to refine the criteria for restoration success based on indicator species, productivity, water quality and hydrologic conditions. While not a true reference marsh, the Hawizeh site can still function as a baseline from which to make a framework for restoration goals. In addition, changes in parameters over time can be used to assess biotic changes in relationship to water quality and hydrologic changes. Clear goals for monitoring need to be established.

Data from 2004 will be collected as indicated in the protocol draft tables. An analysis will be done in order to determine the ecological responses at all trophic levels to hydrologic patterns, nutrient gradients, and salinity changes within the marsh. Data will be collected in 2004 in association with specific water level manipulation events. The criteria for restoration success will be developed utilizing data from the monitoring effort.

A workshop to further refine the criteria and assess the findings of the monitoring program will be held in the fall of 2004 at the University of Basra, sponsored by the College of Agriculture, College of Science, and Marine Science Center. Data from the field collections will be used to assess restoration success, determine problem areas, and provide the information needed to create the final restoration criteria that can be used to determine options for marsh restoration.

Proposed Cost: $175,000

3. Create a marshland management database

Data from the intensive field site monitoring carried out at Abu Zarag, Hawizeh, and Suq Al-Shayukh will be compiled into a data base for the Ministry of Water Resources, and housed in CRIM. Information in the database will include data qualifiers, units of measurement, GPS locations of all samples, QA/QC components, as well as full site descriptors. Access software will be used for initial database development, since it is readily available in Microsoft Office and easy to operate. These data will be stored on a central computer in the ministry once all data has been validated. Copies of the data base will be made available to all regional offices, universities, scientists, and managers who request copies. A short-workshop or training session will be given in the fall of 2004 to teach the principles of data management and data transfer.

Technical Assistance

The following technical expertise is required:

- Wetland ecologist (Expatriate) with hands-on experience in large database development to assist in the design of the database – 20 days

- Database manager (Iraqi) to establish the database and hold the training sessions for the scientists and data managers – 80 days

- Two local computer data operators (Iraqi) to assist in the development of the effort – 100 days

- Two local computer trainees for database design and maintenance – 60 days

Estimated Cost: $35,000

4. Develop restoration criteria

Data collected from the intensive field site monitoring at Abu Zarag, Al-Hawizeh and Suq Al-Shayukh will be used to create and refine criteria for determining restoration success and the selection of future sites for restoration in Iraq. The criteria will include the following items:

- Population size/support
- Water quality for re-establishment
- Soil suitability/unsuitability for other uses
- Cost/size
- Connectivity
- Sustainability of water supply
- Sufficient depth and duration
- Degree/pattern of impoundment
- Original landscape configuration/diversity
- Likelihood of success in meeting key objectives such as biodiversity, fisheries and other specific uses

A short-workshop or training session will be needed in the fall of 2004 focusing on principles of wetland restoration and guidelines for future selection of wetland sites.

Actions

- Develop guidelines for the implementation of the criteria to assist in decision making
- Assist CRIM to prioritize areas for sustainable marshland restoration based on theses criteria

Technical Assistance

Experts on wetland restoration will be needed to assist in the development and refinement of the criteria needed to assess restoration success.

Deliverables

Deliverables include:

- Trained Iraqi personnel in field interpretation techniques

- Workshop to identify criteria for marshlands restoration
- Input to the monitoring effort and strategic planning process
- Well-documented indicators of restoration trends and success

Proposed Cost: $50,000

Total Cost of Task 2: $285,000

Task 3: Develop an Integrated Marsh Management Plan

Marshland restoration is only one of the elements necessary to improve human welfare and strengthen economic conditions in a sustainable way in southern Iraq. It cannot be achieved in isolation from other social and economic activities, and neither is it possible to separate it from technical questions related to overall water availability and the needs of competing water demands. Within the areas of the restored marshlands, there are other sectors which require consideration within an overall integrated approach – particularly agriculture, livestock, oil and other economic activities. Task 4 seeks to integrate these different pieces of the marshlands puzzle into a comprehensive plan for use by the Government of Iraq as it develops policies and procedures concerning long-term marsh management and economic development in the southern wetlands.

Objective

The objective is to assist the Ministry of Water Resources and the Center for Restoration of the Iraq Marshlands to develop and apply a plan for integrated marshland management to ensure delivery of a sustainable restoration strategy.

Implementation Steps

The program will provide training and expertise in integrated marsh management principles and methodologies to design a plan and develop tools for implementation. This effort will require carrying out a series of workshops for senior staff with multi-ministerial participation.

The topics will include:

- Basic principles of the ecosystem approach and integrated marshland management at different scales from the site to catchment;
- Linking science to the policy and planning process including possible role(s) of protected areas;
- Engagement of all stakeholders in the integrated plan to decide on criteria for maintaining/selecting sites for possible future restoration; and
- Operational frameworks of international conventions including RAMSAR, Convention on Biological Diversity (CBD), World Heritage, and UNESCO's International Biosphere Reserve Network

As a separately funded activity, the program will design and conduct study tours for senior staff to gain practical experience of major wetland restoration initiatives and integrated management planning in the Danube river basin and delta in Romania and the Ukraine.

Immediate Implementation Steps

Implementation steps include the following:

- Establish a strategy team to develop scope and content of workshops
- Schedule the workshops to coincide with ministerial and program milestones
- Identify the constituency of stakeholders
- Establish drafting group to develop the integrated plan
- Assess needs for implementation of the plan

Technical Assistance

- Expatriate expertise in integrated wetland ecosystem management methodologies and approaches – 50 days
- Experts in the diverse range of fields included in the program most generally from the wide variety of entities – 150 days

Deliverables

Deliverables for Task 3 include:

- Integrated marsh management plan and training of personnel
- Workshop agenda and related materials

Proposed Cost: $100,000

Proposed Additional Tasks for Year 1 (Presently Unfunded)

1. Monitor Additional Reflooded Marsh Sites (Estimated cost: $450,000)
Current funding will reasonably support three sites in the marshes. However, additional sites could be added at a relatively low cost.

Proposed Tasks for Years 2 and 3

1. Monitor Reflooded Marsh Sites (Estimated cost: $500,000)
In keeping with the protocols developed during Year one, a number of marshland sites ought to be monitored during Years 2 and 3.

2. Evaluate the Impact of Marsh Restoration on the Local Population (Estimated cost**:** $200,000)

Households and villages depend to various degrees on different components of the restored marsh ecosystem – reeds and other vegetation, water supply, fish, and wildlife – together with the surrounding non-flooded land. The pattern of use and dependency on different natural resources varies according to the resettlement pattern of people within, on the periphery of, and outside the restored marshland. Interviews conducted during the field visits in February confirmed the importance of marshland resources for the social and economic welfare of communities. However, people generally preferred activities, such as farming and livestock, which generated higher income streams to more traditional endeavors. The precise use of the marshland and adjacent natural resources is poorly understood in the reflooded areas. This proposed, additional task seeks to define the local economy of communities at the monitoring sites. The task will integrate with several other activities of the program, including fisheries, livestock, and agriculture and will help to determine the capacity of the restored marsh to improve quality of life, alleviate poverty, and enhance biodiversity.

Approach

The methodology will combine the sustainable livelihoods approach with the ecosystem approach. People are at the center of the ecosystem approach and by focusing on managing peoples' activities within ecosystems, there is a need to understand why people do what they do. The sustainable livelihoods approach places people at the centre of development, based on the premise that the diversity and richness of livelihoods can be understood only by qualitative and participatory analysis at a local level. Livelihoods can be thought of as comprising the capabilities, assets, and activities required for a means of living.

The first dimension of the framework examines different capital assets and natural assets, including land, water, and biodiversity. The second dimension has to do with vulnerability to change, in terms of resource stocks, population trends, and technological trends. Shocks include reduced or excessive flooding, sector conflicts, and disease. Culture and tradition are examined in terms of whether they facilitate or constrain adaptation. A third dimension is transforming structures and processes (such as levels of government, the private sector, laws, policies and cultural institutions). These are all important consideration to be taken into account by the CRIM strategic planning process.

Implementation Steps

Implementation steps include the following:

- Identification of Iraqi personnel
- Development of a memoranda of understanding with local communities
- Pilot techniques at a single site
- Training staff and students
- Carrying out surveys for monitoring marshes
- Documenting and analyzing results
- Plotting livelihood units on map/satellite image for comparison with biophysical units

Technical Assistance

- Wetland expert (Expatriate) to develop the effort, design the fieldwork, and assist in the analysis – 45 days

- Technical experts, including geographer, resource economist, and biologist in a pool – 250 days

Deliverables

The deliverables include the following:

- Record of the local economy for the monitoring sites
- Map and documentation of distinct economic units for monitoring sites
- Interpretive remote sensing imagery tied to economic exploitation patterns
- Informed staff from MoWR who can better advise on ways of improving and where appropriate protecting livelihoods

- Workshops involving local people, ministries coordinated by CRIM, universities, and NGOs to deal with methodological approach/findings/ recommendations for future restoration management

3. Launch Eco-tourism Ventures Based on Marsh Wildlife and Cultural Importance

There is considerable interest both in Iraq and worldwide in the biodiversity of the marshes and their traditional use by the Marsh Arabs. The marshes have also played a globally significant role in the flyways and lifecycle of bird populations including threatened, endangered, and endemic species. In addition, other rare and endemic animals have been recorded in the marshes.
This proposed, biophysical monitoring task will establish the extent to which restoration has enabled the recovery of the significant species as well as the entry of others. The task now is to assess how to:

- Maintain viable populations of important wildlife species and populations; and

- Bring the wider benefits of this biodiversity resource to the local population

Objectives

The objectives are to:

- Determine the recovery of rare endangered and endemic species;
- Link species recovery to known habitats/ecosystem requirements;
- Raise awareness among local people of the wider significance of these species;
- Explore with local communities strategies for increased income generation based on wildlife, including guided access for visitors, viewing points/hides, and handicrafts; and
- Establish the needs of site protection and designation under new environmental policies and the role of local communities in their management.

Implementation Steps

Implementation steps include the following:

- Translate the results form the biophysical monitoring
- Apply other expert knowledge to advise on habitat requirements of key species (identify suitable Iraqi and expatriate experts)
- Create a memo of understanding with local communities
- Conduct a workshop with communities with MoWR and MOEN
- Develop an eco-tourism strategy
- Develop local management plans
- Appoint local wildlife wardens from local population
- Construct simple access/viewing points
- Secure permits and other local access agreements
- Organize transport for visitors
- Safeguard visitor entry

Technical Assistance

Expatriate expertise in wetland ecosystems, reserve management and site management planning, wildlife management, and visitor management will be required, in addition to expertise provided by Iraqi professionals.

Deliverables

Deliverables include:

- Eco-tourism strategy developed with the Government of Iraq
- Management plan to maintain wildlife species and population alongside other uses of the area
- Areas designated for special protection/management measures, if necessary
- New jobs created for wildlife wardens and boat handlers
- Access/viewing facilities built
- Opportunities created for sale of handicrafts

Proposed cost: $1,000,000

2 ENCOURAGE AGRICULTURAL PRODUCTION AND AGRIBUSINESS

Photographs

Palm trees on the edge of Hammar City displaying inattention and poor condition, a typical sight in the marshlands

Wheat fields near

Wholesale market facilities in disrepair in Al-Amarah market

A market stall in Al-Medinah selling produce grown outside the marshlands

2 ENCOURAGE AGRICULTURAL PRODUCTION AND AGRIBUSINESS

Background

Prior to drainage of the Iraqi marshes, the main elements of the local economy were based on their biological diversity: livestock, fishing, hunting, and mat-making. Agriculture was always an important economic activity in the mashes, carried out on land as the water receded during the drying period. More recently, as the marshes were drained, agriculture became even more important as a key source of income and nutrition for former marsh dwellers.

During and subsequent to the years of drainage, agricultural activities were disrupted and strictly controlled. Displaced people grew wheat almost exclusively as it appears that the regime forbade the marsh dwellers from cultivating anything else. With the demise of the former regime, there is opportunity for the former marsh dwellers to improve agriculture in the drained marshes. The agricultural team of the Iraq Marshlands Restoration Program spent two weeks in mid-February in drained marsh areas interviewing the local population extensively, collecting data from markets, and in general observing the situation with respect to agriculture in these areas. These activities were done in order to determine potential activities to be implemented by the program to assist former marsh dwellers to develop their agricultural systems and to prepare them to participate fully in the changing agricultural economy of Iraq.

Agriculture Technical Team

The team consisted of the following members:

Dr. Jane Gleason (DAI), Dr. Amer Jabarin (ECOConsult), Dr. Robert Fitzpatrick (CSIRO), Dr. Haitham Ali, (University of Basra), Dr. Aqeel Abbas, (Ministry of Agriculture), Dr. Alaa Sabeeh Jabbar, (University of Basra), Dr.Ali Hussein Hassan, (University of Basra), and Mr. Fawzi (MOA-Director of Agriculture in Basra), Dr. Ali Attaha, (University of Basra), Dr. Abdel Jabbar Hassan (University of Basra), Dr. Dakhil Nedawi (University of Basra), Mohamed Malik (University of Basra), Mr. Wisam Jaba'a (AMAR), Mr. Mohamed Jasim (AMAR), Dr. Faraoun Ahmed Hussein (Ministry of Agriculture), Dr. Ali Nasser (AMAR), Mr.Mustafa Ali (Ministry of Agriculture Al-Medinah District).

The aim of the effort is to determine the extent to which current soil and water resources are limiting constraints for agricultural production at the farm and village levels in the drained and reflooded marshlands. It is also to develop a set of practical soil and water indicators to help local government officers and growers identify signs of soil and water degradation and to adopt practices to reverse it, thereby increasing agricultural productivity and sustainability. This involves developing and evaluating indicators for salt-affected soils

(saline and sodic), waterlogging, water use efficiency, and water quality at local and regional scales.

Soil and Water

Objectives

The objectives of the soil and water effort were to establish:

- Key limitations of soil and water resources to agricultural production at the farm and village levels;
- Satisfactory approaches for describing and predicting the pathways, mobility, loads and sources of salts and colloids (clays) in drained and re-flooded marshland soils;
- Soil and water processes involved in the major causes of land degradation in several key focus study sites in southern Iraq marshlands,
- Preliminary soil-water models for the feedbacks between soil salinity, soil sodicity and hydraulic properties of soil profiles based on the base data collected at selected paired sites,
- Preliminary soil and water indicators to assist in farm planning for achieving environmentally sustainable production,

Summary of Outcomes

To get both a quantitative assessment of the soil materials present and reasonable spatial coverage of salt/sulfide-affected soil risk, a set of soil samples and 15 water samples from 25 selected areas soil and water samples were collected for further analyses. Thirteen areas consisted of paired drained and re-flooded sites. This information is proposed for eventual use to develop a preliminary “practical user-friendly guide” to help Iraqi land managers assess, monitor, and manage salt-affected marshland soils when drained, disturbed or reflooded. The approach also involves establishing methodologies for on-the-ground field sampling and monitoring to characterize marshland salt-affected soils and assess salinity risk. The preliminary results are in Appendix 1 to this section.

The sampling carried out in February was undertaken at focus sites in the following four zones which are major agricultural areas associated with significant problems of soil and water degradation:

- Farming on dried marshland
- Reflooded on dried marshland
- Edge of the marshland
- Existing marshland

Findings

Soil salinisation and sodicity of land and water resources is a growing problem and concern in all four zones. Little is known about the physico-chemical changes in these saline/sulfidic soils when they were drained, such as when these soils desiccate, burn, and are subsequently sown to annual crops and pastures for wheat and barley. Certain soil types are prone to pugging where animals graze waterlogged soils and erosion may also develop.

Various types of salt-affected soils occur in these altered marshlands, depending on the conditions under which they form and their morphological, physical, chemical and biological properties. Some of these saline/sulfidic soils have already reached a state of irreversibility. Preliminary data indicated three conceptual soil-water models, which tends to summarize the physico-chemical processes involved in the changes that lead to different soils (e.g. sodic, eroded, saline – halitic or gypsic, acid sulfate – sulfidic) and poor water quality (mobilised salts and soil particles) when the marshlands are drained or otherwise disturbed. The models include:

- Soils progressively affected by sodium and chloride in ground and surface waters (halite dominant)

- Soils progressively affected by sulfur, sodium and chloride in ground and surface waters (sulfidic, gypsic)

- Soils progressively affected by salinity and sodicity in the root zone caused by restricted permeability within sodic sub-soil layers

- Soils irreversibly changed by high temperature burning (>600 degrees centigrade) when the dried marshlands were burned over 10 years ago

- Soils progressively affected by anthropogenic alteration caused by the addition of organic materials and sediments over long periods of time.

Intense reducing conditions (i.e. low redox potential or Eh values to -345 mV) were measured in sulfidic materials in potential acid sulfate soils on islands that were recently reflooded. This could be the result of increased nutrient loads (eutrophic conditions) and of the high concentration of detritus sapric material remaining from the organic matter in the drained marshland soils. This finely divided soil organic matter decomposes fast. These soil processes and materials must be better understood if effective approaches to management are to be developed.

Management strategies should be based on adequate characterisation and mapping of the sulfidic materials other soil layers. Understanding the distribution, evolution, nature and interrelationships of the soils and sediments is vital for effective planning of agricultural management and selection of appropriate remediation options.

In many parts of the marshlands, improving agricultural water use efficiency will lead to increased agricultural productivity and sustainability. Soil degradation (mostly salt-affected

soils) is often the primary limiting factor in the efficient use of the often limited water resource. Soil degradation and water resource depletion proceed at varying rates and occur at different scales. Thus, to assess water related limitations to agricultural production and the off-farm impacts of inefficient water use and quality, effective tools, such as predictive models and indicators of environmental sustainability, are necessary. For example, in some of these saline/sulfidic landscapes, knowledge of soil and water properties and how the underlying aquifer responds to changed land management can lead to remedial action can minimize or possibly reverse the spread of salinity.

Production and Marketing

Objectives

The objectives of the work of the agricultural team are to assess the resource base of the drained marshes and its relationship to agricultural production potential. In addition, the team assessed local and regional market operations with a view to developing marketing strategies related to the production system in the drained marshlands. The specific objectives are:

- To determine the current and potential future importance of agriculture and agribusiness as part of the economic systems in the marshes;
- Assess the financial opportunities of agricultural production for Marsh Arabs for the next three to five years and clarify opportunities and the challenges in developing production and marketing interventions; and
- Identify implementation strategies and immediate interventions to jumpstart agricultural production and agribusiness by the Iraq Marshland Restoration Program.

Field Visits

To accomplish the objective related to determining the current importance of agricultural and agribusiness as part of the economic system in the marshes, the team made several field visits to different parts of the marshes including: parts at the edge of the marshes, re-flooded marshes, and dried marshes. We conducted a rapid appraisal through face to face interviews with groups of growers in the different regions of the marshes. In order to identify the current importance of agriculture and agribusiness in the marshes, the interviews focused on the following:

- Structure of current production systems (animal, plant and fish) in terms of types of cultivated crops, area, production quantities, productivity, cultivation and harvesting time, crop rotations, and number and types of animals per household;
- Sources of income of households living in the different communities in the marshes and the proportion of the different sources;

- Costs of production of the most important crops in terms of quantities and prices of inputs used. This information was used to prepare crop enterprise budgets for the main crops produced as well as for potential crops that can be produced in the dried marshes. The budgets were used to estimate the gross margins of the crops currently produced in the marshlands and those that can potentially be produced. These budgets were also used to estimate the size of funding needed by the project to help the selected communities in producing the selected winter and summer crops;

- Market outlets, market channels and sources of inputs used in the production process; and

- Main production and marketing constraints facing growers in the region.

The sub-team visited the following sites and interviewed groups of farmers on the following locations:

- Al-Azair district (GPS location is Lo N 31^{O} 19' 45.50" and La E 47^{O} 24' 53.91"). Two villages at this district were visited: Al-Bayda and Abu Laila. In the first village, a group of seven farmers were interviewed at the office of the director of agriculture in the district. At Abu Laila village, the sheikh of the Beyt Khawaf tribe and more than ten others from the tribe attended a meeting at the mudhif.

- Qal'ah Salih district (GPS location is Lo N 31^{O} 22' 52.98" and La E 47^{O} 32' 65.10"). Two villages were visited: Al-Turabah and Tulybat. In the first village, the sheikh of the Abu Ghanam tribe, the director of agriculture, and more than ten farmers were interviewed. At the second village, a group of more than seven farmers were interviewed.

- Al-Al-Chabayish district (GPS location is Lo N 30^{O} 56' 39.96" and La E 46^{O} 59' 22.67"). Two villages were also visited in this district, Al-Albaher and Al-Mabar. In the first village, the sheikh of the tribe in addition to a group of farmers was interviewed. In the second village, the meeting was also attended by the sheikh of the tribe and a group of six farmers.

- Al-Qurneh local wholesale market (GPS location is Lo N 30^{O} 59' 19.77" and La E 47^{O} 26' 05.22"). The team met with a group of three wholesalers in this market to obtain information related to marketing issues and conducted an observation visit to the market.

- Al-Medinah local wholesale market (GPS location is Lo N 30^{O} 57' 46.15" and La E 47^{O} 17' 08.85"). This is a smaller local market than the one in Al-Qurneh. In this market, the team also met with a group of wholesalers and conducted an observation tour inside the market.

Common Characteristics of the Growers

Primary data were collected through direct interviews with the farmers and field tours showed the following socioeconomic characteristics of the marsh communities:

- The family size is large with a high dependency rate. The average size of the family is about 8-10 members.

- The size of the land holdings ranges between 12 and 50 dunums. The average size of the holding is about 25 Iraqi dunums (6.1 hectares).

- Sheep, water buffalo and goats are the major livestock types found in the marshes, but former marsh dwellers also keep pigeons, ducks and indigenous types of chicken. The size of herds kept by the household widely varied based on location in the drained marsh and the wellbeing of the family. However, the majority of the households in the visited communities keep at least 4-5 head of sheep and few birds.

- The main cultivated winter crops are wheat and barley in a proportion of 70 percent wheat and 30 percent barley. In some districts, sorghum is produced as a summer crop. Few patches of vegetables are also grown including okra, melons, tomatoes, and potato.

- The main source of household income is agriculture, including livestock (about 75 percent). The other sources are mainly fishing and reed-gathering.

Almost all of the interviewed farmers are originally from the same part of the marsh where their agricultural community is now situated. Many of them were displaced numerous time, and they returned to their original locations.

Below are a more complete descriptions of conditions of farmers on the edge of the drained marshes and former marsh dwellers now agriculturalists living and working in the drained marshes.

Variations in Agriculture in the Marshlands

Farming on the Edge of the Marsh

The agriculture team met with a group of farmers who live on the edge of the marsh in Al-Azair (Lo N 31^{O} 19' 45.50" and La E 47^{O} 24' 53.91"). The team and the group of farmers met in the Ministry of Agriculture building in the center of town. The farmers were not former marsh dwellers, but their farming depends on marsh water, most of which is now channeled into a large north south canal located east of the town.

Farmers in this town, like farmers all across the south of Iraq, cultivate mainly wheat and barley in the winter. There are small areas cultivated to vegetables. Wheat and barley are sold to the Ministry of Trade (MOT) grain silos in Al-Amarah at set government prices, last

year being USD 105/ton for wheat and USD 90/ton for barley for first quality. Black smut, a problem common to this area, often reduces grain quality and thereby the price.

If farmers receive full price for wheat or barley, they were able to make a small profit, mainly because last year production inputs, especially fertilizers, were procured by the Oil for Food Program and distributed by the Ministry of Agriculture (MOA). In the past decade or so, production inputs, especially fertilizers, were sold to farmers at highly subsidized prices, perhaps a mere 20 percent of cost (this under the terms of the OFF). This permitted the government to purchase wheat and barley at prices far below the world market price.[1] Other crops are marketed in Al-Azair.

In summer, farmers grow small amounts of corn or sorghum. Date palms grow haphazardly in the area, and are not deemed important, especially compared to years past when dates were an important crop for both domestic and export markets.

The farmers on the edge of the marsh face the same constraints to agricultural production that all farmers in Iraq face. This year especially, lack of inputs is farmers' main complaint. Except for seed, which is derived from previous harvests, the farmers in most parts of Iraq were unable to acquire any production inputs, whether for pest control, fertilizers or machinery.

Of great importance is the lack of extension provided to farmers. None of the farmers in the meeting have had contact with extension personnel in years, even though there is an administrative representative of the MOA in the village. The extension system was allowed to deteriorate during the past two decades of the former regime. The MOA in Baghdad reports that there are only 200 extension personnel in the whole country, and the main focus of extension was infrequent television and radio messages, perhaps two to five minutes in length, about agricultural production. The research system in the country, while staffed by highly qualified scientists, suffered from lack of funds or recognition, and the inability to participate in international research efforts or seminars and symposia abroad. Lack of extension coupled with a broken research system means that these farmers, like most farmers in Iraq, have not had the benefit of new seed varieties, other modern technologies or new techniques or good advice for about two decades.

During the 2003/2004 cropping season, farmers across Iraq have faced a shortage of fertilizer, both DAP and urea. As of mid-January 2004, only about 50 percent of the estimated DAP has been procured from the country, and virtually none of the estimated urea was made available. [2] The same is true for pesticides. In the past, most pesticides were procured through OFF, and distributed at highly subsidized prices to farmers. With the transfer of OFF contracts to CPA, the estimated requirements for chemicals for pest control

[1] For the 2003/2004 season, the Ministry of Trade announced procurement prices for wheat and barley at USD 180/ton and USD 150/ton, and substantial and welcome increase over previous years.
[2] The reason for the shortage is confusion regarding the management of the OFF contracts after the CPA took over from the UN. Deliveries were not made at the time of the handover, and CPA neglected to make new contracts. In early February, the MOA took over management of the contracts and tendered for about 100,000 tons of urea. This will not cover total needs, and it is not yet clear how the fertilizer will be distributed.

were not procured. Of particular importance to farmers in this part of Iraq is the chemical for aerial spraying of date palms which is currently not available in Iraq.

Farmers were anxious to learn about new crops and to gain access to new seed varieties of known crops. New crops mentioned were sesame, cotton, and such vegetable crops as potato or carrots.

The obstacles to profitable agricultural production in Al-Azair are systemic in nature, the solutions contingent largely on the revitalization of the entire sector. Assistance to this set of farmers could come in many forms – for example, provision of new seed, introduction of new crops, regular and high quality extension help, and improvement of marketing links. Farmers also identified credit as a major constraint to production and marketing, and this is likely to become a more seriously binding constraint as the economy transitions. While assistance to these farmers is warranted from the point of view of need, the inventory of problems given to the agriculture team is what one hears in every village in Iraq. Thus, any intervention to change the plight of these farmers will depend on movement in Baghdad to correct a system broken by years of sanctions and war, and a proper transition from a government controlled to a market-based agricultural economy. The situation of these farmers is characteristic of farmers all across the country, and not particular to those living on the edge of the marsh. For this reason, the team does not recommend programs of assistance for this population. In comparison, the plight of farmers in the drained marshes is even more acute and deserving of special attention and assistance.

Farming in the Drained Marshlands

The international and domestic political circumstances of the last two decades in the southeastern and southern parts of Iraq have forced marsh dwellers to become farmers. The transition from marsh to drained land has not been easy for the former marsh dwellers. Faced with challenges particular to their land and water conditions, the former marsh dwellers eke out a difficult existence. Yet, surprisingly, all former marsh dwellers interviewed for this program confessed that if given a choice between living in the marsh as they had done for millennia and living on drained marsh land cultivating crops, they would choose agriculture. They believe that agriculture provides the potential to improve their living conditions in ways and in magnitude that marsh living could not.

The farmers cultivating the dried marshes, like their counterparts living on the edge of the marsh face the same constraints as most farmers in Iraq. There is a lack of inputs, especially fertilizer, transportation is difficult, and they receive little or no extension advice. Yet, the circumstances resulting from drying of the marshes present other more difficult challenges to these people, challenges which are serious enough to warrant specially assistance programs to these population groups. Those distinctive challenges facing marsh dwellers turned farmers are:

- **Lack of experience in farming**. For millennia, the marsh dwellers lived off limited and seasonal agriculture livestock tending, and fishing in the marshes. They had limited experience with farming grain crops. The events of the past two decades forced them to dispense with most economic activities they did as marsh dwellers in favor of cultivating crops as their maim source of income. Now they are moving into a new form of

agriculture - growing for the market. They are making this change without any training or help from the Ministry of Agriculture or other agencies.

- **Soil and water constraints.** There are significant and growing problems of salinization of soil and water in the dried marshes. Further, little is known about the physico-chemical changes in these saline/sulfidic soils when drained, such as when these soils desiccate, burn, and are subsequently sown to annual crops and pastures (wheat and barley). Lack of knowledge about these soils makes it difficult to provide good advice on crop selection, site selection or level and type of input.

- **Internal displacement.** Most marsh dwellers were forced to move from their homes more than once and often 10 or more times over the past 13 to 20 years. The psychological and emotional effects of this tragedy are compounded by the near total loss of assets and resources. Under any circumstances this would be hard to overcome, but in the Iraq of the past two decades, it has been virtually impossible for these people to recover their losses.

The agriculture team toured the dried marsh areas in and around the Hawizeh marsh, the Hammar marsh and the Central marsh to discuss with the former marsh dwellers their current agricultural practices and to elicit their thoughts about future prospects for agriculture in the area.

Farming in the Dried Hawizeh Marsh. In the village of Al-Turaba, about 15 kilometers east of Qalit Salih (Lo N 31^{O} 22' 52.98" and La E 47^{O} 32' 65.10"), former marsh dwellers have been cultivating the dried Hawizeh Marsh since 1997. The Ministry of Water built an extensive irrigation system which receives water directly from the remaining portion of the Hawizeh Marsh, about 6 kilometers to the east of the village. The main east-west canal has the capacity to irrigate large extents of land. Of the thousands of hectares dried by policies of the former regime and upstream infrastructure development, cultivation in Turaba village does not exceed 100 or 150 hectares, even though the 520 farm families of the village own about 2000 hectares. What cultivation does occur is mostly to devoted to wheat and barley in the winter, and small amounts of sorghum in the summer. Wheat, 70 percent of the total grain production, is routinely sold to the MOT at government prices in Al Amarah like other farmers in the region (Al-Amarah is a mere 45 kilometers from Turaba village). Barley is usually fed to animals.

In a second village west of the remaining Hawizeh Marsh, the village of Abu Laila (Lo N 31^{O} 19' 45.50" and La E 47^{O} 24' 53.91"), former marsh dwellers have been cultivating for about three years. This group of people had lived in this spot when water covered the area, but they were forced to evacuate during Iran-Iraq War. One hundred sixty families live in this village, each family with about 5 hectares each. Of the 800 hectares owned by families in this village, very little is cultivated in an average year, and during the 2003/2004 season no cultivation occurred at all. Farmers were unable to acquire any inputs. Lack of a pump made cultivation impossible also. These families also do not fish, nor do they have many animals.

The catalogue of constraints to production in this area is similar to those of all farmers in the region. Lack of inputs is the main complaint from the village leaders, as is weak markets for

crops other than wheat and barley. There is no extension, and the farmers have little access to modern technologies, though the Ministry of Agriculture introduced a few years ago Abu Ghreib varieties of wheat and barley to this village.

Farming in the Dried Hammar Marsh. The people of village Al-Albahar on the south side of the Euphrates near Al-Chabayish settled in this area after they were displaced by drying of the Hammar Marsh. (GPS location is Lo N 30^{O} 56' 39.96" and La E 46^{O} 59' 22.67") They have been cultivating since 1990. The village is located directly under the south levee of the Euphrates, which supplies irrigation water through a large network of canals and drains.

Al-Albahar has about 100 families, each of which has about 30 dunum of land. Due to drainage problems and soil salinity, very little of the 3000 dunums belonging to this village is cultivated. What is cultivated is sown to wheat and barley, and, surprisingly, a small amount of garlic, which was in poor condition. The villagers noted that close proximity to Al-Chabayish provides them with marketing opportunities not common to most former marsh dwellers. For example, these farmers have the option of selling their harvested wheat and barley to private buyers, in addition to the MOT.

In addition to crop cultivation, each family has between 1 and 3 buffalo. This is only a fraction of the average number of animals most families had before the marsh was dried. In addition, before drying of the marsh, families relied on fish for their livelihoods. Now, they can fish directly in the Euphrates, though quantities caught are not great.

Families in the village of Al-Mabar, 15 or so kilometers east of Al-Albaher under the levee of the Euphrates, also cultivate wheat and barley. In addition, these former marsh dwellers cultivate tomato, carrots, zucchini and a few date palms. The soils found in Al-Mabar are good, suitable for a wide range of crops. There is little or no salinity possibly because the village is located next to a drainage facility which pumps excess ground water into the Euphrates.

The former marsh dwellers living in the drained marsh were surprisingly optimistic about current and future potential for agriculture in their area, unlike former marsh dwellers in the drained portions of the Hawizeh Marsh. The context of our discussion with families from these two villages may have biased some of the answers they gave to us. Within the last three weeks, a large area of land north of the Euphrates, directly across the river from both of these villages, has recently been reflooded. All of it was part of the Hamar Marsh, and some of it contained a large irrigation system, where cultivation had taken place.

The consequences of this reflooding are that, yet again, families of the marsh were forced from their homes and their livelihoods again destroyed. The families in Al- Albaher andAl-Mabar were very clear that they did not want the water to return to their side of the dried marsh. When asked about the general problems they face as agriculturalists, they gave no answer, testifying, unlike all other farmers in the drained marsh that they face but few constraints or difficulties. Their fields and houses do not support this assertion. All of these people are very poor, and most face production problems derived from salinity and poor water quality. The team concluded that families in both villages refused to discuss their difficulties out of fear that doing so would endorse reflooding of the area.

Agriculture Potential in the Reflooded Areas

Four families have returned to the reflooded area north of the Euphrates referred to above. There is no village name. We spoke to one family, which had returned from years in Hillah only three days ago. Living on a small patch of high ground amongst a newly formed sea of water, this family intends to grow crops. They have expectations to grow melons or other high value vegetables of fruits on their small parcel of land.

Water quality in the newly flooded area mitigates against agriculture at the present time. The agriculture team does not propose to do any work in this area until water quality improves and plans for site-specific reflooding become clearer. We recommend regular and frequent water quality monitoring in the interim.

Agriculture in the existing marsh is also not possible. Water and soil analyses from the Hammar Marsh east of Suq Al-Shayukh, concluded that both are too saline to support agriculture. The agriculture team does not recommend any agricultural work in existing marshes.

Agricultural Production in the Drained Marshes

The main purpose of interviewing former marsh dwellers was to acquire production data on their current set of crops. This was done to give an idea of the potential for agricultural production in the area and determine if soil and water conditions are good or easily made to be appropriate for agriculture.

Crop budgets are presented below. These were used to estimate the gross margins (GM) for wheat, barley, sorghum, maize, tomato, okra, broad bean, and date palm trees. Wheat, barley and sorghum are the major field crops currently produced in the marshes. Date palm trees are also widely grown in the drained marshes, although the conditions of many orchards have deteriorated as a result of the drastic changes in the ecological system.

The gross margin of an agricultural activity per area of land is the gross income (value of the sold product) minus the direct variable costs attributed to that activity. Crop budgets are considered the backbone of farm income analysis and are used to identify the financial opportunities of agricultural production. The crop enterprise budgets developed for the currently existing crops using current technologies and under existing production systems were abstracted from data acquired through interviews with farmers. The budgets are used to compare the gross margins of the different crops.

Table 1 includes a summary of the main financial indicators found in crop budgets for the potentially and currently produced crops in the marshlands. The table shows that traditional crops currently produced such as wheat and barley have very low gross margins compared to horticultural crops that can be produced in the drained marshes assuming that inputs and the “know how” are made available. Wheat and barley, for example, provide gross margins of a mere ID 55,000/dunum, or about $40/dunum ($160/hectare). Assuming for example that a family owns and cultivates 30 dunum (7.5 hectares), the total gross margin would be $1200. Unfortunately, most families are not able to cultivate anything close to the full extent

of land that they own, and often they grow nothing at all. The many problems associated with agricultural production discussed above prevent larger scale cultivation.

The table shows that broad beans, okra and tomato give the highest returns per unit of land (dunum). For example, sorghum provides a gross margin of ID 659,750/dunum or $1882/hectare. Tomato under plastic, broad bean and okra all give gross margins of a similar magnitude. Unfortunately, to date, few former marsh dwellers have had the opportunity to cultivate these crops.[3]

These rough estimation of costs and benefits of the different crops clearly shows the financial opportunities of other agricultural production activities that can be adopted by former marsh dwellers. The table indicates also that returns of date palms are much higher than traditional crops currently produced in the marshes.

Table 2.1
Financial Indicators for Potentially and Currently Produced
(ID/Dunum)

	Wheat	Barley	Maize	Sorghum	Tomato	Broad Bean	Okra	Date Palm*
Total returns	90,000	94,000	660,000	900,000	1,600,000	1,100,000	1,050,000	500,000
Variable costs	37,000	38,250	398,500	241,000	970,250	323,000	316,000	250,900
Gross margins	53,000	55,750	261,500	659,000	629,750	777,000	734,000	249,100

* The data for date palm trees assumes trees in the full production stage

Figure 1 shows labor requirements per dunum of land needed for the eight studied crops. It is clear from the figure that traditional field crops rank at the lowest level in providing employment opportunities to the peoples of the marshes. Unlike grain crops, tomato, okra and date palm provide high employment opportunities since they are labor intensive and require lots of labor in all stages of production.

[3] The cost and returns are based on current prices as of February 2004. Two notes of caution are worth stating: 1) the MOA currently subsidizes certain inputs, especially fertilizer, some seeds and some chemicals. It is not certain how long these subsidies will remain in effect; as the government intends to eliminate subsidies over the course of the next few years. 2) prices for horticultural crops are likely to exhibit volatility depending on the season. There is no information on the seasonality of prices in southern Iraq. Grain prices, on the other hand, are fixed by the government.

Figure 1. Labor requirement by crop (Person-day/Dunum)

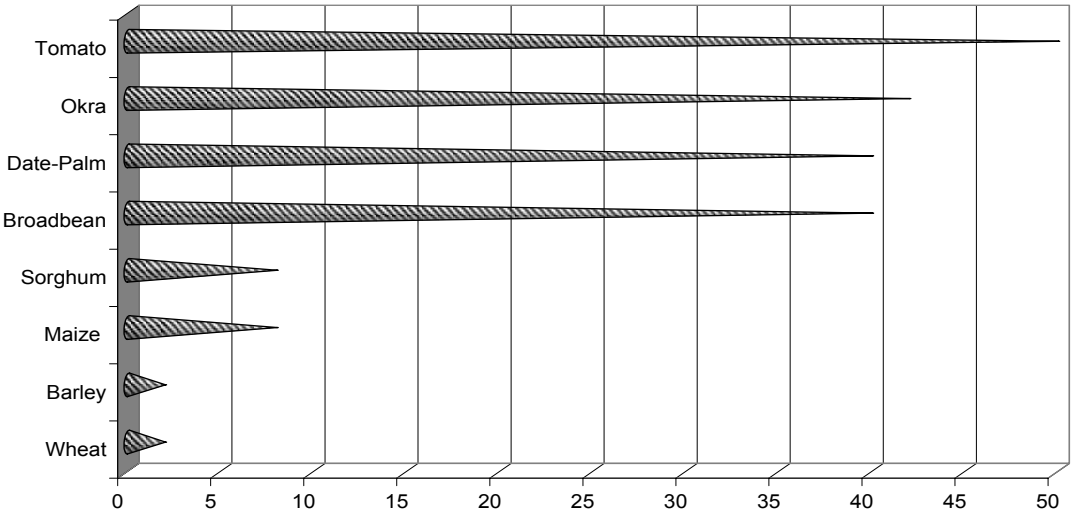


Table 2.2
Input-Output Data and Gross Margin per Dunum of Winter Wheat

	Unit	No. Units	Price/Unit (ID)	Total Cost (ID)
Crop 1: Grain[4]	kg	500	16	80,000
Crop 2: Hay		1	10000	10,000
Total Gross Output				**90,000**
Seed/seedling Bought	kg	25	260	6500
Manure - Fertilizer	m^3	0		0
Total mineral fertilizer	kg	0		0
DAP	kg	0	280	0
Urea	kg	0	980	0
Sacks	sack	10	200	2000
Costs of hired machinery	ID			26500
- land preparation	dunum	1	700	7000
- Irrigation	dunum	1	12500	12500
- harvesting		1	700	7000
Labor[5]	person/day	2	2000	4000
Total Variable Costs	**ID**			**37,000**
Gross Margin	**ID**		**dunum**	**53,000**

Source: Field interviews

[4] It is useful to compare grain yield with average yields in Jordan. Jordanian wheat cultivation represents a level of production achievable in Iraq assuming that new seeds and other technologies eventually become available to Iraqi farmers. Irrigated wheat in the Jordan Valley will give an average yield of three metric tons per hectare, while in the drained marshes, former marsh dwellers reported yields of only two metric tons per hectare. This indicates that there is ample room for increase if soil, water and technologic packages are improved. Yet, even with an increase of 50 percent in yield, under today's prices and costs, gross margins would remain frightfully low and unappealing.

[5] Imputed cost for labor, most likely families will supply labor at no cost.

Table 2.3
Input-Output Data and Gross Margin per Dunum of Winter Barley

	Unit	No. Units	Price/Unit (ID)	Total Cost (ID)
Crop produce 1: Grain	kg	700	120	84,000
Crop produce 2: Hay		1	10000	10,000
Total Gross Output				94,000
Seed/seedling: Bought	kg	25	150	3750
Manure - Fertilizer	m^3	0	0	0
Total mineral fertilizer	kg	0	0	0
DAP	kg	0	280	0
Urea	kg	0	980	0
Sacks	Sack	14	200	2800
Costs of hired machinery	ID			30500
- land preparation	Du	1	7000	7000
- Irrigation	Du	1	12500	12500
- harvesting	Du	1	7000	7000
Labor	person/day	2	2000	4000
Total Variable Costs	ID			38,250
Gross Margin	ID			55,750

Table 2.4
Input-output data and Gross Margin per Dunum of Winter Tomato

	Unit	No. Units	Price/Unit (ID)	Total Cost (ID)
Crop produce 1: Tomato	kg	8,000	200	1,600,000
Crop produce 2: None			-	-
Total Gross Output				1,600,000
Seed/seedling: Bought	kg	0.25	217,000	54,250
Total Chemicals	ID	-		252,000
-Pesticides	Liter	4	21,000	84,000
-Insecticides	Liter	4	21,000	84,000
-Fungicides	Liter	4	21,000	84,000
Total mineral fertilizer	kg	-		118,150
DAP	kg	100	280	28,000
Urea	kg	80	980	78,400
Packing boxes	Box	25	470	11,750
Costs of hired machinery	ID			106,500
- land preparation	Du	1	16,500	16,500
- Irrigation	Du	1	90,000	90,000
- harvesting	Du	1	-	-
- White Plastic sheets	Ton	0.30	1,092,000	327,600
Labor	person/day	50.00	2000.000	100,000
Total Variable Costs	**ID**			**970,250**
Gross Margin	**ID**			**629,750**

Source: Data collected from markets complemented by information from the University of Basra.

Table 2.5
Input-Output Data and Gross Margin per Dunum of Winter Broad Bean

	Unit	No. Units	Price/Unit (ID)	Total Cost (ID)
Crop produce 1: Broad bean	kg	2,000	550	1,100,000
Crop produce 2: None		1	-	-
Total Gross Output				**1,100,000**
Seed/seedling: Bought	kg	25	1,000	25,000
Total Chemicals	ID	-		126,000
-Pesticides	Liter	2	21,000	42,000
-Insecticides	Liter	2	21,000	42,000
-Fungicides	Liter	2	21,000	42,000
Total mineral fertilizer	kg	-		63,000
DAP	kg	50	280	14,000
Urea	kg	50	980	49,000
Packing boxes	Box	10	-	-
Costs of hired machinery	ID			29,000
- land preparation	Du	1	16,500	16,500
- Irrigation	Du	1	12,500	12,500
- harvesting	Du	1	-	-
Manual labor	person/day	40.00	2,000	80,000
Total Variable Costs	**ID**			**323,000**
Gross Margin	**ID**			**777,000**

Sowing time: 1st of September
Harvest time: Dec., and January
Proposed varieties: Shamyia

Table 2.6
Input-Output Data and Gross Margin per Dunum of Maize (Summer Season)

	Unit	No. Units	Price/Unit (ID)	Total Cost (ID)
Crop produce 1: Maize	kg	2,200	300	660,000
Crop produce 2: Hay		1	6,000	6,000
Total Gross Output				**666,000**
Seed/seedling: Bought	kg	10.00	1,000	10,000
Total Chemicals	ID	-		126,000
-Pesticides	Liter	2	21,000	42,000
-Insecticides	Liter	2	21,000	42,000
-Fungicides	Liter	2	21,000	42,000
Total mineral fertilizer	kg	-		74,750
DAP	kg	50	280	14,000
Urea	kg	50	980	49,000
Packing boxes	Box	25	470	11,750
Costs of hired machinery	ID			29,000
- land preparation	Du	1	16,500	16,500
- Irrigation	Du	1	12,500	12,500
- harvesting	Du	1	-	-
Manual labor	person/day	8	2000.000	16000.000
Total Variable Costs	**ID**			**267,500**
Gross Margin	**ID**			**398,500**

Table 2.7
Input-Output Data and Gross Margin per Dunum of Okra

	Unit	No. Units	Price/Unit (ID)	Total Cost (ID)
Crop produce 1: Okra	kg	2,500	420	1,050,000
Crop produce 2: None		1.00	-	-
Total Gross Output				**1,050,000**
Seed/seedling: Bought	kg	6	2,333	14,000
Total Chemicals	ID	-		126,000
-Pesticides	Liter	2	21,000	42,000
-Insecticides	Liter	2	21,000	42,000
-Fungicides	Liter	2	21,000	42,000
Total mineral fertilizer	kg	-		63,000
DAP	kg	50	280	14,000
Urea	kg	50	980	49,000
Packing boxes	Box	10	-	-
Costs of hired machinery	ID			29,000
- land preparation	Du	1	16,500	16,500
- Irrigation	Du	1	12,500	12,500
- harvesting	Du	1	-	-
Manual labor	person/day	42	2,000	84,000
Total Variable Costs	**ID**			**316,000**
Gross Margin	**ID**			**734,000**

Sowing time: 1st of March to 15th April
Harvest time: May, June and July
Proposed varieties: Boterah or Hussienwayia

Table 2.8
Input-Output Data and Gross Margin per Dunum of Sorghum (Summer Season)

	Unit	No. Units	Price/Unit (ID)	Total Cost (ID)
Crop produce 1: Sorghum	kg	1,500	600	900,000
Crop produce 2: Hay		1.00	6,000	6,000
Total Gross Output				**906,000**
Seed/seedling: Bought	kg	3	1,000	3,000
Total Chemicals	ID	-		126,000
-Pesticides	Liter	2	21,000	42,000
-Insecticides	Liter	2	21,000	42,000
-Fungicides	Liter	2	21,000	42,000
Total mineral fertilizer	kg	-		65,000
DAP	kg	50	280	14,000
Urea	kg	50	980	49,000
Sacks	Sack	10	200	2,000
Costs of hired machinery	ID			29,000
- land preparation	Du	1	16,500	16,500
- Irrigation	Du	1	12,500	12,500
- harvesting	Du	1	-	-
Total Variable Costs	**ID**			**225,000**
Gross Margin	**ID**			**681,000**

Table 2.9
Input-Output Data and Gross Margin per Dunum of Date Palms (Chibchab and Sayer Varieties)

Item	Establishment Year				4-10 years of production			10-70 years of full production		
	Unit Definition:	Unit:	Price ID Unit:	TOTAL ID	Unit:	Price ID Unit:	TOTAL ID	Unit:	Price ID Unit:	TOTAL ID
Crop produce 1: Dates	kg	-	-	-	250	200	50,000	2,500	200	500,000
Crop produce 2: None		-	-	-	-	-	-	-	-	-
Total Gross Output				**-**			**50,000**			**500,000**
Seed/seedling: Bought	Seedling	1,000	4,000	4,000,000	-	-	-	-	-	-
Total Chemicals	ID	-		52,500	-		52,500	-		52,500
-Pesticides	Liter	2.50	21,000	52,500	2.50	21,000	52,500	2.50	21,000	52,500
-Insecticides	Liter	-	21,000	-	-	21,000	-	-	21,000	-
-Fungicides	Liter	-	21,000	-	-	21,000	-	-	21,000	-
Total mineral fertilizer	kg	-		49,000	-		49,000	-		98,000
DAP	kg	-	280	-	-	280	-	-	280	-
Urea	kg	50.00	980	49,000	50.00	980	49,000	100.00	980	98,000
Costs of hired machinery	ID			28,900			17,400			17,400
- land preparation	Du	1.00	16,500	16,500	1.00	5,000	5,000	1.00	5,000	5,000
- Irrigation	Du	1.00	12,400	12,400	1.00	12,400	12,400	1.00	12,400	12,400
- harvesting	Du	1.00	-	-	1.00	-	-	1.00	-	-
- Technical labor (pruning, …etc.)	Tree	-	-	-	1.00	2,000	2,000	1.00	3,000	3,000
Manual labor	Du	6.00	2,000	12,000	10.00	2,000	20,000	40.00	2,000	80,000
Total Variable Costs	**ID**			**4,142,400**			**140,900**			**250,900**
GROSS MARGIN	ID			4,142,400-			90,900-			249,100

Marketing Systems in the Marshlands

In Iraq, grain trading is, at least at present, controlled by the government. There is some private marketing of grain, but it does not provide significant opportunities for farmers. Most grain silos are owned by the Ministry of Trade, and there is little private storage of grains. There is widespread uncertainty about the future of grain trading in Iraq, an uncertainty mainly derived from ambiguity regarding the future of the Public Distribution System (PDS). There is discussion for example that the PDS will continue to purchase grains for direct distribution to a majority of the Iraqi population, yet there is also talk that the system will be monetized in favor of direct purchases of foodstuffs from private marketing agents or farms. Whatever the future holds, it will likely see an increase in private grain marketing, but it may take some years to develop. The focus of this section of the report is therefore on marketing of horticulture crops, nearly all of which is privately marketed.

The basic marketing functions needed for horticultural products in any wholesale market should include:

- proper packing and transportation;
- existence of efficient wholesalers or commission agents;
- adequate number of retailers; and
- facilities for storing and cooling, especially for exported products

The marketing system of the horticultural crops in the marsh areas consists of several local wholesale markets called (*alwahs*) usually located in the middle of the village or town. Depending on the production season, these a*lwahs* receive the majority of the marketed produce from the central wholesale markets in Basra, Al-Nasiriyah, Al-Amarah, and Baghdad. Fruits and vegetables marketed in central wholesale markets are sold through auctions held in the early mornings. Wholesalers play a substantial role in determining the prices in the local market.[6]

A quick assessment of the two local wholesale markets in Al-Qurneh and Al-Medinah revealed that almost all kinds of support infrastructures are lacking although these markets play an important role in the distribution chain of fresh fruits and vegetables in the marshlands. These local wholesale markets consist of small stores lined in a few parallel rows. None of these markets contains any kind of services such as cold storage, storing or packing capacities. Price fluctuations follow those determined in the central wholesale markets in the main cities.

Several types of fruits and vegetables are traded in the two markets including potato,

[6] The direction of product flow from center (Basra) to the periphery (Qurneh and Medynah) is contrary to most marketing systems. Under normal marketing structures in most developing countries, products flow from the periphery to the center, and this is especially true for those that can be produced in the periphery. The fact that tomato, carrot, and other horticultural crops flow from Syria and Iran to periphery towns shows significant opportunities for former marsh dwellers if production and marketing technologies are adopted to permit farmers and traders to become competitive.

tomato, green onion, dry onion, sugar beat, carrot, cauliflower, cabbage, cucumber, eggplant, and squash. Currently, the majority of the traded vegetables are produced in other governorates or imported from Iran, Syria, Kuwait and Turkey. As shown in Tables 10 and 11, there is huge variation in prices at all levels: central wholesale market, local wholesale market, and retail price. In Table 10, the marketing margins range between 40 to 400 percent. These margins are considered high especially given that such services as grading, packing, cooling, that is, services to increase the value of the product, are not offered to consumers. High marketing margins are caused by several possible factors: inefficiencies in the marketing system, long market channels, imbalance of market powers between buyers and sellers, and between producers and traders, and perishability of the crop. Without the benefit of time for serious research into the causes, the agriculture team assumes that the third and fourth factors are the most important factors causes these high margins. Further work in this area is warranted.

Table 11 demonstrates that the main traded fruits at this time of the year are orange, clementines, lemons, grapefruits, apples, pomegranates, bananas, kiwis and grapes. The majority of these crops are imported from Iran, Syria, Turkey and Kuwait. As in the case of vegetables, the marketing margins are also high and range between 40 and 100 percent.

When the wholesalers were asked why they charge such high marketing margins, the answer was: to cover the high commission fee that is charged by wholesalers in the central wholesale markets (8%) and the high transportation costs.

The majority of the traded vegetables are packed in plastic boxes which vary in size and may hold weights between 5-25 kilograms based on the type of product. Carrots and eggplants are packed and transported in large polyethylene sacks. These practices shorten the shelf life of perishable products.

According to the traders in the two wholesale markets, the marshes were a major production area of tomato and many other vegetable crops prior to 1985. People living on the edge of the marsh engaged in recessional agriculture as the waters from the marshes receded in the fall of each year. Large quantities of the tomatoes during that era were exported to Kuwait, Saudi Arabia and UAE markets. Currently, during the fall season traders are able to procure small volumes of carrots, cucumbers, beans, melons, squash, and maize from the edges of the drained marshes. These vegetables are produced in the marshes of Al-Hammar, Al-Gubaysh, Qal'at Salih, Al-Hawizeh, Al-Hwar, Al-Majer, Al-Amareh and Beni Malek. Now that Iraq is no longer subject to UN sanctions, local farmers will have to compete with produce imported from neighboring countries. In the short term, it is not likely that Iraqi farmers on the edges of or in the drained marshes will be able to compete successfully with produce from those countries.

Date palm is the major fruit in the drained marshes. Date palm is currently produced in the areas at the edges of the marshes such as Al-Medyaneh, Al-Hwai, and Al-Gubahysh. The most popular varieties are Al-Barhi, Chebchab, Khadrawi, Sayer, Showaishi, Hallawy, Dairi, and Zehdi. However, traders in the wholesale markets stated that the amounts of traded dates in these markets have declined sharply in recent years due to the deterioration in the production conditions of date palms in the marshes as a result of drying parts of the marshes, increase of water salinity and cutting large numbers of trees by the former regime.

Table 2.10
Sources, Prices and Marketing Margins of Major Traded Vegetable Crops at Al-Qurna Local Wholesale Market

Vegetable Crop	Source	Price level (ID/kg)			Marketing Margin (Percent)
		Central Wholesale Market	Local Wholesale Market	Retail	
Potato	Local	200	250	350	75
	Syria	300	350	450	50
	Turkey	200	250	350	75
Tomato	Local	166	200	250	51
Green Onion	Local	60	100	150	150
Dry Onion	Iran	425	500	600	41
Garlic	Syria	1500	2000	2500	67
Sugar beat	Local	25	50	85	240
Carrot	Local	50	100	250	400
Cauliflower	Local	75	125	200	167
Cucumber	Iran	350	400	500	43
	Kuwait	400	500	600	50
	Syria	400	500	600	50
Eggplant	Syria	350	450	600	71
	Iran	250	300	350	40
Squash	Kuwait	300	400	500	67

Source: Interviews with wholesalers at Al-Qurna local wholesale market

Table 2.11
Sources, Prices, and Marketing Margins of Major Traded Fruits at Al-Qurna Local Wholesale Market

Fruits	Source	Price level (ID/kg)			Marketing Margin (Percent)
		Central Wholesale Market	Local Wholesale Market	Retail	
Orange	Local	500	625	750	50
	Iran	225	300	400	78
Clementine	Local	500	600	750	50
	Iran	400	500	600	50
Lemon	Iran	550	700	1000	82
Grapefruit	Iran	400	500	600	50
Apple (Red)	Iran	500	600	650	30
Apple (Yellow)	Iran	400	500	600	50
Pomegranate	Local	300	400	500	67
Banana	Kuwait	750	1000	1300	73
Kiwi	Iran	750	1000	1500	100
Grape	Kuwait	1000	1500	2000	100
	Syria	400	500	600	50

Source: Interviews with wholesalers at Al-Qurna local wholesale market

The existing marshlands offer such important products as reeds and papyrus which are used by many of the marsh dwellers to produce mats and other products used in construction of buildings in the area. Many small-traditional workshops are found on the side roads that marsh dwellers, former and present, make different types of construction sheets. In an interview with one of the traders, he stated that he buys bundles of reeds from the dwellers for ID 500 and resells them for ID 750. The prices usually increase during summer as a result of the increase in demand for building houses and a decrease in supply. The papyrus which is collected from Al-Hammar marshes is not currently fully utilized in preparing sheets since it needs processing plants. Papyrus is currently used as animal forage to feed cows and water buffalo

Marketing and Agribusiness Related Problems

Production and marketing systems of crops and livestock in Iraq have not kept pace with worldwide technological developments due to wars, the embargo and UN sanctions. The following marketing constraints were drawn from interviews with farmers, traders, agricultural experts, and team's observations during the different field visits to the different locations in the marshes. Many of these constraints may also apply to the Iraqi agricultural sector as whole:

Institutional Constraints

- Nonexistence of production, marketing and agribusiness strategies for optimal utilization of the available natural resources in the marshlands in sustainable way;
- In addition to other production constraints, the low income of producers is a result of the unclear identification of the opportunities offered by new agribusiness opportunities to promote development;
- Lack of focus on marketing and agribusiness opportunities by academic institutions, private business and government. For instance, there is no agricultural economics or agribusiness department at Basra University;
- Absence of regulations relating to grading, standards, and packaging materials for local and export markets;
- Despite the existence of few non-functional cooperatives, an absence of any sort of market organization such as associations or cooperatives to develop the agribusiness sector in the marshes; and
- Week private sector companies capable of dealing effectively with global trade.

Technical Constraints

- Nonexistence of consistent decision making information system on demand, supply and prices;

- Lack of effective market research;
- Lack of experience in pre and post harvest technologies;
- Inadequate proper direct export facilities, especially for high value products such as date palm;
- Weak agro-processing industry;
- High marketing margins and unstable prices in the domestic markets;
- Lack of marketing services of pre-cooling, grading, export packaging, cold storage and trucks; and
- Transportation of agricultural products suffers from the conditions of the rural road networks that may slow movement of people, goods and inputs inside Iraq and cause damages to perishable products such as bruises.

Export-related Constraints

- There is little knowledge of the financial opportunities in cultivating and managing potential crops, mainly date palm for export markets;
- It seems that there is a severe lack of detailed technical and economic information on products demanded, timing, quality, forms…etc, both in local and export markets;
- There is an urgent need to well-established export companies specialized in fresh horticultural crops and processed products.

Appendix 1
An Initial Morphological Description

Tuesda, 10 February 2004
Regions: Al-Azair and Prosperity River

1. **Area: Shakhra**

Soils: (Notation used = IM where I=Iraq; M=marshlands);
IM 1 and IM 2 are adjacent paired sites.

IM1 area: Saline area approximately 500 m from canal. Area was drained in about 1982 (i.e. for over 20 years). The area is barren - almost devoid of vegetation. Apparently, the military did not permit farmers to irrigate this area. According to the local farmers the area has never been irrigated since it was drained.
GPS: N: 3120 40.8; E: 473116.1

IM Soil: Saline/sodic calcareous grey soil with gypsum accumulation at depth (>80cm)
IM 1.1 (0-0.5) Salt crust is evident and in places a dispersed clay layer/crust is evident Frequent patches (50 – 80 cm diameter) with salt efflorescences (appears to be mixture of halite, carbonates, Mg and sulfate salts (sample taken for XRD – to confirm type of salts). See photograph)
IM 1.2 (0-5) Grey silty clay loam; with sodic crusts and some saline areas.
IM 1.3 (5- 10) Dark grey, silty clay loam; sodic; fine streaks of calcium carbonate.
IM 1.4 (10 – 20 cm) similar to 1.3
IM 1.5 (20 – 50 cm) similar to 1.3
IM 1.6 (50 – 70 cm) Brown silty clay, with fine streaks of calcium carbonate (calcite) and gypsum crystals.
IM 1.7 (70 – 80) similar to 1.3
IM 1.8 (90 - 100). similar to 1.3
IM 1.2: (>1.2 m) similar to 1.3.

IM 2 (Shakhra village area) Productive wheat/barley area – 100 m from canal. No evidence of salinity but rather a deep sodic, calcareous brownish soil with gypsum accumulation at depth (>80cm). Dispersed clay layer/crust is evident in a few places and where the crust is thicker (2-4mm) there is reduced yield (See photograph)
N: 3120 40.8; E: 473116.1

Sodic calcareous soil with gypsum accumulation at depth
IM 2.1 Dispersed clay layer/crust is evident – and where the crust is thicker (2-4mm) there is clear evidence of reduced yield in some small patches (see photograph)
IM 2.2 (0-5) Grey silty clay loam; sodic, fine streaks of calcium carbonate.
IM 2.3 (5-25) Very dark grey, silty clay loam; sodic; fine streaks of calcium carbonate.
IM 2.4 (25 – 50 cm) Brown silty clay, with fine streaks of calcium carbonate (calcite) and gypsum crystals.similar to 2.4
IM 2.5 (50 – 50 cm) similar to 1.4
IM 2.2: >1.2 m similar to 1.4

Water: (Notation used: W 1 where W = water; 1 --- = sample number);

2. Area: Shakhra

W 1: Canal water – from Tigris River
EC: 2.41 dS/m
Ph: 8.36
T: 15.9

W 2: Canal water – from Tigris River
EC: 2.38 dS/m
Ph: 8.30
T: 15.8

W 3: Canal water – from Tigris River
EC: 2.24 dS/m
Ph: 8.31
T: 16.2

3. Area: Prosperity River

Soils:
Strongly salt-affected and waterlogged area - immediately adjacent to the bund wall - in drained area that was once a dam. The area has scattering of houses and polluted water is abundant.

IM 3.1: 0-1cm White salt efflorescences
IM 3.2 0-1cm Yellowish salt efflorescences
IM 3.3: 1- 5cm Black material

Water:
W 4: Beside road adjacent to culverts in Prosperity River – from Tigris River
EC: 1.9 dS/m
Ph: 8.73
T: 16.7

W 5: Surface sample (10cm) From boat in Prosperity River – from Tigris River:
EC: 1.81 dS/m
Ph: 8.57
T: 16.3

W 5: Sub-surface (1m) From boat in Prosperity River – from Tigris River
EC: 1.80 dS/m
Ph: 8.59
T: 15.6

Wednesday, 11 February 2004
(Al-Turaba region / Qal' ah Salith/ Al Kahla Towns)

4. Area: Um Sbeta village

Soils

Strongly salt-affected and waterlogged area - immediately adjacent to canal and between road (elevated with steep slopes). NOTE: several "surface drains" (50 – 80 cm deep) have been excavated around this area obsiously in an attempt to drain the area and flush salts from the saline waterlogged area.
GPS: N: 31 2040.8; E: 473126.1 - ?
IM 4.1 0-1cm White salt efflorescences – crusting on the surface
IM 4.2: (0-1cm) Yellowish-brown salt efflorescences – crusting on the surface.
IM 4.3 (0-5 cm) Black peaty silty loam with clear steaks of lime.
IM 4.4: (5-20 cm): similar to 4.3.
IM 4.5: (20-30) similar to 4.3.
IM 4.6: (30-65) Medium to heavy silty clay weakly mottled – slowly permeable
IM 4.7: (65-75) – Heavy silty clay with mottles. Slowly permeable. Perched ground water present at 50cm (EC: 10.4 dS/m; pH: 7.62; T 17.6)

Water:
W 6: Canal water – from Tigris River
EC: 2.02 dS/m
Ph: 8.90
T: 15.6

W 7: Canal water – from Tigris River/ turbidity is high.
EC: 2.1 dS/m
Ph: 8.55
T: 15.2

Soils:

IM 5: Cultivated area. Good stand of wheat (see photo). Sampled approximately 40 m from site immediately adjacent to the main road (just prior to turn-off to Turaba).

IM 5.1 (0-1cm) Crusts of dispersed clay on the surface / pale grey colour.
IM 5.2: (0-5cm) Sandy clay loam. Brownish in colour.
IM 5.3 (5-20 cm) Peaty silty clay loam; some lime (former marshland).
IM 5.4: (20 - 33 cm) Peaty silty clay loam; some lime (former marshland); abrupt transition to:
IM 5.5: (33-50 cm) Medium to heavy clay weakly mottled – slowly permeable
IM 5.6: (50-100 cm) Medium to heavy clay weakly mottled – slowly permeable
IM 5.7: (1 – 120 m) Brown, heavy silty clay with mottles and lime streaks. Slowly permeable. Perched ground water present at 50cm (EC: 10.4 dS/m; pH: 7.62; T 17.6)

IM 6: Cultivated / irrigated area - approximately 40 m from the dirt road (between Um Sbetha and Al-Kahbla – approximately 2 km from the school in saline field). Large cracks and salt efflorescences (appears to be mixture of halite, carbonates, Mg and sulfate salts - sample taken for XRD – to confirm type of salts; See photograph) occur in all

depression areas. We excavated a pit (photo) in the depression, which clearly shows the large cracks and sodic columnar B horizon / and no or very poor crop growth occurs in these areas. This occurs primarily in the depression areas. On the mounds (50 cm high) the wheat growth is substantially improved because of better drainage and soil tilth. Samples were also taken of salt layers / efflorescences in the immediately adjacent uncultivated area, which was never irrigated. Huge expansive area of salt-affected soils. Clearly, the salt has accumulated in these areas because there is poor drainage at these sites.

E: 38 7233 47; N: 3487531.

Soil

IM 6,1 (0-0.5cm): Salt efflorescences (mixture of salts) and highly friable clay layer because of clay flocculation by high salt contents in the surface layers of the soil.
IM 6.2 (0-15): Brown; heavy clay – silty; few lime and gypsum crystals.
IM 6.3 (15 – 50) Brown; heavy clay – silty; few lime and gypsum crystals.

Water

W 8: Canal water – from Tigris River
EC: 2.55 dS/m
pH: 8.1
T: 16.5

Thursday 12 February 2004

5. Region: Kabaish

Area: Kabaish village IM 7 and 8; W 9.
E: 38686601; N: 3426359.
IM 7: (Kabaish village area) Productive wheat/barley area – 50 m from canal. No evidence of salinity in cultivated lands (IM 7) but suspect most layers / horizons to be sodic. At depth the soil is clayey (heavy clay), grey matrix with few mottles and weakly calcareous (See photograph). However, immedialty adjact to field in fallow row there is clear evidence of salinity salt efflorescences (IM8).

IM 7: Sodic calcareous soil with heavy clay at depth
IM 7.1 (0-5 cm) Dark grey, silty clay, weak dispersed clay layer/crust is evident in places; weak lime and gypsum.
IM 7.2 (5-25 cm). Dark grey, silty clay, weak lime and gypsum.
IM 7.3: (25-50 cm) Dark grey, silty medium clay, weak lime and gypsum.
IM 7.4 (50-88 cm). Dark grey, silty medium clay, weak lime and gypsum; many shells.
IM 7.5 (88-115 cm) Dark grey, silt loam; weakly peaty in places; highly calcareous (nodules and mottles).

IM 8: Saline calcareous soil with heavy clay at depth
IM 8.1 Salt efflorescences (mixture of salts) and friable clay layer because of clay flocculation by high salt contents in the surface layers of the soil

Water

W 9: Canal water – from Tigris River tributary canal for transport of sweat water to region.
EC: 1.65 dS/m
pH: 8.42
T: 25

Area: Kabaish area with island: IM 9 and 10; W 12
(Marsh Arab family recently moved back to live on island; samples taken from recent pits excavated to grow trees (?)
E: 38694472; N: 3428034.

IM 9.1 (0-15 cm) Light grey dispersed silty clay loam; mostly transported to mound Island – possibly 1000's of years ago.
IM 9.2 (15-40 cm) Black peaty silty loam with few lime and gypsum crystals.
IM 9.3 (40-70 cm) Heavy clay – silty; with few lime and gypsum crystals.

IM 10.1 (0-15 cm) Composite from 4 sites on Island. Light grey dispersed silty clay loam; mostly transported to mound Island – possibly 1000's of years ago.

W 12: Recently flooded water from Euphrates surrounding the island.
EC: 3.87 dS/m
pH: 8.50
T: 24.3
Also evidence of dissolved organic carbon and reddish iron coloring to water along the edges of island.

Area: Al-Al-Chabayish small village: drained burnt soil and drained soil area: IM 11, 12; and 13; W 12
E: 38700659; N: 3427096.

Drained burnt soil
IM 11.1 (0-15 cm) Strongly burnt soil; red, pink and cream colored porous ceramic-like material, magnetic.
IM 11.2 (15-20 cm) Weakly burnt layer, charcoal and black color: magnetic. Roots still evident.
IM 11.3 (20-50 cm) Dried peaty silty loam with many remnants of marshland roots present. Light gray color. Few shells, lime and gypsum crystals.

Drained soil – no evidence of burning
IM 12.1 (0-10 cm) Dried peaty silty loam with abundant remnants of marshland roots present. Dark gray color.
IM 12.2 (10-25 cm) Dried peaty silty loam with abundant remnants of marshland roots present. Dark gray color. May shells, few lime and gypsum crystals – and salts
IM 12.3 (25-50 cm) Dried peaty silty clay with many remnants of marshland roots present. Light gray color. Few shells, lime and gypsum crystals – and salts
IM 12.3 (3m – 3.5 cm) Silty medium clay, Light grey to cream with yellowish to oronge coloured mottles. Few remnants of marshland roots present. Light gray color. Few shells, lime and gypsum crystals.

W 12: Recently flooded water from Euphrates on north side of the road.
EC: 3.65 dS/m
pH: 8.19
T: 24.3
Saturday 14 February 2004
Al-Turabah region
E: 38700659; N: 3427096.

IM 14 – 17.
- to describe from sample bags/samples.

W12 - 14
- to transcribe data from Rob's log book.

6. Region: Hammar reflooded marshland

- to transcribe water data from Rob's log book: canal data.

Area: Bani Asad village
N 30 51 4741 E 46 40 3877
IM 20.1 (0-15 cm) Surface layer of mulch from the addition of reeds surrounding the houses. When this layer is trampled (see photograph) sulfidic material rises.
EC = 20.4 dS/m
pH = 7.04.
Eh = -340 mV

IM 20.2 (15-30 cm) Black sulfidic material; strong hydrogen sulfide smell.
EC = 20.4 dS/m
pH = 7.04.
Eh = -205 mV

Water
Flooded water – from Euphrates – surrounding island
EC: 4.47 dS/m
pH: 8.11
T: 20
Eh = - 130 mV

Area: Bani Asad village
IM 21

IM 21.1 (10 – 30 cm) under water on edge of island.

IM 22.1 (10 – 30 cm) Silty clay on mounded island – clay used to make houses and mound island.

ACTION PLAN 2

ENCOURAGE AGRICULTURAL PRODUCTION AND AGRIBUSINESS

The desiccation of the marshes has forced many former dwellers into agriculture. Large extents of land have been dried and in many areas once covered by water, complex irrigation and drainage systems have been built. Many of the former marsh dwellers now view themselves as agriculturalists, since most of their income is derived from growing and selling crops. Yet, agriculture in these areas is poor, even in the areas where former marsh dwellers have been cultivating for more than a decade. The major reasons for the low level of success in agriculture are the following:

Low levels of productivity enhancing inputs, especially fertilizer. Access to inputs is difficult given the remote locations of many former marsh dwellers, and costs are sometimes prohibitive. Cost constraints are especially important with respect to modern seed varieties and pesticides.

Poor or unknown resource base. Desiccated marshes present unusual circumstances with respect to soil and water. Some areas in the dried marshes have good, productive soils and sufficiently good quality water, permitting cultivation of a wide range of crops. Other areas have saline soils and poor water quality, thereby constraining the number of crops to only those that tolerate saline conditions. Often, one village will have more than one soil and water condition, making generalizations about the ability of an area to support agriculture difficult to make. Further, the condition of the soil is dependent on how quickly the marsh was dried, the number of years it has been dry, and whether the area was burnt after desiccation occurred (a deliberate policy of the former regime to destroy the resource base of the marsh dwellers).

Lack of knowledge. Few former marsh dwellers have access to extension services or other means of acquiring knowledge of production techniques or technologies. In addition, many marsh dwellers were compelled by the former regime to cultivate wheat and barley only, thereby preventing them from acquiring experience with other more lucrative or nutritious crops.

Lack of or prohibitive distance from markets. Former marsh dwellers lack knowledge of markets, and many have transportation problems.

Objective

Despite these many difficulties, the agriculture team saw enough good agriculture in the marshes to believe that program interventions designed to tackle some of the main issues noted above can help former marsh dwellers to succeed in agriculture. The tasks presented below have the following objective:

To jumpstart agriculture production and agribusiness in the desiccated marshes and identify opportunities for and prepare former marsh dwellers to participate fully in a growing and more profitable Iraqi agricultural economy in the future.

Tasks

The tasks outlined below contribute to restoring an economically viable set of opportunities to the former marsh dwellers. Implementation of these tasks is contingent on the absence of reflooding of former marsh lands. They are designed to stabilize and improve the living conditions of former marsh dwellers who are now farmers and who wish to remain farmers. The tasks are based on the team's interviews and data collection in the drained areas of Hawizeh, Hammar and Central marshes. The team collected data on current production levels and costs. Markets were also surveyed in the regions close to the dried marshes. The team took over 80 soil samples and more than 30 water samples in order to obtain the full range of soil and water characteristics of the dried marshes. Finally, the team conducted extensive interviews with former marsh dwellers who now agriculturalists to determine their priorities and needs in order to improve their abilities as agriculturalists, leading to improved livelihoods.

The proposed tasks are:

1. Carry Out Large-Scale Crop Demonstrations for Field Crops and Horticulture

2. Establish Date Palm Nurseries for Growing and Distributing Off-Shoots

Task 1: Carry Out Large-Scale Crop Demonstrations for Field Crops and Horticulture

Former marsh dwellers have had little or no training or extension in how to grow, manage, or harvest crops. The agriculture team proposes a set of large-scale demonstrations in four locations in the drained areas of the Hawizeh, Central, and Hammar marshes to overcome the knowledge constraint in agriculture. The task coincides with a large-scale crop demonstration program conducted by the Ministry of Agriculture and supported by the Agriculture Reconstruction and Development for Iraq Program (ARDI).

Objectives

The objectives of Task 1 are to:

- Broad the range of crops grown by the marsh dwellers by introducing higher-value options in order to increase household incomes;
- Provide technical assistance to growers to improve farm management; and
- Stimulate regional markets through an influx of locally-produced goods.

Approach

The overall approach to the task Includes carrying out the following:

- In consultation with the local population, the program will select five hectare sites in three locations which have good soil and water characteristics. Sites will be selected using soil and water indicators.
- Working with communities, a technical team will demonstrate proper cultivation methods for commonly grown and easily marketed crops in the region. For summer, the agriculture team is proposing sorghum and maize, and for winter, wheat, barley, tomato under plastic, and broad bean. Other crops may be introduced as more information is gathered.
- Farmers will be encouraged to use simple farm record keeping sheets to track expenses and labor utilization.
- Dissemination will be supported by farmer field days for other former marsh dwellers to show agricultural techniques aimed at creating profitable cultivation and the use of the soil and water indicators kits.

Implementation Steps

The detailed implementation steps for Task 1 are:

1. Select sites based on soil and water indicators. The team proposes the following villages: Al-Turaba and Abu Laila in the drained areas of the Hawizeh Marsh and Al-Albahar and a location to be chosen village along Prosperity River.

2. Negotiate a memorandum of understanding for each location among the Iraq Marshlands Restoration Program, the Ministry of Agriculture, the village sheikhs and elders, and other potential stakeholders. The general feature of these MOUs will be that the program will provide production inputs including land preparation, the MOA will provide continuing support, and the village will provide labor for the demonstration. If any party fails to honor its obligation in a timely way, it will be considered a breach of contract and the demonstration will end. The village retains the revenue from the demonstration, its distribution is determined internally amongst the sheikh and the village elders. The university will provide technical staff to conduct weekly monitoring of demonstration progress, and will be required to report to IMP weekly.

3. Prepare a complete workplan with each village for each crop including land preparation dates, planting dates, etc. The program will prepare a delivery schedule for inputs.

4. Prepare, distribute and train village personnel on the use of a simple record keeping system to track input use, labor utilization, and revenues for each crop.

5. The Task 1 team will visit each site weekly to assess progress. (Continuous through October for the summer season).

6. Conduct farmer field days at each site. (Based on the workplan in implementation step 3).

7. After marketing of the product, prepare a report on the outcomes of the demonstration.

As mentioned above, we propose sorghum and maize for the summer season, and wheat, barley, tomato under plastic and broad bean for the winter season if funding permits.

Technical Assistance

The following technical assistance is proposed for Task 1:

- Soil and Water Specialist (Expatriate) to develop the kits and help with site selection – 10 days

- Agribusiness Specialist (Expatriate) to negotiate the MOUs with the villages and develop a comprehensive workplan for each demonstration site, to write the final report on the summer season, and evaluate the impact on the demonstration village and surrounding villages – 24 days

- Resource Economist (Expatriate) to write the final report on the summer season and evaluate the impact on the demonstration village and surrounding villages – 14 days

- Two Agronomists (Iraqi) to monitor the execution of the demonstration – 96 days during the summer season

- Horticulturalist (Iraqi) to monitor execution of the winter demonstration in tomatoes and broad – 48 days during the winter season.

- Two Soil and Water Experts (Iraqis) to monitor soil and water impacts from cultivation – 88 days for the summer season.

- Machinery Specialist (Iraqi) to assist with sub-soiling and other mechanization issues – 48 days for the summer season.

- Plant Protection Specialist (Iraqi) to monitor pest and diseases – 40 days for the summer season.

Deliverables

The task has the following deliverables:

- Eight demonstration plots in four locations

- Four MOUs signed by tribal representatives, the Ministry of Agriculture, and the program

- Four workplans for detailed implementation of the demonstrations

- Eight simple farm record keeping systems that serve as a model for other locations

- One final report on the results of the summer season demonstrations and lessons learned

Proposed Cost: $100,000

Task 2: Establish Date Palm Nurseries for Growing and Distributing Off-Shoots

Date palms have the potential of earning significant export revenues for Iraq. The country is blessed with 629 varieties of date palms, many of which qualify as high-end export varieties capable of generating substantial revenues for individual farmers and for exporters. Dates are mainly exported to the Arab Gulf, but with the fall of the former regime, Iraqis, in both the public and private sectors, intend to put great efforts in expanding their market for dates to Europe, North America, and Japan. There is a large internal market for dates, also. Date palms have cultural value as the symbol of Iraq, and recovery of this sector is viewed as more than an economic goal. It symbolizes the recovery of the nation.

Date palms were traditionally important in southern Iraq. To punish the people of the region, the former regime destroyed many palm orchards through either cutting the trees or starving them of water. The result is that nationwide, the number of date palm trees has decreased to about 50 percent of the total 20 years ago, and the percentage loss is higher in the south than any other part of the country.

The Ministry of Agriculture with the assistance of ARDI, has embarked on a program to establish nurseries in every date-growing governorate in Iraq, and in Basra, because of the importance of date palms the program envisions establishing three nurseries in this governorate. The purpose of this task is to develop a source of supply of off-shoots for farmers wishing to grow dates and to protect the country's rich genetic resources of this crop. The agriculture team for the Iraq Marshlands Restoration Program proposes to work with the MOA and the ARDI team to establish two additional date palm nurseries in desiccated marshlands.

The Marshlands Program proposes to begin with two date palm nurseries, each 10 dunum or 2.5 hectares in size, one each in the Hammar Marsh and in Hawizeh Marsh. Each dunum (2,500 square meters) will support 1,000 date palm offshoots, and this in turn will provide after about one year's time an additional 28 dunum (assuming the usual 70 percent survival rate) of date palms. Thus, two 10-dunum nurseries will supply enough off-shoots after one year to plant 560 dunums of date palms, after one year alone. The team and the MOA governorate offices in Nasiriyah and Al-Amarah will work together to determine the appropriate means of distributing off-shoots to the marsh dwellers.

This task will initiate a long-term program of development for the marsh dwellers. Date palms require between three and four years before fruit production begins, and full production commences only after eight or ten years. None the less, this effort, when it reaches full production levels, has the potential to provide significant and long-term stable income for the local population. In addition, the task has the opportunity to provide incomes to an increasing number of families as time goes on. The date palms off-shoots in the first year will continue to produce off-shoots in years to come. A well-established program of supply and distribution has the potential to have an effect for a long time to come.

There are several good private palm orchards on the north side of Euphrates that could provide off-shoots to the program. At least one of the orchards is in the marshlands,

operated by former marsh dwellers. Eng. Mustafa Ali of the Agricultural Directorate has offered to help identify the locations of this and other supplies of off-shoots. Dr. Faraoun Ahmed Hussain, MOA Director General of the State Board for Date Palms, worked with the agriculture team to identify the nursery site and potential sources of off-shoot supply in February.

The agricultural team identified Al-Mabar village in Hammar Marsh, about 6 kilometers west of Al-Medinah, on the south banks of the Euphrates. This village has good soil and water, and already is growing a small number of date palms. The community in principle is in agreement with our proposal to host a nursery. The second site is proposed for Hawizeh Marsh in a site to be determined. Before establishing the nursery there, additional scoping must be done with respect to the suitability of land and water resources, and further discussions need to be held with the sheikh and community leaders.

Objectives

The objectives of the task are to:

- Establish date palm nurseries each 2.5 hectares in size in two locations, one in Hammar marsh and the other in the Hawizeh Marsh;

- Transfer to former marsh dwellers technology regarding nursery establishment; and

- In the longer term, provide a source of date palm off-shoots to former marsh dwellers, which could be a good source of income for former marsh dwellers for many years.

Implementation Steps

The detailed implementation steps for Task 2 are as follows:

1. Select sites based on soil and water indicators. The team proposes the following villages: Al-Mabar Village in a drained portion of the Hammar Marsh and a location in Hawizeh Marsh.

2. Negotiate a memorandum of understanding among the Iraq Marshlands Restoration Program, Ministry of Agriculture, the village sheikhs and elders, and other potential stakeholders in each location. The general feature of these MOUs will be that the program will provide production inputs including land preparation, the MOA continuing support, and the village labor for the nurseries. If commitments are not provided in a timely way, it will be considered breach of contract and the nursery will be abandoned or moved to another location. The MOU will also detail the system of distribution of off-shoots to other farmers with consideration that the price for off-shoots should be based on labor costs only as the program will be providing all other inputs. For its part, the program will provide technical staff to conduct weekly monitoring of demonstration progress and will be required to report to IMP weekly. The University of Basra is a source of technical expertise on the program. The MOA will join the university as monitors of progress, and it will help the program to find high quality off-shoots from local farmers.

3. Prepare a complete workplan with each village for each crop including land preparation dates and a planting schedule. The program, in consultation with the village and the Ministry of Agriculture, will prepare a delivery schedule for inputs.

4. Ensure that land is prepared and purchase the off-shoots from local orchards near Al-Medinah. The Ministry of Agriculture, the Date Palm Directorate, and the Agricultural Directorate in Al-Medinah will help to find suppliers of off-shoots.

5. Ensure that the off-shoots are planted and tended to. Tasks 4 and 5 should be part of the work plan written in subtask 3.

6. The Task 2 team will visit each site bi-weekly to assess progress through the life of the program. The MOA will take over monitoring at its conclusion.

7. Conduct farmer field days at each site. (Based on the workplan in implementation step 3).

8. Prepare a report on the outcomes of the work.

Technical Assistance

Proposed technical assistance for Task 2 includes the following

- Soil and Water Expert (Expatriate) to assess soil and water conditions in the proposed areas – 5 days

- Agribusiness Specialist (Expatriate) to negotiate and plan for the program and to complete the final report – 10 days

- Soil Specialist (Iraqi) to work on soil and water testing for the areas – 17 days

- Machinery Specialist (Iraqi) to assist and advise on soil preparation – 17 days

- Horticulturalist (Iraqi) to assist with nursery establishment – 26 days

- Plant protection Specialist (Iraqi) to advise on management of pest and diseases – 20 days

Deliverables

The deliverables for Task 2 include:

- Two memoranda of understanding among the villages hosting the nurseries, the Ministry of Agriculture, and the program

- Two workplans for establishment of the nurseries

- Two fully operating and community-run palm nurseries

Proposed Cost: $100,000

Proposed Additional Tasks for Year 1 (Presently Unfunded)

1. **Restoration of the Date Orchards** (Estimated cost: $300,000)

As mentioned above, date palms are extremely important to Iraqis. The potential to regain its position in international markets will be contingent upon recovery of the production and marketing. Given the wide variety of dates in the country, and the evident will to work towards that goal, the agriculture team recommends continued work in this area.

There is a large date palm orchard with mature trees located about three kilometers west of Al-Medinah, in the drained Hammar Marsh. At one time, this orchard produced a large quantity of dates. In recent years however, the orchard suffers from poor drainage and neglect. The Director General of Agriculture for Basra noted that the trees are owned by individuals living in the area, most of whom are former marsh dwellers.

The agriculture team proposes the restoration of this orchard. Restoration would include improving the drainage of the area, pruning the trees, and pollination. The benefits to this task are two-fold:

- The activities to accomplish this task are labor intensive, and would require hiring of large numbers of laborers; and

- It would, in one year, improve the production of dates and increase incomes of the owners. Without these improvements, the orchard will eventually die.

2. **Rural Finance Program** (Estimated cost: $1,000,000)

If significant funding becomes available, the agriculture team supports the establishment of a rural finance program dedicated to providing credit facilities to former marsh dwellers. This program will be designed to jumpstart agricultural production by providing the financial resources requisite to purchase technologies for improved production. At the moment former marsh dwellers have little or no access to credit.

The program we envision could come in many forms – revolving fund operated by the village; a finance program operated and owned by an NGO; or the funs could be delivered through the Agricultural Bank. The program would have to be designed carefully to build in checks and balances to ensure financial and accounting integrity. Eventually, the program could be integrated into a normal rural credit program.

Proposed Tasks for Years 2 and 3

1. Scale up the demonstration program to include more villages and more types of crops. Estimated budget: $400,000

2. Develop cooperatives or business associations for production and marketing date palm or other horticultural crops: Estimated budget: $200,000

3. Marketing information system to improve decision making regarding production and marketing. Estimated budget: $100,000

4. Extension materials based on the demonstration programs to transfer new technologies or crops introduced by the program. Estimated budget: $200,000

5. Training courses targeting farmers, extension personnel, and MOA district managers. The curriculum for farmers will concentrate on production and marketing technologies and practices; curriculum for extension personnel will focus on communications techniques with the farmers; and MOA district managers will be trained in improving managerial skills and improving their decision making capabilities. Estimated budget: $200,000

6. Comprehensive analysis of irrigation and drainage in Hawizeh and Hammar marshes, after all reflooding is done. Estimated budget: $500,000

7. Investment in cold storage or other post harvest facilities targeting former marsh dwellers. The difficulty with this task is determining ownership. Estimated budget: $250,000.

8. Marketing research and training program. This could include a training program for agriculture students in the University of Basra. This program will benefit former marsh dwellers as well as other farmers and marketing personnel. Estimated budget: $300,000

3 RE-ESTABLISH LIVESTOCK AND DAIRY PRODUCTION

Photographs

Water buffalo along Prosperity River

At a milk collection point along Prosperity River where small trucks travel through settlements

A woman tending cattle on a floating island inside Hammar Marsh

A young girl tending sheep near Hawizeh Marsh, a common chore for females

3 RE-ESTABLISH LIVESTOCK AND DAIRY PRODUCTION

Background

Animal husbandry was clearly a mainstay of the Marsh Arab economy before the drainage of the marshes. Water buffalo provided the major source of protein to the people, but fully grown and productive animals were not sold or slaughtered for meat. Their major products were butter and cheese; milk was also consumed fresh. These products were sold outside the marshes, and some have estimated that 60-65 percent of the dairy products in Iraq originated in the marshlands. This figure still needs to be confirmed, but it is likely that a significant portion was produced by the Marsh Arabs for sale in the South, at a minimum. Water buffalo dung also provided fuel for fires. For many Marsh Arabs, this dung remains their only fuel, and neatly stacked domes of fuel are found everywhere in their settlements.

Furthermore, livestock were central to the identity of the people. As S.M. Salim noted in his 1962 ethnography, *Marsh Dwellers of the Euphrates Delta*, Marsh Arabs had three broad divisions, based on occupation: cultivators, reed-gatherers, and buffalo-breeders. Iraqi townspeople incorrectly used the term Ma'dan for all marsh dwellers. Traveler accounts and the wider public have used Ma'dan interchangeably with Marsh Arab. Among the Marsh Arabs themselves, the term was reserved for the buffalo-breeders. This division was fluid, as Salim noted. Many of the immigrant bedouin tribes coming into the marshes adopted buffalo-breeding as an occupation and eventually became indistinguishable from the indigenous population.

According to Salim, the Ma'dan comprised four tribes: Albu Mhammad (the Bait Nasr Allah and Albu Ghannam clans) in Hawizeh marsh, Il-Bunda in Athaim marsh, Iagail in Al-Jdwal on the lower reaches of the Gharraf, and Il-Fartous in Al-Abid marsh. They lived mainly on their herds of water buffalo, with families owning between one and ten animals. The more prosperous families tended their buffalo exclusively, feeding them on young, green reeds. At certain times of the year, they bought grazing rights in the harvested fields. A Ma'dan family might sell young animals for income; others made mats, worked as hired laborers, or took up cultivation, but these were a small part of their economy. They also fished but mainly for household use, not for sale.

It is possible that other Marsh Arabs raised water buffalo as a source of food for the household, keeping it as a small part of a mixed economy, much as the Ma'dan cultivated, wove mats, and fished. It is also possible that the three occupational divisions noted in 1962 are no longer strictly relevant in the marshes after years of persecution and deprivation. Military attacks and forced moves effectively destroyed the local economy. From 1991 to roughly 2000, Marsh Arabs were forcibly and repeatedly moved within the area. Living in settlements in the drained marshes they disposed of their water buffalo, selling them off. Following the war in April 2003, visits to the still existing, desiccated, and now reflooded marshes revealed a widespread presence of water buffalo, although their number is not known.

This section of the action plan is an initial attempt to understand the importance of livestock in the current marsh economy, identify the constraints on animal and dairy production, and design tasks which begin to address them on a pilot project level.

Objectives

This activity will investigate the extent to which livestock production and dairy production can be reestablished as a significant part of the local economy in the marshlands. Its specific objectives include the following:

- Determine the present importance of animal husbandry (water buffalo and other livestock, including cattle, sheep and chickens) in the marshes;

- Assess the financial opportunities of livestock and dairy production for Marsh Arabs for the next three to five years and clarify the challenges in reestablishing production;

- Determine the need and provide a range of options for improved animal care, including discussions with the Ministry of Agriculture and other government entities, regarding veterinary and other services; and

- Identify implementation strategies and immediate interventions to jumpstart animal and dairy production

Livestock Team Members

The development of a program to re-establish livestock and dairy production in the marshlands is a product of a partnership among the Ministries of Agriculture and Water Resources, University of Basra's College of Agriculture, AMAR International Charitable Foundation, and a foreign expert. The livestock team included the following members:

Dr. Khalid al-Zubaidi, Marketing Expert, National Center for Agricultural Research and Training, Jordan

<u>Ministry of Agriculture</u>
Dr. Mohamed Ghazi, Livestock Department, Ministry of Agriculture, Baghdad
Eng. Tareq Khadem, Deputy Director, Ministry of Agriculture, Misan Province
Eng. Hussein Abed El Hassan, Ministry of Agriculture, Misan Province
Eng. Hadi Hussein, Ministry of Agriculture, Misan Province
Eng. Ali Hadi, Ministry of Agriculture, Basra Province
Eng. Shaker Eisa, Ministry of Agriculture, Basra Province

<u>University of Basra</u>
Dr. Asaad Yheia Ayied, Head, Department of Animal Production
Dr. Ali Mohsine Al-Maraashi, Department of Animal Production
Dr. Amad Falah Hassan, Department of Animal Production
Dr. Amera Kadhem. Nasser, Department of Animal Production

Ms. Khawla Rashige Hassan, Department of Animal Production
Dr. Riyadh Kadham Mossa, Department of Animal Production and Waterfowl Center
Dr. Samir Stephan Hanna, Department of Animal Production

AMAR International Charitable Foundation
Dr. Ali Nasir, Iraq Country Director

Technical Approach

During the period from 8-21 February, the team carried out the following activities:

- Field trips to the two southern provinces of Misan and Al-Nasiriyah to meet with local animal owners in villages through the marshes to explore livestock populations and concentrations, animal health, dairy production, and local maketing infrastructure. Villages visited included Al-Toraba, Beit Hlail, and Albu Bakheet in Hawizeh Marsh; settlements along Prosperity River populated by members of the Al- Shadah, Sayed Jaber, Al-Shaghanba sub-tribes; Al-Chabayish; and the villages of Al-Albahar, Al-Garmasheya, Abu Zarag, and Al-Arathem village in Hammar Marsh.

- Visits to animal and dairy markets and slaughterhouses in Al-Nasiriya, Al-Amara, Qalat Salih, Al-Medinah, and Garmit Ali to assess the available services, mechanisms for buying and selling, current market prices, obstacles faced by these markets, as well learning about weights of slaughtered animals, numbers slaughtered, and types of examinations performed.

- Visit to veterinary facilities in Basra to understand the quality of government veterinary services and explore the availability of unemployed veterinarians for possible program participation.

Recent Trends in Livestock Population

Certainly, one of the most striking observations about livestock populations in the marshes is the dramatic shift over the past quarter century from water buffalo to sheep herding. With the displacement of most of the indigenous people into drained areas between 1980 and 1992, animal owners could not care for their buffalo, which we were told were killed by the regime or sold. Water buffalo numbers have decreased to low levels throughout the area, with the exception of inside Hammar Marsh, beyond Garmit Beni Said, where small communities of Marsh Arabs live traditionally on islands and are said to have thousands of water buffalo. Otherwise, animals of preference are *arabi* breed sheep and cows which are a cross between Friesian and Al-Jenoubi breeds. The local Iraqi breed is a low milk producer and is crossbred with the Friesian.

Interviews with marsh dwellers suggest that about half of the families in Hawizeh and Hammar and two-thirds of those in Prosperity River own buffalo, but the numbers owned are small. Families with water buffalo generally have four in Prosperity River, two in Hawizeh, and one in Hammar. People have much larger numbers of sheep, as is evident

from Table 3.1: average flock sizes are about 50 heads of sheep in Al Hawizeh and Hammar, but the number grows to 100 along Prosperity River. Three-quarters of families have sheep in Hawizeh, and 85 percent do in Prosperity River and Hammar. The ownership of cows is less prominent, since about half the families have cows in Hawizeh and Hammar and 35% in Prosperity River. The numbers are small for family owned cows: about two in Hammar, three in Hawizeh, and five in Prosperity River.

These animals, and the chickens and ducks found in settlements, are rarely eaten by people in the marshes. Sheep supply coarse wool for tribal rug weaving and are sold in the market. Buffalo and cows supply milk for household use, and the excess is sold through a primitive marketing system with little evident processing and no apparent measures regarding cleanliness. The daily diet of marsh dwellers is very restricted. Lamb and beef are eaten two or three times a year, at special religious holidays and for weddings, when an animal might be slaughtered. Otherwise, they purchase meat in the market for those rare occasions. The mainstays of people's diet are bread, eggs, milk, tea, and beans or lentils. Fish is eaten occasionally. It is likely that an analysis of calorie intake would indicate that people are generally malnourished.

Livestock and Dairy Production

Milk productivity of water buffalo is very low: about seven kilograms daily in Hawizeh, ten in Prosperity River, and five in Hammar and Al-Chabayish. This may be because the forage and feed for the buffalo are better in Prosperity River than elsewhere. Buffalo are milked once a day in the evening upon return from pastures beyond the settlements. Cows provide nine kilograms of milk in Hawizeh, 12 along Prosperity River, but only six in Hammar and Al-Chabayish daily. Low yields are largely related to the amount of food given to animals. Similar information for sheep was difficult to obtain because owners do not milk them. The milk is left to newborns to speed their growth. Sheep are shorn once a year for their coarse wool which is sold for about ID 1000 per kilo.

Sheep in the marshes reproduce three times every two years on average. Owners sell the males when they weigh about 30 kilograms for slaughter. Females are kept for breeding. Buffalo and cows reproduce every ten months.

The feeding of animals is similar throughout the area. Buffalo are taken to nearby water each day to feed. They return in the evenings and are fed wheat and barley hay and bran, about four kilograms of hay and two kilograms of bran. Hay costs ID 50,000 for one ton, and bran costs ID 80,000, but there are shortages of hay for sale so breeders must pay the additional cost for bran. Cow and buffalo milk production improves on a bran diet. When the hay is exhausted, people feed their animals only bran. Sheep are also fed when they return from grazing during the day. People do not feed their animals based on a strategy of how to increase milk productivity or meat.

The mortality of buffalo and cows from disease is believed to be low. The buffalo population suffered a serious blow in the mid-1980s when the devastating rinderpest disease was introduced with cattle from India and from Iran in the early 1980s during the Iran-Iraq War when soldiers brought cows into Iraq from Mohammara. The local population seems to have recovered, and the disease has been eradicated.

Animals in the marshes have a high incidence of parasitic diseases. They are at risk of helminthic infestation and sarcoptic mange during periods of drought. Buffalo suffer from nutritional hemaglobinurea, acidosis, and alkaosis. They are susceptible to degnala disease which occurs in non-paddy growing areas when they fed on paddy straw. This disease results in gangrene of extremities, ultimately resulting in death. Degnala disease may be due to mycotoxicosis and/or selenium toxicity.

Buffalo suffer from bovine viral diarrhea, mucosal complex, anthrax, hemorrhage septicemia, and buffalo lymphasarcoma. Buffalo in the marshes have a high incidence of anoestrus and torsion uterus. Genital mycoplasma is a leading cause of infertility, both in male and female buffalo. Calf mortality in buffalo is very high. *Ascariasis* and *Toxocara vitulorum* are the major causes of calf mortality in addition to neonatal diarrhea and pneumonia. Rota and corona viruses along with virulent strains of *E. coli* are associated with diarrhea.

Buffalo calves are also prone to the adverse effects of inclement weather. Early suckling after birth, hygienic conditions of quarters where calves are kept, regular deworming, and protection against ectoparasites and administration of pro-biotic (eg. *Lactobacillus bacteria*) may help to reduce calf mortality.

Disease surveillance could be used to determine patterns of diseases. By and large, veterinary services do not exist. Vaccinations are very spotty, but people will pay for the services.

Table 3.1 provides information collected during interviews in the marshes about milk yields for buffalo and cows and the daily cost per animal.

Table 3.1
Product Characteristics and Feeding Requirements for Buffalo and Cows
(Iraqi dinars)

Animal	Production Characteristics			Feed Requirements		Daily Cost/Animal (ID)
	Daily Milk Production (Kg)	Lactation Period (Days)	Total Milk Yield (Kg)	Bran (Kg)	Straw (Kg)	
Buffalo	5	150	750	3	5	539
Cow	3	150	450	2	3	341

Source: Field interviews

Milk is used to produce cheese and cream in small quantities. Cream is prepared by bringing milk to a boil, cooling it, and skimming the cream off the surface. About one-third of the cream prepared is said to be consumed by the household, although this amount must be related to the size of the household and the number of animals owned. One kilogram of milk produces 0.1 kilogram of cream and 0.09 kilogram of cheese. The total price of one kilogram of processed milk is ID 590. However, raw milk can be sold for ID 500. This may explain why marsh dwellers do not like to process milk. It is worth mentioning that most of

the cream and cheese in the markets now comes from areas near the cities where production is high, rather than from the marshes, which was the historical source.

Table 3.2 presents an analysis of information collected in the field on the cost of milk production to producers.

Table 3.2
Estimated Annual Cost of Milk Production for Buffalo and Cows
(Iraq Dinars)

Livestock	Daily Feed Cost/Animal	Vaccines	Annual Feed Cost/Animal	Total	Annual Production (Kg)	Cost per Kilogram Milk (ID)
Buffalo	539	1500	196735	198235	750	264
Cows	341	1500	124465	125965	450	280

Source: Field interviews

Table 3.3 provides information related to the cost of meat production in the marshes.

Table 3.3
Live Weight, Growth Rate, and Meat Prices for Buffalo, Cows, and Sheep
(Iraqi dinars)

Animal	Birth Weight (Kg)	Daily Growth Rate (Kg)	Daily Feed Consumption (Kg)		Marketing Weight (Kg)	Price of Live Weight (Kg)	Meat Price (ID/Kg)
			Bran	Straw			
Buffalo	**40**	**0.3**	**2**	**4**	**149.5**	**2000**	**4000**
Cattle	**25**	**0.2**	**1.5**	**3**	**98.0**	**2000**	**4000**
Sheep	**3.5**	**0.1**	**1.5**	**1.5[1]**	**24.5**	**3250**	**7000**

[1]This quantity refers to barley use. The price of one kilogram of barley is ID 110.

Source: Field interviews

Table 3.4 provides information about the cost of raising calves and lambs for slaughtering.

Table 3.4
Cost of Raising Calves for One Year and Lambs for Four Months for Meat in the Marshes

Animal	Cost of Daily Feed (ID)	Raising Period (Days)	Cost of Total Feed (ID)	Vaccines	Total Cost (ID)	Annual Production (Kg)	Cost/Kilogram
Buffalo	396	270	106920	1500	108420	149.5	725
Cattle	297	270	80690	1500	81690	98.0	834
Sheep	313.5	120	37620	1000	38620	24.5	1576

The net profit per kilogram of live weight is for livestock is the price of the live weight less the cost: for buffalo calves: 2000 less 725 or ID 1275, for cattle calves: 2000 less 834 or ID 1166, and for lambs 3250 less 1576 or ID 1674.

Livestock and Dairy Markets

The most important livestock markets for sheep and buffalo are in Al-Amara, Al-Nasiriya, Shawekh, and Al-Qalaa. The markets are small stockades which are managed by an operator. About 30 sellers in the buffalo and cow market and as many as 100 sellers in the sheep market arrange sales with the market operators. Sellers pay the market operators ID 500 per buffalo or cow and ID 150 for each sheep that enters the stockades. About 500 sheep and 30 buffalo and cows are sold daily in each of the markets. Slaughterhouses in Al-Amara and Al-Nasirya fail to meet minimal standards of cleanliness and meat quality testing.

The major markets for milk in the area of the marshes are in the large towns and cities, including Al-Amara, Al-Qalaa, Al-Zair, Al-Qurna, Al-Medina, Al-Nasiriyah, and Suq Al-Shayoukh, and Suq Al-Adel where women sell milk, cheese, and cream spending three to four hours. No organized, regular markets for milk exist in the marshes. These markets are characterized by poor standards for cleanliness, a lack of support services including cooling and weighing equipment, low quantities for sale which do not meet the local demand, and an absence of market information about pricing and market movement. There are ten milk plants in the region, in all of the cities and towns. Most of privately run and present an opportunity for possible future collaboration with the program.

There are informal places within the area for milk collection and sale. Small, open-back, unrefrigerated pick-up trucks travel through the settlements on the roads along the canals as collection points. Residents, effectively women and girls, carry milk in metal containers to these points. In general, females are responsible for the livestock and dairy production. The presence of women in the markets may also be related to the high incidence of inter-tribal blood feuds in the marshes. Fear of retribution over a past killing of one tribesman by a member of another group is said to keep men out of public venues, like markets, for years until an accord can be reached.

ACTION PLAN 3

RE-ESTABLISH LIVESTOCK AND DAIRY PRODUCTION

Livestock have always been an important part of the marsh economy, but with the drainage of the area, the traditional means of production were eroded and disrupted. In response to the drainage and to their general inaccessibility to water, people in the marshes made a dramatic shift to different livestock management patterns – from water buffalo to sheep. Livestock herding remains a critical endeavor in the marshes, both as a source of basic nutrition and income for families, but serious constraints exist.

Despite the evident dedication of people to their livestock, production, animal health, dairy processing, and marketing are all poor, even as the people have developed strategies to adjust to their newly imposed conditions. The main reasons for the poor performance of the livestock sector include the following:

Inadequate food supply for the animals. Animals are generally underfed, leading to low production levels. Foraging is restricted and herders do not have the resources to purchase feed. They do not cultivate forage crops like alfalfa or clover for the animals.

Unreliable or unavailable veterinary services. Although herders make occasional use of veterinary services, particularly for vaccinations, there is no veterinary service in the marshes, or likely in much of the rest of the south. Apparently, there are more than 200 unemployed veterinarians in the region. The inadequate services reflect the general rural malaise in the country. Poor animal health was consistently cited by people as one of the two most important constraints on production.

Poor Animal Stock. A serious constraint on production is the existing breeds found in the marshes. This is particularly true of cattle which are a cross between Friesian and local al-jenoubi (literally “southern”) breeds. The local variety is a low milk producer, but pure Friesian cattle could not survive the hot climate.

Poor or nonexistent collection and processing services. Milk collections are made in the settlements, but conditions are elementary, at best. Unrefrigerated trucks collect milk unhygienically. There are virtually no processing services available in the marshes; no plants exit in the south. People make cream and cheese in their homes using the most basic techniques. With low production, few milk and dairy products appear to reach the outside markets, in any event.

Inaccessible market infrastructure. Livestock and dairy markets in the South are characterized by poor standards for cleanliness, a lack of support services including cooling and weighing equipment, low quantities for sale which do not meet the local demand, and an absence of market information about pricing and market movement.

Objectives

The objectives of the livestock and dairy activity are to:

- Increase livestock and dairy production in the drained marshes by addressing major constraints related to animal health and nutrition in order;
- Improve household incomes by increasing production;
- Provide income-generating and educational opportunities to women and girls who are the animal tenders and herders and dairy marketers; and
- Provide meaningful employment to Iraqi unemployed or under-utilized professionals in the livestock sector.

Approach

The following are key components of the implementation approach:

- Reach consensus with the Ministry of Agriculture in Baghdad and provincial offices in Misan and Al-Nasiriyah and with stakeholders in a three-way partnership on the vision of the range of services to be provided and on commitments of each's contribution. The program will not be able to cover all of the costs involved, nor should it. The government is expected to play an active role by providing facilities; assuming an increasingly active role in the management, implementation, and monitoring of the task; and provide both personnel and other inputs. Stakeholders are expected to participate in good faith, contribute to the development and security of the facilities in kind, and assume some part of the cost of services, to be decided at an appropriate level.
- Establish village-based sites for service centers in Hawizeh and Hammar Marshes which are tied to other program activities, particularly primary health services, to enhance program impact. Close and ongoing contact with the former marsh dwellers is required if the program is to gain their trust and confidence. In many areas in the marshes, the settlements are insecure and even dangerous. How that presence will be made requires the cooperation and support of the residents, but the task will not succeed if it is run out of a distant administration center.
- Harness underutilized, but talented, Iraqi expertise to make an importance contribution to rural welfare and boost the skills and pride of the country's labor force. The program will sometimes need to mobilize the unemployed, if the government is not able to offer adequate and skilled staff. The task depends on the enthusiasm, commitment, and reliability of participants. If need be, it is prepared to hire outside the public section, as a last resort.
- Work with government institutions and NGOs to develop effective and reasonably-priced strategies to provide help to under-served areas and build local entities in the

process. An objective of the task is to begin to institutionalize within the government agency a cadre of staff and an organizational framework so that the initiative will continue, albeit it in an admittedly modified form. Efforts under this task cannot operate independently of the government or attempt to replace it unilaterally.

- Provide critical services and technologies to stimulate production and improve livelihoods. The explicit objective of the task is to raise incomes in the marshes through improved livestock and dairy production as part of the larger effort to develop strategies to restore Iraq's marshlands and assist the marsh dwellers. An important effort under the task will be to monitor and evaluate the impact of these livestock health care services on production to determine the relationship and to decide if the continuation and expansion of the work are warranted.

Tasks

An assessment of the livestock sector determined that livestock and dairy production require immediate attention and improvement. Successively, issues related to processing and marketing ought to be addressed, once production levels increase. Tasks for the livestock activity then focus on the most important constraints for increased production: animal feed and animal health. It will do this by demonstrating the cultivation of alfalfa on cooperating farmers'/herders' fields. Alfalfa is a relatively accessible crop to grow, and once stabilized it can be repeatedly harvested for five years. Another task is to extend veterinary services to marsh dwellers in areas of particularly high livestock concentration in association with the Ministry of Agriculture and the private sector. Since women and girls are essentially the sole tenders of animals and makers and marketers of dairy products, a third task will focus on extending educational and income-generating opportunities to them.

The proposed tasks in the livestock sector are:

1. Extend Veterinary Services to Marsh Communities

2. Demonstrate Forage Cultivation to Improve Livestock Nutrition

3. Provide Educational and Income-Generating Opportunities for Marsh Dwelling Women and Girls

Task 1: Extend Veterinary Services to Marsh Communities

Veterinary services are essentially non-existent in the marshlands, although many talented, trained people are available and in need of work. Nationwide, statistics suggest that at least 500-600 veterinarian graduates are presently unemployed. People working in government entities in the South believe that 200 veterinarians may be seeking employment now. Those are in addition to the veterinarians already on the government lists who are underutilized and lack equipment, medicine, transport, and motivation. On the other side are the livestock owners who have little or no access to services and usually limit care to irregular vaccinations, at best. This task seeks to bring together the service providers and the service users under the umbrella of the Ministry of Agriculture as a model for collaboration with the program and effective assistance. Clearly, the most sensitive and challenging part of the task will be reaching agreement on the contributions of the parties and having those agreements honored. With the support of the government, the program will establish initially a small number of veterinary service centers which will share space with public health clinics so that together they can build momentum and interest and increase the program's impact. Veterinarian staff will make regular visits to identified areas. A monitoring effort will determine if the services do indeed boost production and income and justify continuation.

Task Objectives

Specific objectives of Task 1 include the following:

- Provide health services to livestock in the marshes on a pilot project basis in order to improve dairy and meat production
- Develop a successful strategy for partnering with the Ministry of Agriculture and marsh dwellers to encourage sustainability of the effort through a turnover to government
- Provide useful and meaningful work to unemployed, capable veterinarian graduates
- Educate stakeholders, particularly women and girls as the most important recipients, in improved techniques
- Stimulate local market processes with expanded products and sales

Steps to Implementation

The following is a list of the steps to be carried out in implementation of Task 1:

1. Develop a joint vision, in the form of a strategic plan, with the Ministry of Agriculture of the range of veterinary services to be provided within the context of a government/program partnership
2. Determine criteria for selection of sites for veterinary service centers, including among others concentration of livestock in the area, state of the physical facilities, access to

settlements, security in the area, cooperation and interest of the beneficiaries, access to existing services, and likelihood of other program initiatives. Program preference is for these service centers to share space with public health clinics in order to heighten impact.

3. With the participation of local agricultural directorates and in association with the Public Health Activity team, continue the identification of candidates for veterinary service center sites based on clear criteria for selection.

4. Select two to three sites for service centers. One potential site is a largely unused, but recently refurbished, clinic along Prosperity River in an administrative cluster.

5. Co-author and sign a memorandum of understanding for each center with the Ministry of Agriculture offices in Misan and Al-Nasariya and with tribal elders concerning the roles and commitments of each. These MOUs provide the formal underpinnings of the working relationship. Failure to honor the terms of the agreement could lead to the untimely termination of the effort by any of the signatories.

6. Develop the veterinary service centers in keeping with the MOU terms, including provision of furniture, equipment, transport, medicine, and other inputs. These centers will most likely act as administrative offices, since the focus of activity will be in the settlements with the herders.

7. Mobilize a veterinary team from the government and private sector and provide skills and management training and instruction on the larger objectives of the program.

8. Develop and implement a service-oriented approach to veterinary medicine which acts as the standard operating approach of the task and against which performance is measured. The approach will include educational program targeted at women and girls who are the primary animal herders and dairy processors. The program would ideally incorporated aspects of public health and cleanliness to increase the value of their products.

9. Provide services to livestock herders in the area of operation, joining the team together regularly to assessment and modification.

10. Develop and carry out a monitoring program to determine the impact of improved animal health care on livestock production levels and household income generation.

11. Prepare a final report which presents results, lessons learned, and a strategy for expanded implementation, if appropriate, based on the tri-partite partnership.

Technical Assistance

The following expertise will be required to carry out Task 1:

- Livestock Activity Leader (Iraqi) with veterinary and/or livestock expertise to manage all tasks under this activity and oversee field operations, based in the program office in Basra – Full-time

- Veterinarian (Expatriate) with experience establishing rural animal care services and designing and managing impact monitoring programs –25 days

- Livestock experts (Iraqi) from the University of Basra to monitor field effort – 150 days as a technical pool

- Veterinary school graduates (Iraqis) – exact number to be determined according to MOA contribution of personnel to program – Full-time

- Veterinarian assistants and other limited, support staff for the service centers, to be determined (Iraqis) – Full-time

Deliverables

The task has the following deliverables:

- Strategic plan produced jointly by the program and the Ministry of Agriculture for the provision of veterinarian service

- Agreed upon criteria for selection of sites for the veterinary service centers

- Memorandum of understanding for each center, signed by the program, government, and stakeholders, defining the terms of engagement and contribution

- Functioning service centers and field operations

- Active, motivated team of veterinary and support staff

- Educational materials targeted at women and girls regarding animal care and simple processing improvements in cleanliness and techniques

- Monitoring reports examining the impact of improved health care on livestock and income

- Final report which presents results, lessons learned, and a strategy for expanded implementation, if appropriate, based on the tri-partite partnership

Proposed cost: $100,000

Task 2: Introduce Forage Crop Cultivation to Improve Livestock Nutrition

Throughout the marshes, animal herders uniformly identified inadequate food supply as the leading problem they face. This program is not designed to distribute animal fodder, but it can develop approaches to increase food for animals as part of an agricultural production effort. To that end, the program suggested carrying about a task to introduce alfalfa cultivation in the marshes in areas with high livestock concentrations, such as along Prosperity River.

Task Objective

Specific objectives of Task 2 are the following:

- Increase animal fodder by introducing alfalfa on a trial basis through demonstration pilot projects in a small number of sites in the area
- Demonstrate new techniques to broaden the options for people in the marshes to increase incomes
- Improve animal production and reproduction
- Build a close, collaborative relationship with the Agricultural Directorates in the South in order to carry out joint programs with greater degree of sustainability

Implementation Steps

The following is a list of the steps to be carried out in implementation of Task 2:

1. Select sites based on the soil and water indicators developed under Task 1 of the Agriculture and Agribusiness Activity in association with the agricultural directorate.
2. Negotiate memoranda of understanding among the program, the agricultural directorate, and tribal elders for each site. According to the MOUs, the program will provide production inputs including land preparation, and the village will provide labor for the demonstration. The MOA is encouraged to participate, although its exact role still needs to be defined.
3. Prepare a workplan with each village that has agreed to cultivate alfalfa, which includes a delivery schedule for inputs.
4. Visit each site weekly to assess progress.
5. Develop a monitoring plan to examine the impact of alfalfa consumption on the livestock related to increased production.
6. Conduct farmer field days at each site to encourage participation.

7. After marketing of the product, prepare a report on the outcomes of the demonstration.

Technical Assistance

- Livestock Activity Leader (Iraqi) with veterinary and/or livestock expertise to manage all tasks under this activity and oversee field operations, based in the program office in Basra – Full-time
- Soil and Water Specialist (Expatriate) to help identify sites – 5 days
- Soil Expert (Iraqi) to monitor soil impacts from cultivation – 40 days
- Water Expert (Iraqi) to monitor the soil impacts on cultivation – 40 days
- Agronomist (Iraqi) to oversee planting and monitoring growth and production – 60 days
- Machinery specialist – to assist with sub-soiling and other mechanization issues – 20 days
- Plant protection specialist to monitor pest and diseases – 40 days
- Livestock experts (Iraqi) from the University of Basra to monitor milk production and animal health – 100 days as a technical pool

Deliverables

The task has the following deliverables:

- Eight demonstration plots in four locations
- Memoranda of understanding with each community, the program, and stakeholders defined the roles and responsibilities of each
- Workplans for each demonstration n
- Monitoring plan to examine the impact of alfalfa consumption on the livestock related to increased production.
- Farmer field days at each site to encourage participation.
- A final report on the outcomes of the demonstration and the impact of alfalfa on livestock production and health

Proposed Cost: $50,000

Task 3: Provide Educational and Income-Generating Opportunities for Marsh Dwelling Women and Girls

If marsh dwellers are the poorest and most under-served people in Iraq, as seems to be the case, then marsh women and girls are clearly in the worst position. In addition to their household chores as wives and mothers, usually going from one pregnancy and childbirth immediately into another, women are responsible for many of the income-generating activities in their households. They play an important role in agriculture and post-harvest work and are essentially the exclusive managers of livestock and the sole dairy processors and marketers. Only fishing is a largely male domain. While the educational system in the marsh region is barely operating, it is boys who largely attend school. Most women and girls are illiterate. Nor are they able to retain some share of the income for themselves, despite its being almost entirely of their making. There is effectively no existing service directed specifically at women and girls, save the work of AMAR which provides midwifery services in their three clinics. This task seeks to provide women and girls with opportunities for education, albeit very limited, and income-generation, using their livestock chores as a possible point of entry in the communities.

Objectives

Specific objectives of Task 3 are the following:

- Support household activities related to livestock and dairy management to improve food processing and marketing arrangements;
- Improve women's and girl's social and economic positions by providing opportunities for education and income-generation;
- Develop strategies for assisting marsh women and girls by bringing their plight to the government and other service providers; and
- Strengthen women-focused non-governmental groups to support and expand governance.

Implementation Steps

The following is a list of the steps to be carried out in implementation of Task 3:

1. Identify critical partners in the government, NGO community, and private sector at the national and governorate levels to generate interest and support.
2. To the extent they exist, identify women leaders in the communities who would serve as designers and outreach initiators of efforts.
3. Working with members of the NGO, technical experts, governorates offices, and members of the community develop a common vision of what are the most serious

immediate needs and how they can be addressed through the program across the activities.

4. Work with livestock experts, particularly in Task 1, to identify sites for implementation of dairy and marketing initiatives and with health and other experts on other activities.

5. Design pilot programs based on the needs assessment.

6. Recruit and train women's outreach staff.

7. Implement initiatives and monitor their impact.

8. Develop a strategy for increased GOI-NGO partnerships on an expanded basis.

Technical Assistance

- Livestock Activity Leader (Iraqi) with veterinary and/or livestock expertise to manage all tasks under this activity and oversee field operations, based in the program office in Basra – Full-time

- Gender Specialist (Expatriate) with experience working on poverty alleviation, education, and health initiatives with women and girls and on strengthening women-focused NGOs in the Middle East – 30 days

- Dairy Production and Processing Experts (Iraqi) with experience in small-scale, household-based programs in rural areas – 50 days as a technical pool

- Gender Experts (Iraqi) to be supplied through a local non-governmental association based in the region in medical and health services, education, income-generation, social work who will be charged with visiting women in their communities regularly and developing and implementing pilot activities, the exact number and level of effort to be determined in association with relevant governorate offices and the NGO

Deliverables

The task has the following deliverables:

- Income-generation and educational programs implemented in the marsh communities

- Strategy for providing a range of services to women and girls in partnership with government and NGOs

- Strengthened NGOs providing diverse services to women in marsh communities

Proposed Cost: $50,000

Proposed Additional Tasks for Year 1 (Presently Unfunded)

If additional funding becomes available, the following tasks are recommended:

- **Expand the Number of Veterinary Service Centers** (Estimated cost: $250,000)

If the veterinary service centers prove to be as successful as expected, then the program could expand the number quickly drawing on the large pool of available veterinarians.

- **Expand Alfalfa Demonstration Plots** (Estimated cost: $100,000)

The demonstration plots can be expanded to engage more farmers and herders in the marshes, since the original number of sites is expected to be small.

- **Expand Efforts to Assist Women and Girls in Education and Income-Generation** (Estimated cost: $100,000)

Similarly, the women-focused task fills a desperate need in the marsh communities. Available funds will only permit a small number of implementation sites, although much of the up-front work will establish implementation plans that can be further developed and expanded.

Proposed Tasks for Years 2 and 3

Should the program be extended into succeeding years, the following tasks are recommended for implementation:

- **Stimulate Private Sector Provisions of Veterinarian Services**
  (Estimated cost: $200,000)

Task 1 seeks to develop and implement a veterinary service program in close partnership with the Ministry of Agriculture. However, it remains highly possible that the MOA cannot provide the necessary personnel or services in ways that meet the real needs in the communities. The system might be so broken that present government restrictions and disincentives make a government-centered service unrealistic. Even if the government can provide these services on a limited basis, the private sector operating in a new Iraqi economy may be the best source of consumer-oriented services. This proposed task would explore the potential of the private sector to provide services, perhaps in association with the government. It would then undertake measures to stimulate private sector interventions for better and sustainable services to livestock herders.

- **Expand Efforts to Assist Women and Girls in Education and Income-Generation**
  (Estimated cost: $500,000)

Depending on the success of Task 3, efforts can be expanded into succeeding years. Any expansion or extension requires a careful assessment of lessons learned to ensure that the efforts did indeed the most critical needs and that there were the beginnings of a concrete improvement in the lives of marsh women and girls.

- **Introduce New Technologies for Household Dairy Processing** (Estimated cost: $250,000)

The program has deliberately avoided developing a task related to dairy processing, although processing adds value to milk production and income to needy households. This task will explore current processing techniques and introduce new technologies for improved cleanliness, milk-use efficiency, and improved product lines and handling.

- **Strengthen Burgeoning Private Sector Initiatives in Dairy Processing** (Estimated cost: $500,000)

Just as the private sector may be the best source for animal health services, it is likely to be the best locus for improvements in dairy processing, beyond the household systems. About ten processing plants are presently operating throughout the South. They require new technologies, management systems, and product development strategies to take their place in what is expected to be an increasingly prosperous Iraqi economy. These private

operations will demand better quality milk from producers and ought themselves to stimulate improvements in handling.

- **Improve Livestock and Dairy Market Operations** (Estimated cost: $500,000)

The present animal and dairy markets which serve the marshlands are in a dismal state of activity. In the longer term, some investment must be made to correct market systems. While arguably outside the confines of a marshlands-focused program, the markets will set the terms of production and must be improved for the sake of the sector and the efforts of the program.

4 SUPPORT CAPTURE FISHING AND FISH FARMING

Photographs

Fishermen straightening a nylon net on the edge of Hawizeh marsh

Fish for sale in a local market in the marshes.

A fisherman in Hawizeh marsh with his electrofishing gear run off a battery

On an reed island in Hawizeh marsh where fisherman spend several days at a time fishing and sleeping in small shelters, bringing in larger hauls

4 SUPPORT CAPTURE FISHING AND FISH FARMING

Background

In the 1950s and 1960s, the main elements of the marshlands economy were based on their biological diversity: agriculture, livestock-raising, birding, mat-making, and fishing (Salim 1962, Thesiger 1964). Although fishing was a primary economic livelihood for only a small number of low-status tribes (mainly the Berbera), subsistence fishing was practiced widely in the marshes, and fish were a major, some say the major, food item for the people.

The economic importance of fishing increased until the drainage of the marshes. Water buffalo were the basis of household wealth in some tribes, but, where fish markets were accessible, fishing played an increasingly important role in the local economy. A combination of factors, including the Iran-Iraq War in the mid-1980s and the building of the drainage system in the 1990s, diminished the flow of nutrients to the marshlands and its fish and led to a precipitous fall in catches. The situation worsened with the massive displacement of the local population, and restrictions on access to those marshes still under water.

The native marshland fish populations were originally dominated by Cyprinid fish of the genus *Barbus*. In 1990, the FAO estimated that the total inland catch of fish in Iraq was 23,600 tons, with over 60 percent of this amount coming from the Mesopotamian marshes (UNEP 2001). In Al-Chibayish, the largest town in the marshes, Marsh Arabs estimated that until 1991, four truckloads of fish were sent daily to cities to the north. Fish were originally caught with tridents, but dwellers also used nets, although the size of the holes decreased as the catches decreased. As the marshes were drained after 1991, some people used mesh or cloth from which nothing escaped; others used poisons to take the final fish remaining in the drying ponds. With the drying of the marshes, the commercial trade was said to have virtually ceased.

Freshwater aquaculture in Iraq in the past was estimated at 7,500 hectares. The main species cultured is common carp, and to a lesser extent, grass and silver carp. The industry was concentrated in the area around Baghdad rather than the southern marshes. Freshwater aquaculture of tilapia, (*Oreochromis niloticus* or *O. spilurus*), has already been introduced in neighboring Kuwait and Jordan.

Coastal fisheries in the Arabian Gulf used the marshlands for spawning migrations, and they served as nursery grounds for shrimp and fish. Several marine fish species of great economic importance are dependent on the estuarine systems and marshes for spawning, namely the pomphret, *Pampus argenteus,* and the hilsa or saboor, *Tenualosa ilisha*. The penaeid shrimp, *Metapenaeus affinis,* undertakes seasonal migrations between spawning in the gulf and nursery and feeding grounds in the Iraqi marshes.

With the reflooding of parts of the Hawizeh, Hammar, and Central marshes, people have returned to their boats to fish, mostly with nylon gill nets and electric fishing sets. The catches in June 2003 in the newly flooded water were disappointing in number and size. The scoping team did not see any fish longer than about six inches, and shared a concern that the resumption of fishing practices, growing out the people's delight that the waters had returned and the need for food and income, would lead to over fishing and deplete the fragile fish stocks.

Examinations of fishing practices also raise issues about rights to marsh access. Traditionally, fishing areas were controlled by tribes and sub-tribes, and only members of those groups were permitted access, unless the groups allowed outsiders to use them. Travelers' accounts suggest that this did not happen frequently. The marshes were dangerous places for outsiders, and many people were killed in intra- and inter-tribal fighting. Some deaths appear to have been caused by poaching. Today's situation, caused by drainage and displacement, is even more complicated. People are living outside their historic areas and new people are now moving onto the vacant land of others.

Objectives

The objectives of for the fish activity are to:

- Initiate restoration of the reproductive capacity of the endemic *Barbus sharpeyi*, in all three marsh areas, by stocking cultured fingerlings;

- Encourage the sustainable management of marshlands fish species by involving tribes in co-management activities emphasizing the dry season survival and unhindered reproductive migrations of their local fish stocks;

- Develop fish culture capacity in the Ministry of Agriculture's Department of Fisheries and the University of Basra and pilot effective fish farming technologies of proven fish species (grass and silver carp) in suitable marsh locations; and

- Monitor fishing activities and resource status as a baseline for future assessments of the outcomes of the program, in combination with hydrological and ecological data from the Integrated Marsh Management activity.

Activities proposed for the delivery of these objectives are described below for a 12- month program. The program could promote the further restoration of two other depleted Barbus species – *B. xanthopterus* and *B. grypuss* if the program is extended beyond the first year.

Technical Team Members

The fishing and fish farming team includes the following members:

Dr. Daniel Hoggarth, MRAG Americas Inc.
Dr. John Woiwode, AquaMatrix International Inc.

Mr. Mohamed Mohamed Halous, Department of Fisheries, Ministry of Agriculture
Dr. Najah A. Hussein, University of Basra
Dr. Sadek Hussein, University of Basra
Mr. Mustafa Al-Muchtar, University of Basra
Dr. Najim R. Khamees, University of Basra
Dr. Azhar Al-Saboonchi, University of Basra
Dr. Sajed Al-Noor, University of Basra
Dr. Adel Al-Dubakel, University of Basra
Dr. Amna A. Hashem, University of Basra
Dr. Basim M. Jasim, University of Basra
Dr. Sumaya Mohamed Ahmed, University of Basra
Dr. Azhar A. Al-Saboonchi, University of Basra
Mr. Riyadh A. Al-Tameme, University of Basra

Capture Fishing Analysis

This technical analysis is based on a series of field observations at villages and fish landing sites around the marshes (see Annex 1). The locations for the field visits were guided by the more locally experienced program staff and the 'fish team' collaborators from the University of Basra. A checklist of questions was prepared to guide interviews, but attention was also given to the needs and suggestions of the respondents. The study villages had between 10 and 400 households, and the fishers reportedly operated in fishing grounds with between 50 and 1000 fishermen.

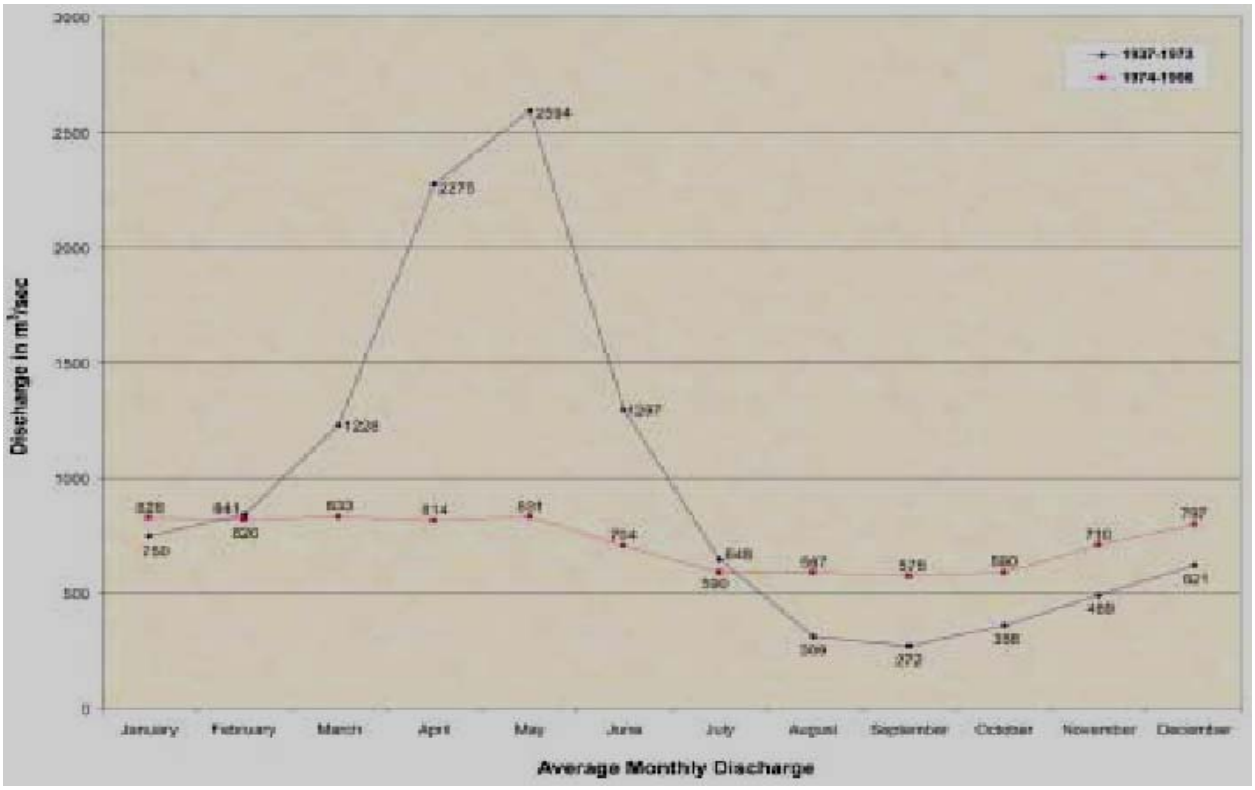
The Iraq Marshlands and the Riverine Environment

The environmental and hydrological features of the Mesopotamian marshes were studied in depth by the Monitoring Reflooding project team. From a fisheries production perspective, it is important to recognize the enormous hydrological modifications suffered by the marshes in recent times. The fisheries productivity of healthy floodplain rivers is roughly proportional to the total area of the waters in the high-water flood season (Welcomme 2001). According to UNEP (2001), the total post-drainage flooded area of the Mesopotamian marshes in 2000 was only 14.5 percent of the pre-drainage area in 1973-76. Most of the remaining area was in Hawizeh marsh, with only three percent in Central marsh and six percent in Hammar marsh. Even if there had been no other influences on the system, the productivity of these areas may have been reduced in approximate proportion to this loss of their floodplain areas.

In addition to this overall impact, the construction of dams in Turkey, Iraq, Iran and Syria since 1951 has also altered the hydrological regime dramatically (Figure 4.1). The destruction of the annual high water flood pulse from the upstream snowmelt has removed the fishes' natural spawning cues and reduced the annual deposition of silt-borne nutrients to the floodplains. Within the marshlands area, the 1992-97 drainage program has redirected water into man-made canals with virtually none of the natural habitats required by fish for their reproduction and growth. Remaining marsh habitats (mainly Hawizeh marsh and the wide Prosperity River) have been embanked and partitioned, restricting the connections between the various habitats required by fish for their different life stages. Water quality has also declined in both the Tigris and Euphrates, with waters now carrying

increased salinity from upstream irrigation works, and higher levels of agricultural chemicals and urban and industrial effluents (UNEP 2001). The aggregate impact of these changes is unquantified but clearly compounds the simple reduction in flood water area.

Figure 4.1
Comparison of the Discharge Regime for the Euphrates River at Hit-Husabia, Iraq during Pre-Dam (1937-1973) and Post-Dam (1974-1998) Periods



Source: UNEP 2001

Fishing in the Marshlands

Fishing activities in the marshes are unsophisticated compared to the immense barricade traps, fish drives and dewatering carried out by fishing teams in Asian river fisheries. For most of its history, the Mesopotamian fishery has been relatively lightly exploited, though certain areas and times have been heavily fished. Today the fishery is returning as a largely open access resource, at least within individual tribal areas.

For most of the marsh Arab tribes, fishing was originally only a subsistence activity. Fishing for sale was culturally disapproved and commercial fishing was practiced only by the Berbera tribe. Most Marsh Arab tribes fished occasionally to eat, but trade was fundamentally a despised activity. Nowadays, many more Marsh Arabs are fishing for a living, but the gears used are still mostly small scale and inefficient.

In historic times, the Berbera fished mainly with seine nets, but also with drift nets on rivers and with long fixed stake nets (Thesiger 1964). Marsh Arabs traditionally used spears, but not nets. They also used *datura* poison to catch fish in the winter and spring dry season before the waters reflooded each year. The *datura* was mixed into pellets or shrimp baits and fed to fish for collection when they rose stupefied to the surface. In the dry season, both the marsh dwellers joined fishing parties to the remote deep lakes in the marsh, sweeping up and down the lake in lines of boats, spearing any fish dashing past beneath. Thesiger describes the immense catches of two kilogram *binni* (*Barbus sharpeyi*) taken in the very dry season of 1951, taken both with both seine nets and spears.

In current times, all of the fishing communities observed in the field visits mainly used gill nets and electric fishing. Simple barrier trap nets were seen suspended downstream of the culvert outlets in Abu Zarag marsh. Only one seine fishing operation was observed at the southern end of Prosperity River. Most fishers still operate only from small canoes, without engines, generally with two men per boat for electrofishing, or with one to two men for gill netting.

Gill net mesh sizes were five to seven centimeters before drainage, but are now more often of two to three centimeters. Interviewed fishermen noted that the larger meshed nets now catch almost nothing at this time in the early flood, but that they may return to such gears later as the fish grow with the flood.

Many of the interviewees talked of problems with poison fishing. Most tribal leaders had prohibited the use of poisons in their areas, but still had problems with outsiders. Poison fishing is used widely around the tropics, although it is prohibited in most countries, including Iraq. Natural poisons (including derris root and rotenone) generally affect the gills of fish leaving the flesh safe to eat. Some synthetic pesticides may however accumulate in fish flesh to toxic levels. As indiscriminate, unselective fishing gears, poisons affect both fish and other aquatic and benthic organisms in the waterbodies and have negative impacts on the food chain. Poisons are traditionally only used in the dry season, often with devastating effect on the highly concentrated fish stocks at that time. Their relatively inefficient use now at this early stage in the flood season may indicate the current desperation of the Marsh Arab fishers.

Electric fishing was observed both in individual boats and as teams of up to ten boats moving through the open waters in a line, with their electrodes in front. Electric fishing is dangerous and illegal in most countries. Its impact on fish partly depends on where it is used – from little impact on the open floodplain, to potentially complete destruction of local spawning stocks when used in dry season ponds. The reproductive capacity of any mature fish that do manage to escape may also be reduced by the destruction of the maturing eggs.

Several interview groups mentioned the increase in catches that they expect to see in the dry season, and confirmed the good catches taken in last summer's dry season. This seasonality of fishing is common with most floodplain river fisheries, where each new flood brings nutrients into the system, and stimulates the spawning of that year's fish stock. These fish spread out over the newly flooded marshes and grow fast over the high water season, but are hard to catch at this time in the open waters. As the flood waters fall in the drawdown season, fish attempt to return from the floodplains to the rivers and many fish

may then be caught in barrier gears or nets placed across their emigration routes. Those fish that become stranded in the dry season pools are large, concentrated and easily caught. The size of the catches at this time depends on the length and duration of the dry season. In very dry years, huge catches may sometimes be taken, as reported by Thesiger (1964) in 1951. In wet years, the fish may not concentrate at all, and no fishing may be possible. As may have been expected, dry season fishing became increasingly effective as the marshlands were drained during the 1990s (see below).

Those fish that survive the dry season fishery, either in floodplain pools or by returning to the river channels then migrate to their breeding grounds either upstream or on the floodplains to spawn at the start of the next year's flood. Maintaining the migration routes of the few remaining spawners at this time is critical to the long term productivity of the fishery. Most marsh channels observed during the fieldwork were open to passage. One net was seen suspended below a culvert drain in Abu Zarag marsh, whose owner reported taking the usual catfish and carps, but also the occasional migrating *shabut* and *binni* up to four kilograms in weight. Only one gill net was seen stretched across the current below the canal flowing into Al Hawizeh marsh. The general absence of these gears at this time supports claims by fishermen that the more migratory species of the Mesopotamian fish community are now depleted.

Marshlands Fish Population

From both an ecological and a management perspective, floodplain river fish may be usefully divided into two main categories, reflecting their behavioral responses to seasonal changes in the floodplain environment (Welcomme 1985). The 'whitefish' species inhabit rivers and other flowing channels and undertake seasonal spawning and/or feeding migrations either longitudinally (upstream) or laterally onto the floodplain, or a combination of both. Longitudinal migrations may be upstream or downstream. Some are local covering only small distances; others, usually upstream, may be substantial. Upstream spawning locations offer a number of advantages, including higher dissolved oxygen concentrations and fewer predators. Furthermore, the duration of the downstream drift of developing fry may take several weeks allowing time for individuals to grow beyond a size which is particularly vulnerable to predation. Fry may move onto the floodplain either passively or actively, or in the case of the anadromous, *Tenualosa ilisha*, be swept downstream to the sea. Adults of some species return to the floodplains after spawning, usually before the eggs or fry to take advantage of the rich feeding. Whitefish species are generally intolerant of the extreme conditions that exist in the floodplain habitat during the dry season (low oxygen and pH levels and high temperatures), and hence they must return to the rivers each year to survive.

'Blackfish' species are generally still-water fish with only limited migrations between wet and dry-season habitats. Many blackfish species are adapted to survive low oxygen concentrations, high temperatures and even desiccation, and may thus remain in the residual floodplain pools during the dry season. Blackfish disperse only locally on to the floodplains to spawn and feed and do not undertake large scale longitudinal migrations.

Of course there are also some greyfish species in between the two main categories with variable levels of tolerance to low oxygen and raised temperatures. From a fishery management perspective, it is most important to maintain the spawning migration routes of

the whitefish and to ensure the dry season survival of at least some of the blackfish at this most catchable time. With their greater migration scales, whitefish require management on a larger catchment or sub-catchment scale. Communities may need to coordinate their efforts at maintaining spawning whitefish stocks, e.g. by keeping all channels open at key times in the flood season. Blackfish, in contrast, may be effectively managed within smaller units, where the floodplain can be sub-divided into natural hydrological units. A village management unit may for example unilaterally maintain its blackfish stocks with a dry season refuge, but will always be vulnerable to the actions of its neighbors for the seasonal access of any migratory whitefish stocks.

In the Mesopotamian marshes, fish stocks are dominated by a variety of fish of the *Cyprinidae* family. Catch composition has changed radically in recent decades both due to the negative effects of the marsh drainage program especially on the whitefish species, and to the introduction of some highly competitive carp species.

In the 1960s, the commonest fish in the catches, in order of importance, were *binni* (*Barbus sharpeyi*), *khatan* (*B. xanthopterus*), *hemri* (*B. luteus*), and *shabut* (*B. grypus*). Of these four culturally important Barbus species, the largest *shabut* and *khatan* are both migratory whitefish, while the two smaller species, *bunni* and *hemri* are more floodplain greyfish or blackfish species (see Table 1 for summary). The two migratory cyprinids were captured both in the marshes and also in heavy fisheries especially around Baghdad, as the basis of the traditional 'masgouff' roasted on open fires in restaurants along the bank of the Euphrates. In 1964, Thesiger describes how the fishermen caught both *binni* (also known in some dialects as *bunni*) and *khatan* 'as long as their arm'. *Shabut* lived in flowing water and were caught 'twice that long'. Fishermen in Hammar Marsh confirmed that such fish were still available before the draining of the marsh. Even larger *gessan* (*Barbus kersen*) were also reportedly caught by hand hiding under the floating islands, but such fish have now disappeared from the marsh.

Bunni (*B. sharpeyi*) is the only fish species found in the marshes that is endemic to the Tigris and Euphrates rivers (UNEP 2001). Two other Iraqi cyprinids - *Caecocypris basimi* and *Typhlogarra widdowsoni* - are also endemic, but are only found in the upstream river reaches.

The fourth listed Barbus species, *B. luteus – hemri*, is smaller and less tasty than the three larger species, but is the only species still common in the marsh. During the field visits, small catches of bunni were observed, particularly from the western marshes. In the five field visit, only one *kattan* (in Abu Zarag) and two *shabut* (one in Hawizeh, one in Suq Al-Shayoukh) were seen.

Current fish stocks are now dominated by the black/greyfish species catfish or *juri*, *Silurus triostegus*, and two introduced carp species, the crucian carp, *Carassius carassius*, and common carp, *Cyprinus carpio*. Respondents in both Hawizeh and Qurna (Central) marshes said their catches comprised over 60 percent of *juri*. In the western central marshes, the introduced carps now contribute about 80 percent of the catches, while *juri* comprised 15 to 30 percent.

In the western marshes, open pickup trucks were observed taking full loads of small carps to market simply loaded around ice blocks under canvas sacks. Although common, *juri* is

not consumed by the majority Shia population in southern Iraq and may fetch only ID 250 per kilogram in some markets. In Al Fahoud village, fishermen reported throwing the *juri* aside when they approached the electrofishing anodes, as they were not worth landing. Unfortunately, *juri* is a highly predatory catfish that preys on the juveniles of other species, including presumably the prioritized Barbus cyprinids. The reduction of the juri stocks (by targeted harvest and marketing) may thus improve the chances for the other fish stocks.

The spawning behaviors and locations of the marsh fish are already fairly well known for the more abundant introduced carps and *juri*, having been well studied by University of Basra staff especially in waters close to campus. Common carp for example were found to spawn March to April in the rising waters (Sufian and Ayad 1991). *Juri*, *S. triostega*, are also believed to spawn in the downstream floodplains. Little detailed research has been carried out on the now depleted Barbus species, partly due to the cost and distance involved in sampling such expensive and wide-ranging fish. Welcomme (1985), however, indicates that *Barbus xanthopterus*, *B. grypus* and *Aspius vorax* spawn on upstream gravel beds while *Barbus sharpeyi* and *B. luteus* remain downstream to spawn in the river channel or in the swamps. The life cycles of the two whitefish Barbus species (*shabut* and *kattan*) are thus highly dependent on the several fish passes installed in the dams in both the Tigris and Euphrates rivers. The 1936-built fish pass at Al Kut for example is reputed to remain operational, though the gates are often closed for no apparent reason, and many fish are taken by illegal fishing in the vicinity of the gate.

In addition to its freshwater stocks, the marshes also provide valuable spawning grounds for *hilsa* shad and pomphret that migrate annually upstream from the gulf to spawn. In contrast, the *Metapenaeus affinis* shrimp stocks spawn in the marine or estuarine waters and migrate upstream as juveniles to nursery waters in the marsh. During their spawning run, *hilsa* may contribute over 50 percent of the catches in Basra market. Commercial landings of the shrimp *M. affinis* at the two main fish markets in Basra during September - November 1985 averaged 1,000 kilograms per day.

Of the non-native species, the Common carp *Cyprinus carpio* was introduced to promote fish farming in 1968. It has since spread widely into the field, out-competing the natural fauna with its fast growth and abundant spawning. Crucian carps arrived accidentally, being first observed in the Shatt al Arab in 1995. As another opportunistic asynchronous spawner, they have also expanded rapidly in the waters of the newly flooded marshes. Unfortunately the lower value of such fish may mean that this competition will reduce the overall value of the fishery.

Two other carp species – the silver carp, *Hypophthalmichthus molitrix*, and the grass carp, *Ctenopharyngodon idella* – were also introduced for culture fisheries in 1985. Both species were seen at the private fish farms near Al-Medinah. Both silver and grass carp require a strong flood pulse to stimulate their synchronous spawning behavior, and have not recruited significantly into the wild marsh stocks. Only two grass carp caught in the Euphrates River were seen on sale in Suq Al-Shayoukh market. Bighead carp, *Arystichthys nobilis*, were imported by the Fisheries Department for culture in 2002, but were stolen, presumed eaten, during the looting of the recent conflict. No bighead carp were observed in the marshes.

Given the impact of the previous introductions, the collaborating academics advised that they were against any further introductions of new fish species. The 1995 FAO Code of

Conduct for Responsible Fisheries advises strong precaution before making any such introductions. No new introductions of non-native fish are anticipated under this program.

The fish program will instead promote the restoration of wild marshland stocks with the three highest values: the locally preferred, Barbus species, once common in the marshes, and the already proven silver and grass carp.

Fish Stock Assessment

Available FAO catch statistics for Iraqi fish production are plotted in Figures 4.2 and 4.3, as downloaded from the www.FishBase.org website. As is common with many countries, catches are only reported in aggregated species groups, not broken down by district, or gear type, and thus do not allow detailed stock assessment analysis. More detailed catch data were requested from the MOA Department of Fisheries for the districts including the marshes. This information is in principle available, but it was not provided in time for this report.

According to available information, total freshwater fish landings since 1950 have ranged between 5,000 and 30,000 tons (Figure 4.2). In the 1950s and 1960s, inland catches much exceeded marine. Marine catches peaked in 1970 to 1973, then declined subsequently, but have again exceeded inland catches in recent years since the drainage of the marshes.

Carp culture production is recorded since 1984 at between 2-5,000 tons per year. The culture industry has declined somewhat in recent years due to the high price of fish feed and the shortage of water in the catchment. The Department of Fisheries reported that they were instructed to restrict licenses for fish farms from 1996 to 2003 to save water.

Prior to the main period of marsh drainage from 1992, reported total inland fish catches had been in the range 10,000 to 18,000 tons (Figure 4.3). Between 1992 and 1997 catches increased, up to a peak of almost 23,000 tons in 1995. From 1998 to 2001, catches declined significantly to only 8,000 to 9,000 tons. This pattern is believed to demonstrate the increased dry season catches that were taken with the drying out of the marshes. In these years, much of the abundant catches were dried and ground up for fish meal production.

The figures above include the whole inland production for Iraq, including the areas outside the marsh (40 percent of the total in 1990 according to UNEP 2001). Having been sampled from landings at the major markets, however, the figures do not include either subsistence catches or any fish sold at secondary village fish markets or in rural areas ‘house to house’. Assuming these two factors more or less cancel out, the FAO data (Figure 4.3) are used as estimates of the total catches from the marshes.

As a rough indicator, healthy floodplain river systems produce catches in proportion to their high water flooded areas. Cowx and Welcomme (1998) suggested that large active floodplains should produce approximately 50-80 kilograms per hectare of fish per year. This average figure varies of course with the level of fishing effort. Floodplain river fisheries can become overexploited, but only at very high densities of fishermen. Even at high fishing levels, catches do not collapse completely, but instead shift over to a more depleted species composition as the larger, valuable fish types are fished out.

Table 4.1
Fish and Prawn Species Currently in Mesopotamian Marshes

Family	Scientific name	Common Name	Name in Iraqi Arabic	Origin	Maximum Size (cm)	Seen in Feb. '04	Migratory Behavior	Feeding Behavior
Bagridae	*Mystus pelusius*		Abu zumair	Native	50		Brackish	Carnivore
Clupeidae	*Tenualosa ilisha*	Hilsa shad	Sbour	Native	60		Anadromous	Planktivore
Cyprinidae	*Acanthobrama moselensis*		Samnan	Native	15	●	Blackfish	Omnivore
Cyprinidae	*Alburnus caeruleus*		Samnan	Native	15	●	Greyfish	Omnivore
Cyprinidae	*Aspius vorax*		Shalik	Native	60	●	Whitefish	Piscivore
Cyprinidae	*Barbus grypus*		Shabut	Native	90	● (2)	Whitefish	Omnivore
Cyprinidae	*Barbus luteus*		Hemery	Native	30	●	Greyfish	Omnivore
Cyprinidae	*Barbus sharpeyi*		Binni	Native	60	●	Greyfish	Herbivore
Cyprinidae	*Barbus xanthopterus*		Kattan	Native	90	● (1)	Whitefish	Carnivore
Cyprinidae	*Carassius carassius*	Crucian carp	Semek el vehebi	Accidentally introduced 1995	20	●	Greyfish	Omnivore
Cyprinidae	*Ctenopharyngodon idella*	Grass carp	Ushbi	Introduced 1985	70	●	Greyfish	Herbivore
Cyprinidae	*Cyprinus carpio*	Common carp	Carp	Introduced 1968	70	●	Greyfish	Omnivore
Cyprinidae	*Garra rufa*		Abu kraza	Native	20		Greyfish	Omnivore
Cyprinodontidae	*Aphanius dispar*		Batreik	Native	5	●	Brackish	Carnivore
Cyprinodontidae	*Aphanius mento*			Native	5		Brackish	Carnivore
Cyprinodontidae	*Aphanius sophiae*			Native	5		Brackish	Carnivore
Gobidae	*Boelophthalmus boddarti*	Mudskipper	Abu shalambo	Native	15		Brackish	Carnivore
Heteropneustidae	*Heteropneustes fossilis*	Stinging catfish	Abul hakim	Introduced	20		Blackfish	Omnivore
Mugilidae	*Liza abu*	Abu mullet	Quishni	Native	15	●	Greyfish	Herbivore
Penaeidae	*Metapenaeus affinis*	Prawn	Shahami	Native			Catadromous	Detritivore
Poeciliidae	Gambusia sp.	Mosquitofish		Introduced	5		Blackfish	Insectivore
Siluridae	*Silurus triostegus*		Juri	Native	70	●	Blackfish	Carnivore

In the Iraqi marshes, fishing effort levels are believed to be relatively low. Detailed data on the numbers of fishers are lacking but it is reported that fishing has always been far less important than agriculture, reed collecting and buffalo farming. The total population of the marshes before drainage has been estimated as between 350,000 and 500,000 (UNEP 2001), including men and women, old and young. Assuming that five percent of this number were actively engaged in fishing on a full-time equivalent basis, there may have about 20,000 fishers in the marshlands fishery at its peak. As an average, this translates to a pre-drainage fisherman density of 2.2 fishermen per km^2 (based on the conservative UNEP 2001 estimated pre-drainage flooded area of 8,926 km^2). This is similar to other floodplain fisheries around the world, but far below the fisherman densities seen in Bangladesh of up to 20 to 40 per km^2.

With annual catches of 12,000 to 15,000 tons per year corresponding to a catch per unit area per year of about 15 kilograms per hectare, the marshlands were apparently not overexploited prior to drainage, at least compared to a global sample of other floodplain river fisheries (Figure 4.4).

In the recent field visits, fishermen reported that current catch rates are about 10 times lower now than pre-drainage. Respondents claimed to catch between 150 and 400 kilograms per day prior to drainage, often being able to fill their boats with fish. One respondent from the upper Hammar marsh confirmed that he took catches of both *binni* and *kattan* 'longer than his arm'. Current catches ranged from 2-4 kilogram/day for some respondents up to 17-25 kilograms per day for others, nearly all of small introduced carp species or *juri* catfish.

Estimates of current fishing pressure are similar to before drainage, with both water levels and fisherman numbers decreasing in similar proportion. Department of Fisheries staff estimated that around 3000 fishers are now working in the marshes. This corresponds to a fisherman density of 2.3 per km^2 of the 1,297 km^2 water area estimated by UNEP (2001) for 2000. Flooded water area is higher now with the recent flooding, so fishing density levels may be lower than this now. Fishermen are certainly concentrated in a few small areas. High numbers of fishers were seen at the top of the north-south section of Prosperity River (over 70 canoes, mostly electro-fishing in about 20km^2 of water), even though catches were reportedly disappointing. Densities were also apparently high near Al Fahoud village on Abu Zarag marsh. Many newly flooded marshes had virtually no active fishing in February 2004. Fishers are also constrained to the edges of the marshes by their by simple technology and un-motorized canoes. Fishers in Hawizeh said they only fish the one kilometer reeded margin around the edge of the lake, with the open water in the middle of the lake being too rough for safe access. Large parts of the fish stock may thus be inaccessible to fishing at least until the shrinking of the waters in the dry season.

With no strong evidence of overfishing prior to drainage, the current low levels of production are believed to reflect the gross extraction of fish during the drying phase, and the following ecological factors:

- Deterioration of the hydraulic regime over the last 10-20 years (flattening of the flood pulse) decreasing the spawning stimuli for fish;

- Reduction of nutrients flowing into the system (lower silt deposition due to dams upstream slowing water flows);

- Decrease in water quality due to pollution and salinity of waters;

- Reduction in longitudinal connectivity of the river system (closed sluice gates and ineffective fish passes across main river channels preventing the spawning migrations of fish);

- Reduction in lateral connectivity of the river system (loss of floodplain habitats and reduction of access to remaining areas due to embankments and dikes); and

- Absence of natural spawning, feeding, nursery and sheltering habitats in new drainage canal structures.

As a result of these modifications to the system, fish stocks have changed from their original species composition, dominated by the valuable Barbus species with their more complex whitefish spawning strategies, to the lower value blackfish *juri* and introduced carp varieties. Even in Hawizeh marsh, where the most water remains, and where the Iran-Iraq war and the vicinity to the Iran border both restricted fishing in recent years, catches of the valued Barbus species are still minimal.

Finally, it should also be re-emphasized that catches are depressed at the current time due to the early flood phase of the floodplain cycle. In the short term, catches may be expected to increase after the flood, as the flood waters fall, and reach a peak in the dry season when fish will be larger and more concentrated, and as other gears become possible. In the longer term, catches may also be expected to increase each year, as the floodplain ecology becomes re-established and its natural productivity is restored.

Aquaculture

Historical records indicate Chinese carps were imported into Iraq in the 1960s, and the predictable breeding techniques using hypophysation were introduced in the 1970s. The planktivore silver carp (*Hypophthalmichthys molitrix*) and the macrophyte consuming grass carp (*Ctenopharyngodon idella*) have been grown in polyculture along with the common carp (*Cyprinus carpio*), often achieving a production of up to two tons per hectare per year. The peak freshwater aquaculture area in Iraq was estimated to be 7,500 hectares before the first Gulf War. Production peaked at approximately 14,000 MT/annum, though production data are scarce and much information is anecdotal. The current status of this industry is unknown, as it was concentrated in the area around Baghdad and could not be visited due to security reasons. Anecdotal information indicates that the present production is far below the peak. In fact, virtually no fish were being produced during the second Gulf War, and any verifiable current production has just recently restarted. It is clear that at least some fish are being produced, as some Iraqi silver and grass carp reach the Basra marketplace. But the tonnage coming south is small, making up roughly 10-20 percent of the grass and silver carps in the Basra fish market. There are a few hectares of extensive culture of Chinese carps near Basra, though their current production status is unknown.

Freshwater aquaculture of tilapia (*Oreochromis niloticus* or *O. spilurus*) has been introduced in neighboring Kuwait and Jordan. Tilapia have not, however, been introduced in the marshlands or in the aquaculture regions of Iraq, intentionally, nor is there any interest by the government sector in the introduction of these species.

The primary species cultured has been and continues to be common carp due to the ready availability of fingerlings, and to a lesser extent the grass and silver carps. The one government hatchery that hatched silver, grass and common carps, the Al Sowara Hatchery, is non-operational since the war. There are currently 9-10 operating private sector hatcheries near Babylon, Kut, and Baghdad that produce the grass and silver fingerlings, distributing advanced fingerlings to the south for ID 300 per fish. This price is hugely inflated because there is no competition; the government hatchery produced fingerlings for ID 7-9 per fingerling.

The technical team visited an area near Al-Medinah that was growing fish. This was a recent phenomenon: an extended family had developed ponds for aquaculture after the most recent war, and purchased grass, silver and common carp fingerlings from the hatchery for polyculture. They had indicated that they could not have engaged in this kind of enterprise under the previous regime, as all water had to flow onward under governmental direction, and none could be kept in ponds. However, they did not abide by this directive and had been growing fish for the past three years. They were quite pleased with their evolving technologies and were happy with the returns. One fish farmer said that he had achieved gross revenues of ID 4,000,000 last year with his five ponds that totaled just over one hectare of culture area (almost two tons per hectare per year).

The technology utilized is extensive: the relatively shallow pond structures are dried to cracked soil, fertilized with cattle manures, filled by a low head pump from an adjacent canal, and the water cultured to produce a zooplankton bloom. The fingerlings are then stocked at various densities ranging from 500-750 per hectare, grown for the spring, summer and fall, and harvested in November and December. Some of the family group stocked fingerlings with the larger fish in the pond and selectively harvested the larger fish with cast nets as the market demanded. These ponds would not have a time of drying in the winter, which could cause water quality and disease problems in the future. Pond gate structures were non-existent. This group was very upbeat about the idea of aquaculture, refining their technology within their family group continually.

The Future of Aquaculture in Iraq

Enterprise Development. Every group of people we spoke with, without exception, was interested in growing fish in terrestrial based agronomic systems. There is no question that this enterprise should be supported at all levels. The people desire more fish to eat. Any scaled fish is consumed, especially in the south. All scaled fish command premium market prices; and aquaculture has the potential to create thousands of jobs. Fish culture could be a win-win scenario for all involved, as well as the adjacent communities. Product could be transported to the larger cities and compete effectively with imported Iranian fish. It is likely that tribal/community-based aquaculture will have a greater chance of success than private ownership in the marshlands.

There are two tracks this development should take: the polyculture of carp species, and the culture of *Barbus.* The technology currently exists within the country for polyculture and spawning of the Chinese Carps, though significant gains in production could be realized by refinements in both culture and spawning technologies. The *Barbus spp.* however have not been cultured successfully. Longer term applied research programs should focus on closing the technology gap of *Barbus,* particularly *B. sharpeyi* and *B. xanthopterus,* to provide fingerlings for production, developing supplemental feeding protocols with quality feed, and encouraging private sector development of these high value species. Any production of *Barbus* fingerlings can also be designated for stocking into the marshlands.

Finally, a third track could be developed in the future for the Marsh Arabs: a lower technology such as that which the Chinese utilize, integration of, for example, ducks and fish in smaller ponds.

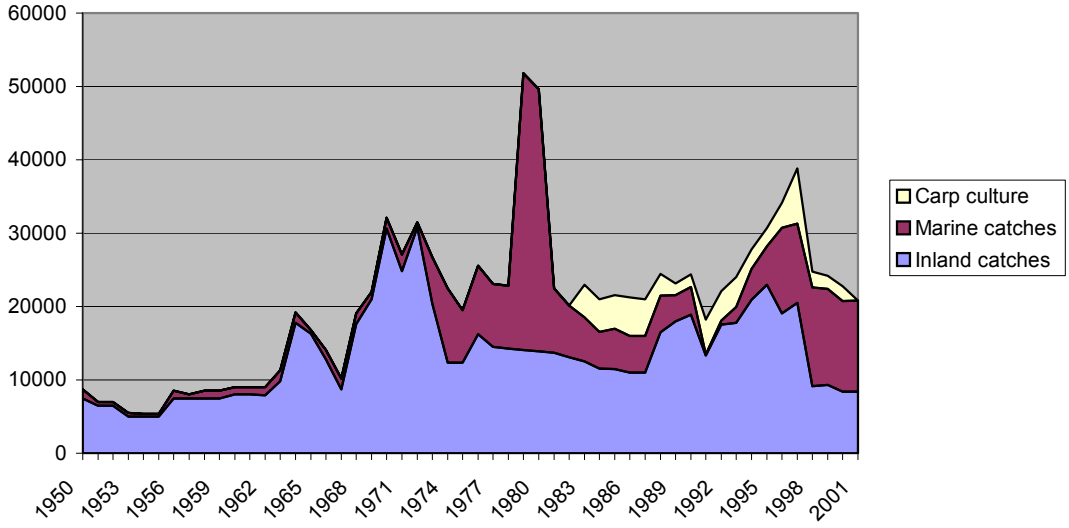
Restoration. Additionally, the marshlands require immediate mitigation and restoration of fish stocks. The rapid reflooding over the past five months has caused the spawning of less desirable asynchronous spawners such as the Crucean Carp and the Common Carp. The low value Silurid catfish is dominating many marshland fisheries. The premium priced and most desired fish, those of the *Barbus* genus, are infrequent or non-existent in the fishery. They are synchronous spawners, and as such have not had a chance to spawn this year. Also, their natural fecundity is far lower than the less desirable species. The fishery is out of synch because of this rapid wetland expansion, and requires immediate action to mitigate this population swing and to restore a more balanced fishery. The fastest and most effective manner in which to accomplish this objective is to spawn the premium *Barbus* species and release them into the wild as advanced fingerlings.

Fish Trade and Marketing

Fish marketing and pricing information was gathered from fishermen, local village fish markets and larger city markets. Information on fish sources was obtained from the city markets.

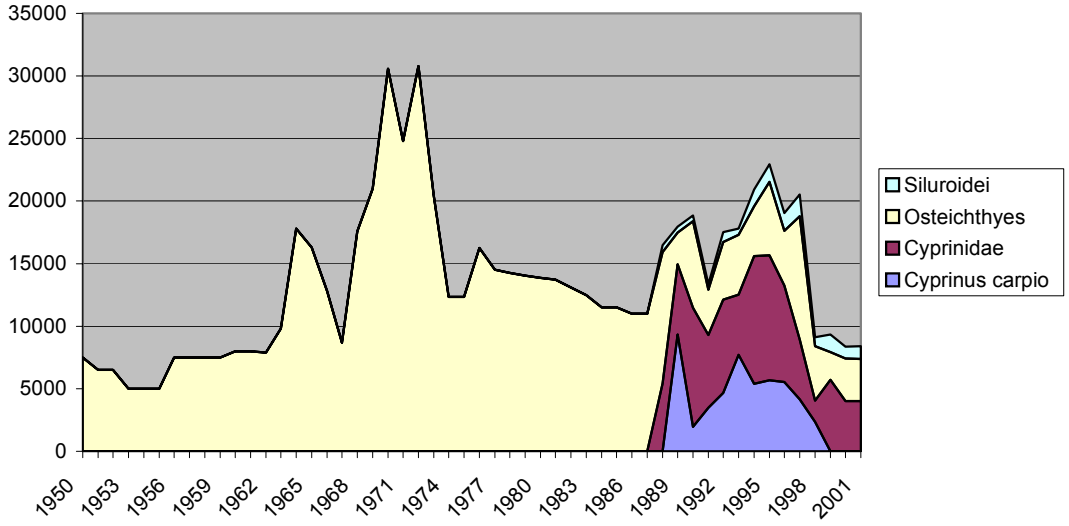
The Basra fish market had the largest selection of fish, as would be expected. They had marine as well as freshwater species available. Our primary interest was the fresh and brackish water species that are from the marshlands and adjacent water bodies.

Figure 4.2
Total Reported Fish Production in Tons from Freshwater and Marine Capture Fisheries and from Carp Culture (1950 to 2001)



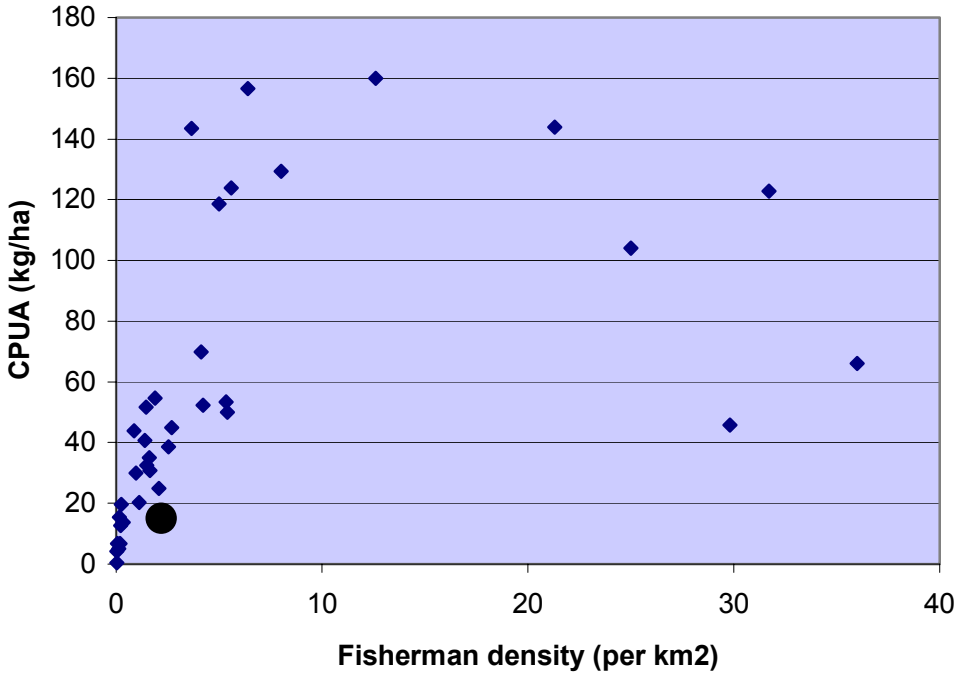
Source: FAO via FishBase

Figure 4.3
Total Reported Freshwater Fish Catches in Tons by Species Group (1950 to 2001)



Source: FAO via FishBase

Figure 4.4
Total Annual Catches per Unit Area (High Water Flooded Area) versus Fishermen Density for Tropical And Sub-Temperate Floodplain River Fisheries from Africa, Asia And Latin America



Comment: The approximate position of the Iraq floodplains is indicated by the large circle.
Source: Halls et al. Unpublished

These species include:

Common Name	Latin Name	Length Range (cm.)	Price (ID\kg.)
Silver Carp	*Hypophthalmychthys molitrix*	25-40	1500-2000
Grass Carp	*Ctenopharyngodon idella*	30-50	3500
Common Carp	*Cyprinus carpio*	10-40	2500
Bunni	*Barbus sharpeyi*	20-35	6000
Shaboot	*Barbus grypus*	30-60	2000
Qattan	*Barbus xanthopterus*	20-60	6500
Himri	*Barbus luteus*	5-15	1000
Sheliq	*Aspius vorax*	15-45	1500-2000
Kishni	*Liza abu*	10-15	500
Jerri	*Silurus triostegus*	20-60	500
Crucean Carp	*Carassius carassius*	15-20	1500

More than half of the fish represented in the market were silver carp, common carp and crucean carp. Most silver, grass and common carp were imported from farms in Iran. A

small percentage, perhaps 10-20 percent, came from Iraqi fish farms south of Baghdad. Fish yield from the Shatt Al-Basra and Shatt al-Arab are low and considered “rare”. Most domestic fish yield represented in the market came from the Qarmat-Ali River and the Tigris/Euphrates rivers in the Al-Qurna area. The Silurid catfish are rarely marketed in the south because no local will eat them, as they have no scales. They are utilized for fishmeal, or in the case of larger sizes, transported to Baghdad and sold there, where some ethnic groups consume them. The primary source of the high value Bunni, especially the large size fish, was from Tharthar Lake north of Baghdad. A secondary source was from the river systems near Al-Amara. A few marine migratory (anadromous) species are caught in the Shatt al-Arab river and the Shatt al-Basra canal, and were “rare” in the marketplace. These include the *Sbour* (hilsa shad, *Tenualosa ilisha*), *beiah* (mullet *Liza subviridis*) and *Shanag* (yellow fin sea bream, *Acanthopagrus latus*).

The Suq Al-Shayoukh fish market was also surveyed. Over 70 percent of the fish represented were *Carassius carassius*, in the 15-25 centimeter range. Other species were represented, including *himri*, *bunni*, common carp, silver carp, grass carp and *kishni*. Prices were similar to the Basra market.

At the Al-Chibayish fish market, over 50 percent of the fish represented were common carp and crucean carp. Sizes were not seen. Prices were similar to the Basra market:

Fish Common Name	Market Price (ID\kg.)
Grass carp	3000
Common carp	2500
Common carp (small sizes)	500
Himri	1500
Kishni	1500
Crucean carp	1500

Along the Prosperity River, over 50 percent of the catch was silurid catfish, *juri*. These received a very low price of ID 250/kilogram, and were shipped entirely to Baghdad.

Fishery Management

National regulations for fishing were introduced with the Fisheries Act of 1976 and include the following:

- Closed seasons for freshwater fish capture and sale:
    - Lower (southern) waters 15 February – 15 April
    - Middle waters 1 April – 1 June
    - Upper (northern) waters 1 June – 1 July
- Minimum mesh size of 5 centimeter knot-to-knot (10 centimeter ‘stretched’)
- For all nets (gill nets and seine nets, trawl nets, bag nets etc)

- No import or sale of smaller mesh sized nets
- Minimum legal landing sizes (total fish lengths) for:

    - *Barbus sharpeyi* (*bunni*) 30 centimeters
    - *Barbus xanthopterus* (*kattan*) 45 centimeters
    - *Barbus grypus* (*shabut*) 45 centimeters

- No fishing in river channels from five kilometers upstream to three kilometers downstream of dams and/or fish passes or ladders.

The closed seasons and the minimum legal mesh and fish sizes were estimated as appropriate on the mean sizes at maturity of the Barbus fish species, as determined by Iraqi research programs. The staggered two-month closed seasons were designed to protect spawning of different fish species across the three geographic divisions of the country. The different seasons reflect differences in water temperatures in the three zones and the main spawning times of the different species. The Southern closed season including the Mesopotamian marshes has just started to coincide with the normal start of the flood season (Figure 1).

These national government rules for inland fishing are all sensible and appear to be set at about the optimum levels for the priority Barbus species. Rules were reportedly fairly well enforced up until before the last war. On occasions, government enforcement agencies would confiscate catches, boats and/or gears and sell them in the market. Enforcement of rules is now extremely limited at this time of hardship and absence of government authority. Even before the war, one village leader admitted that perhaps only 80 percent of fishing was fully within the rules, another suggested that most illegal fishing occurred at night.

Within the marsh society, fishing is also partly controlled by the tribal leaders. Access to fishing grounds is restricted to members of the tribe. Within a tribe, though, the fishery operates as a largely open access resource. With plenty of water for most of the year, fishers just agree among themselves, who will fish where and how. Given the recent problems, several tribal leaders have been attempting to prohibit poison fishing but this is harder now. Enforcement is by local agreement and by refusing to allow offenders to sell their fish in the markets.

Appendix 1
References

Cowx, I.G. and R.L. Welcomme, 1998. Rehabilitation of rivers for fish. Food and Agriculture Organization and Fishing News Books, Blackwell Science Ltd.

Halls, A.S., Abeyasekera, S., Burn, R.W. and Welcomme, R., L., (Unpublished paper submitted 2003 to Fisheries Research). The relationship between multi-species catch and effort: among fishery comparisons.

Hoggarth, D.D., S. Koeshendrajana, M. Aeron-Thomas, C. Garaway, A.S. Halls, Z. Nasution, Samuel, and A. Sarnita. In press. An integrated assessment of Indonesian river fishery reserves; Part 1 – Introduction and study design; Part 2 – Institutional analyses; Part 3 – Biological studies; Part 4 – Socio-economic studies and the distribution of fisheries costs and benefits. Indonesian Journal of Fisheries Research.

Salim, S. M., 1962. Marsh Dwellers of the Euphrates Delta. The Athlone Press, University of London.

Sufian K. Al Nasiri and Ayad H. Dawood. 1991. The Biology of Reproduction of Common Carp in Hor Al-Hammar, Southern Iraq. Iraqi Journal of Science. Volume 32, Number 2.

Thesiger, Wilfred. 1964. The Marsh Arabs. Longmans Green. Penguin edition. 1980.

Partow, H. 2001. The Mesopotamian Marshlands: Demise of an Ecosystem. Early Warning and Assessment Technical Report, UNEP/DEWA/TR.01-3 Rev. 1. Division of Early Warning and Assessment. United Nations Environment Program. Nairobi, Kenya. 46pp.

Welcomme, R.L. 1985. River Fisheries. FAO Fisheries Technical Paper. 262. UN FAO, Rome.

Welcomme, R.L. 2001. Inland fisheries ecology and management. Food and Agriculture Organization and Fishing News Books, Blackwell Science Ltd.

Appendix 2
Fishing Systems Team Field Visit Locations

Field interviews were held with fishers, fish farmers, village leaders and elders in the following locations. With up to ten members of the team in the field on some days, the names of the many individual respondents are not listed here.

Monday 16 February 2004 – Hawizeh Marsh
Abu Knam village,
Abu Warid marsh (NW edge of main Hawizeh marsh)

Tuesday 17 February 2004 – Prosperity River
Sakricha village,
Fishers at Al-Salam Bridge,
Al Qurna (confluence of rivers)

Wednesday 18 February 2004 – Western Central Marsh
Abu Zarag marsh, culvert fish traps (north of boundary road, part way to Al Islah)
Abu Zarag marsh, Al Fahoud village, south of boundary road
Karma Beni Saad Bridge with sluice gates and derelict fish pass
Kermashiya marsh
Suq-ash-Shuyuk market

Thursday 19 February 2004 – Hammar Marsh (Al-Chibayish)
Al-Chibayish village – meeting with council of sheikhs in *mudhif*
Al-Chibayish village (E part) – second meeting in *mudhif* of Saeed Kasem
Fish farm near Al-Medinah – Mr Abu Jaffar (Subri), farm owners

Friday 20 February 2004 – Basra market (Sumaya Mohamed only)
Collection of fish price and origin data

Saturday 21 February 2004 – Upper Hammar Marsh
Al Ounas village (via Umm Nachlah canal) (30° 51' 48.6" N, 46° 40' 40.6" E)

ACTION PLAN 4

SUPPORT CAPTURE FISHING AND FISH FARMING

The recommendations of UNEP (2001) to promote an international agreement for the sharing of Tigris and Euphrates waters, restore and maintain the flooding regime, improve water quality, and remove river engineering works where possible would all contribute significantly to the potential recovery and production of the Mesopotamian fish stocks.

Keeping in mind the preference of some communities to keep some drained lands dry for agriculture and the limited availability of water for reflooding, the maximum fish production opportunities will be achieved by reflooding the maximum possible area reasonable. Recovery of the fish stocks will be further enhanced by keeping sluice gates open whenever possible, within flood control and agricultural constraints, to maintain fish migration routes and spawning stimuli. The natural diversity and productivity of the fishery will surely take some years to return, but there are encouraging signs that it can recover.

Objective

The objective of the fishing and fishing system activity is to increase the speed of recovery of the priority *Barbus* fish populations and encourage the sustainable management of the recovering fish stocks.

Tasks

The proposed tasks are:

1. Produce *Barbus Spp.* for Stocking into the Marshlands
2. Co-manage Activities with Fishermen to Protect Local Stocks
3. Develop Aquaculture Enterprises
4. Monitor Fishing Systems

Task 1: Produce *Barbus Spp.* for Stocking into the Marshlands

The recent reflooding of the marshlands has caused the less desirable asynchronous spawners such as the crucean and common carps to aggressively reproduce. The high value, but depleted, *Barbus* species have not reproduced yet, as they are annual spawners and have not had the opportunity and are naturally less fecund. The marshland fishery would be greatly enhanced and more balanced with more of the prime species. Task 1 utilizes available labor and upgraded existing facilities, combined with new chemotherapeutants and technologies, to artificially spawn the *Barbus sharpeyi* for the first time.

Objective

The objective of Task 1 is to immediately culture high-value and highly prized *Barbus* fingerlings through advanced fingerling stage and to stock the advanced fingerlings at select sites in the marshlands to boost overall fishing.

Implementation Steps

The first five implementation steps are to be completed in March - April 2004. The last two are to be completed by August 2004.

1. Secure Broodstock of *Barbus sharpeyi* and Transport Them to the Marine Science Center for Spawning

Broodstock of this high value fish will have to be purchased from local fishermen from the Qurna area. University of Basra and Marine Science Center personnel will make arrangements and agreements with the local fishermen for the purchase of these fish. Three trips to the Qurna area per week for a two week period are forecasted to accomplish this, with 12 days required of Iraqi Team personnel. Two hundred kilogram of fish will be targeted. When spawned, these will produce over five million fry. Two million advanced fingerlings are targeted for release this year.

2. Construct a Fish Transport Tank for Broodstock

The Marine Science Center requires a two to three cubic meter tank capable of transporting broodstock from Qurna area to Basra. We have obtained two local bids for the immediate production of this tank.

3. Upgrade and Strengthen Existing Hatchery Facilities at the Marine Science Center

After decades of neglect and bombings during both Gulf Wars, the University of Basra is getting by as best as it can. The Marine Science Center (MSC) has hatchery facilities, though they have been cobbled together with available parts and materials. A small amount of equipment should be purchased and shipped immediately and the system upgraded accordingly for this year's spawning activities. In addition to the transport tank indicated in

Activity 2, the MSC requires: two low head 4" electrical water pumps; a PSA oxygen generator and related compressor, with ceramic diffuser stones and tubing; a 6000 btu immersion water chiller system; supplemental feed for early life stag fish; dissolved oxygen meter, pH meter, salinity refractometer; ammonia, nitrite and nitrate reagents; secchi disk; plankton sample nets; laptop computer; fish scale; *Artemi;,* and spectrophotometer.

4. Select the Site for Fish Stocking

The fishing team suggested that three to six sites be selected for advanced fingerling release during the summer. These sites should be based not only on water quality and other ecological criteria, but also on socioeconomic issues.

This task has three components:

- Literature survey and field observations of life history behavior of *Barbus* species. Opportunistic collection of fish length, maturity and age data during field visits for fishery monitoring survey, to investigate *Barbus* spawning, nursery and feeding areas, habitats and seasons.

- Spatial analysis of marshlands hydrology (river channel connectivity, compartmentalization, and water flows) and ecology (water quality and habitat diversity) to produce a marshlands fishing waters map in collaboration with the Integrated Marshland Management teams.

- Combining information from the marshlands fishing waters map and the fishing baseline survey, provide guidance on the release of spawned *Barbus* fingerlings (August 2004) to maximize fish survival, migration and social benefits.

5. Introduce Latest Spawning Technologies, Hormones, Anesthetic Agents, Train Key Personnel in Latest Spawning, Broodstock Management, and Early Life Stage Techniques and Spawn *B. sharpeyi*

Because of its isolation, Iraq is behind in most advanced fish culture and spawning activities. To achieve the highest probability of success in spawning a species that has not yet been successfully spawned and cultured through its early life stages, the latest hormone analogues and anesthetic agents should be introduced, and the personnel trained in their use. Concurrent with this should be technology transfer and capacity building of key personnel in latest early life stage and broodstock management techniques.

6. Culture the *Barbus* Larvae To Advanced Fingerling Stage. Complete Immediate, On-Site Applied Research on Early Life Stages of *Barbus sharpeyi*

The fish fry will be cultured to advanced fingerling stage in the ponds at the University of Basra Marine Science Center. Concurrent with this will be feeding trials and refinements in early life stage culture techniques of this species, including application of cultured live feed and use of appropriate artificial feeds. This applied research will be carried out by University of Basra and Marine Science Center personnel.

7. Stock the Advanced Fingerling Fish in the Four Prescribed Areas

When the fish have grown to 10-15 centimeters, they will be stocked in the marshlands based on select criteria determined in step 4.

Technical Assistance

The technical expertise required to implement Task 1 include:

- Fish Farming Expert (Expatriate) to develop equipment specifications for transport to Basra, introduce spawning technologies – 30 days
- Fisheries Ecology Expert (Expatriate) to collaborate with aquaculture team for site selection of fish stocking sites (Activity 4) – 10 days
- GIS Specialist (Expatriate or Iraqi) to prepare marshlands fishing waters map under Step 4 – 10 days
- Fish production Experts (Iraqis) to oversee collection of broodstock, supervise construction of the fish tank, select the site for fish stocking, support spawning efforts, culture the stock to advanced fingerling stage, and complete the stocking as a technical pool – 450 days

Special Equipment Requirements

Special purchases and rentals for the task include:

- Four cages at $100 each, 200 kg of broodstock totaling $1500, and truck rental at $50/day;
- Fish transport tank construction materials;
- Two low head 4” electrical water pumps; a PSA oxygen generator and related compressor, with ceramic diffuser stones and tubing; a 6000 btu immersion water chiller system; supplemental feed for early life stag fish; dissolved oxygen meter, pH meter, salinity refractometer; ammonia, nitrite and nitrate reagents; secchi disk; plankton sample nets; laptop computer; fish scale; *Artemia;* and spectrophotometer;
- Hormones and anesthetic agents; and
- Truck rental for transporting advanced fingerlings to distribution points

Deliverables

Deliverables include:

- Two hundred kilograms of *Barbus sharpeyi*, averaging 2.0 kg each

- Fish transport tank constructed for program use
- Three to six appropriate sites identified for the stocking of *Barbus sharpeyi* advanced fingerlings, illustrated on a detailed fishing waters map
- One hands-on training programs in fish spawning, early life stages, and broodstock management, scheduled tentatively for April 2004
- Cultured fish developing from the fry to advanced fingerling stages
- Approximately 2 million advanced fingerlings of *Barbus sharpeyi* stocked into marshlands at selected sites

Proposed cost: $75,000

Task 2: Co-manage Activities with Fishermen to Protect Local Stocks

The national rules for fishing, designed mainly to protect the Barbus fish species, are currently almost un-enforced within the marshes. Even after the June 31 hand-over of power to the Iraqi government, it is likely that mesh size and species size limits will be hard for government to enforce in most remote marsh communities. Such rules may also be sub-optimal for the exploitation of other, now-dominant species in the marshes. This activity would combine the skills, knowledge and capacities of the Department of Fisheries authorities and the local fishers and village chiefs to develop locally appropriate rules for managing fishing in 12 to 15 villages spread around the marshes.

Such rules are likely to focus on dry season refuges and migration routes. Indonesian river fish stocks that were partly protected over the dry season in community-managed reserves were 5 to 21 times more abundant, comprised up to 31 more species and were five to six times larger by weight, than in villages that used poison-fishing in the dry season. Discussions with villagers would attempt to determine the main spawning and dry season survival locations of the *Barbus* species and promote conservative actions in a selection of such areas. While protecting some areas, attention would also be paid to keeping open the maximum possible area of fishing grounds to promote catches and fishing livelihoods. Recognizing the constraints imposed by the high levels of poverty in some villages, emphasis would also be paid to the trade-offs between long term benefits and short term sacrifices.

This activity would be coordinated with the release of fish from Task 1, to specifically encourage the wise exploitation of the stocked fish in their release areas. Fishing communities may be encouraged to cooperate with the program by the lure of possible stocking of much larger numbers of fish in 2005-2007, especially for the best collaborating villages.

Objectives

The objectives of Task 2 are to:

- Understand and use the key ecological and social features of the resource to determine optimal management sub-catchments and divisions;
- Develop village-level fishery management rules promoting long term sustainability of stocked and existing fish species within a sample of 12-15 fishing villages;
- Ensure the dry season survival and unhindered spawning migrations of priority species by restricting threatening gears (poison fishing, barrier fishing etc) at key times and places, as determined by local knowledge; and
- Determine the key features of villages developing promising local management rules, to guide further development in the 2005-2007 program.

Implementation Steps

1. From existing literature and field visits, document and map original and current distribution of tribal boundaries, and existence of conflicts over fishery resources in all three marsh areas.

2. Training on river fisheries co-management, roles and responsibilities, for Ministry and university staff.

3. Collaborate with Iraq Fisheries Department and others to assess the capacities of different fishery stakeholders and relationships between them, and agree the potential management roles and responsibilities for fishery management in the marshlands.

4. Develop MOU with Fisheries Department authorizing villages to develop and enforce local fishery management rules within tribal areas.

5. Combining the tribal areas map with the marshlands fishing waters map produced in Task 1, determine likely sites for most effective management of blackfish stocks and for necessary maintenance of whitefish migrations. Select a subset of 12-15 villages for field promotion of local management arrangements.

6. Design strategy and field program for facilitating development and enforcement of new rules.

7. Coinciding with release of fingerlings in August, and with AMAR facilitators, hold meetings in selected villages to determine existing fishing rules and extent of enforcement. Facilitate discussions of sustainable management of introduced fish to encourage long term re-establishment of fish stocks. As appropriate, also discuss other problems and issues such as conflicts over access to prime fishing grounds, either within or between-tribes, marketing of catches etc, to assist economic recovery. Encourage participation with social activities.

8. Prepare simple summary management plans for fishing in each village, describing the agreements reached, including strategies for participatory monitoring and enforcement.

9. Assist uptake by announcing plans, and publicizing in villages and surroundings, e.g. using simple posters and/or leaflets.

10. Collaborate with district fisheries officers and village fishers in monitoring enforcement of agreed rules.

11. Report on the accomplishments of the program and recommend most cooperative villages as candidates for future stocking in 2005-2007 program.

Immediate Steps (First three months)

The key initial steps for the task are to initiate the surveying and mapping of village boundaries and to prepare for a training session and stakeholder capacity assessment in

late April/early May. After these activities, there is a three month period during which the MOU authorizing the village level activities may be approved by the Ministry. The main implementation of activities then does not begin until August, coinciding with the stocking of the *binni* fingerlings.

Technical Assistance

The following technical expertise is required to implement Task 2:

- Floodplain river fisheries expert to guide ecological aspects and lead task – 24 days
- GIS/mapping expert to prepare overlay maps of hydrological and tribal features – 10 days
- Institutional/social development expert / facilitator to lead village discussions – 25 days
- Fisheries ecologists – 27 days
- Social scientist – 42 days
- AMAR staff to facilitate village interactions and assist with tribal boundaries mapping – 20 days

Deliverables

Deliverables for Task 2 include:

- Training course notes
- Maps of historical and current tribal boundaries
- An assessment of stakeholder management capacity and MOU with the Department of Fisheries allocating specific responsibilities to villages in project sites
- Approved village fishery co-management plans in 12-15 villages
- Report on effectiveness of program, providing guidance for future stocking and management activities

Proposed cost: $65,000

Task 3: Develop Aquaculture Enterprises

The Marsh Arabs have undergone a seminal shift in their way of living, from reed based floating to terrestrial based habitation. This has resulted in an agronomic model that includes, even embraces, terrestrial agriculture. The growth of wheat, sheep and cows are now seen as a standard part of their culture. We were impressed in every village we visited, without exception, by the enthusiasm expressed for the concept of terrestrial based culture of fish. The Model Fish Farm will culture Chinese carps initially, as the culture technologies and the fingerlings of these species are readily available within the country. The *Barbus* species should be cultured in this system as they become available and protocol is developed for their culture.

Objective

The objective of Task 3 is to design and construct a model fish farm, establish appropriate culture technology given local infrastructure capabilities, train selected Iraqi personnel in culture techniques, and produce fish for local and regional consumption, as well as for regional marketing.

Implementation Steps

1. Design a five hectare Model Fish Farm

A pond based, extensive aquaculture system will be designed for immediate construction. Design issues involve site layout, dike cross sections, inflow and outfall gate structures, catch basins, water delivery and effluent canal systems. A residence/office and storeroom will be required, and will be included in the design. The products include complete design documentation, including blueprints; CADD renditions of the proposed facility, including isometrics; complete equipment specifications and lists; detailed excavation requirements; piping diagrams and planview layouts.

2. Select an appropriate site for the Model Fish Farm

A final site will be selected, most likely near Al-Chibayish, for the Model Fish Farm, and necessary permitting will be secured from the Department of Fisheries. The product includes an appropriate site for the construction of the Model Fish Farm.

3. Construct the Model Fish Farm near Al-Chibayish

Equipment will be sourced in Iraq. The physical structure will be contracted by the University personnel. Direct supervision of the construction will be by University of Basra personnel and by the expatriate expert.

4. Train Iraqi Personnel in Fish Culture Techniques

A course in extensive and semi-intensive fish culture techniques will be offered to select Iraqi fish culturists. This program, to be offered by Dr. Woiwode in country, will transfer

technology specific to the requirements of the model fish farm to be constructed near Al-Chibayish. Appropriate publications will be developed for course participants, including specific fish culture techniques in Arabic. The course will be hands on whenever appropriate.

Technical Assistance

- Fish Farm Expert (Expatriate) to oversee the design and construction of the farm and to conduct training in fish culture techniques, as appropriate – 60 days

- Fishing experts (Iraqis) to oversee implementation and monitor progress and impact in a technical pool – 200 days

Deliverable

The deliverable of Task 3 is the design and construction of a state-of-the-art model fish farm near Al-Chibayish, and the training of appropriate Iraqi personnel for the successful operation of this facility.

Proposed cost: $125,000

Task 4: Monitor Fishing Systems

Given the ecological and physical complexity of floodplain river systems and the complex interactions between different stakeholders in specific local situations, the impact of different management interventions are very hard to predict. In the unusual situation of the Iraq marshes, where the waters have been almost completely drained, and are now being partly reflooded, the uncertainties are even greater. Where knowledge of the fishery is limited as in this case (and most others), an adaptive management strategy is recommended to guide future actions according to analyses of the results achieved in a series of management cycles.

The 1995 FAO Code of Conduct for Responsible Fisheries also requires states to adopt a precautionary approach to management. This involves setting targets and initial management strategies on the basis of the 'best available knowledge', but also collecting appropriate data to confirm that goals are being achieved and to guide future adjustments to management strategies as required.

The Ministry of Agriculture's Department of Fisheries has collected catch data for the marsh lands for many years, but not at a spatial resolution or in adequate detail to assess the impacts of this program or the other factors affecting outcomes. This task would address these constraints to knowledge about the fish populations and fishing activities in the marshes. Other data likely to affect fishery productivity (water quality, quantity, and timing) are being collected under the Integrated Marshland Management activity and should be integrated into an annual analysis of the status of the fishery.

Objectives

The objectives of Task 4 are to:

- Undertake a baseline fishing survey to assess the state of fish stocks and the levels of fishing in 2004, prior to the initiation of marsh restoration efforts;
- Initiate a long term monitoring program to provide data to assess the effectiveness of stocking and other initiatives and to guide future management actions; and
- Develop necessary skills and capacity within the Fisheries Department and the University of Basra for the future stock assessment and management of the marshlands fishery.

Implementation Steps

1. Frame survey of fishing activities (numbers of fishers and fishing boats by village, and their fishing gear use, fishing waters, catch landing places and marketing routes by season), to guide sample design and enable raised estimation of total catches. To be integrated with existing Department of Fisheries data, and repeated annually in future years, as the fishery is re-established, and two-three yearly thereafter.

2. Train Department of Fisheries and University of Basra collaborators in fishery management, stock assessment and catch/effort survey methodologies.

3. Thematic mapping of fishing locations and fish marketing routes, as derived from frame survey.

4. Design fisheries data collection program for the marshlands (sampling frequencies, locations etc), ensuring capacity to provide necessary management variables at minimum time and cost, and incorporating existing Department of Fisheries catch data to enable historical comparisons where possible. Program may include both market-based sampling and household/respondent sampling depending on relative importance of different marketing routes, as determined by frame survey. Prepare data collection forms.

5. Develop and test simple database system (e.g. based on FAO *ArtFish* or another existing database system) for entry and storage of data.

6. Provide training in use of database for data entry, backups and reporting.

7. Develop MOU with Department of Fisheries and University of Basra, agreeing roles and responsibilities of partners in monitoring program.

8. Purchase sampling equipment (length frequency measuring boards, balances, envelopes for scales).

9. Collect twice-monthly samples of catch and effort data by area, gear type, habitat and species. To be summarized on a monthly basis, and continued at selected landing sites in future.

10. Enter data into database, check accuracy and report.

11. Analyze initial results, providing feedback on likely impacts of stocking and co-management initiatives, and guidance on future management plans.

Immediate Steps (First three months)

The key initial step for the task is to begin the frame survey to enable the main survey to be designed and initiated as soon as possible. The frame survey should collect census information from all villages in the marshlands area, on numbers of fishermen, boats, fishing gears, and other information. A data collection form and detailed specification of requirements has been provided. This activity may be carried out alongside the survey and mapping of tribal boundaries. The forms follow.

Technical Assistance

The following technical experts are required to implement Task 4:

- Floodplain river fisheries expert (Expatriate) to provide training, guide development of monitoring program and analyze and report on task outcomes – 33 days

- Fisheries database expert to design and develop database and provide training in use (Expatriate) – 25 days

- GIS Specialist to map frame survey data and assist design of data collection program – 12 days

- Fisheries Ecologist (Iraqi) to collaborate in design aspects, supervise fieldwork, and report on data collected – 87 days

- Two fieldwork assistants (Iraqis) to undertake frame survey and catch/effort surveys – 360 days (180 days each)

- Data entry clerk (Iraqi) – 140 days

Deliverables

Deliverables for Task 4 include the following:

- Training course notes

- Frame survey data and thematic map of fishing activities

- Database of fisheries data for at least 6 months (July to December 2004)

- Report on status of fishery in 2004, including outcome of initial fish stocking, and providing guidance to any future stocking and management activities.

Proposed Cost: $90,000

Frame Survey of Fishing Activities

The following form should be used to collect 'frame survey' data on the structure of fishing activities in each village in the marshlands. A frame survey aims to provide an inventory (census) of the home ports (villages) of fishers, the numbers and types of fishing units (boats and gears) at each home port, and their main fishing waters and landing places. Secondary data are required on the usual landing times of fishers; any days which are usually and regularly *not* spent fishing (e.g. religious days, weekends); the seasonality of gear use and catches, and the marketing of fish. On compilation, the frame survey data will be combined with the marshlands hydrological maps to guide the design of the fishery monitoring program to select villages and landing sites for sampling and to enable the raising of catch/effort sampling data to the total catches of the marshlands.

A separate document should be used for each home port (village with active fishers) in the marshes. The objective is to compile a list of the names of all persons actively involved in fishing, and their ownership of fishing boats and gears. Methods for approaching and interviewing fishers should be developed in discussion with the village chiefs and/or local authorities. Prior to full field use, the form should be ***field tested*** by the interviewers and any necessary changes made. For most villages, it is expected that the ***village chiefs*** will be able to list the names of most fishers in their village, perhaps with some information on gear ownership and fishing and landing sites. Further enquiries in the village may then be made to determine the gear ownership and use of listed fishers within the time available. Where a village requires more than one form to list all the fishers, this should be indicated in the 'Page __ of __' box.

For ***boats***, the number of active (i.e. not broken or derelict) vessels owned in each type and length category should be recorded. Vessels made of different materials should be distinguished (plank-built, dugout, fiberglass etc), as should the presence of engines where used. The ***fishing gears*** used should be recorded with an 'X' in the relevant columns. Where possible, the length of gill nets or seines, or the numbers of bag nets or other gears owned should be recorded. This information will show any significant differences between the fishing activities and intensities in the different villages.

Care should be taken to distinguish between gears used ***concurrently*** (both fished on the same day) and those fished ***sequentially*** (e.g. on alternating days or in different seasons, but never on the *same* day). This ensures that the catch sampling program can be designed to correctly allocate landings to either a single gear type, or to a combined gear category, as appropriate. Where gears are used concurrently (on the same day) the two (or more) gears should be entered on a single line. Gears used sequentially (on different days) should be entered on separate lines.

Two to three letter ***codes*** should be developed and used for all boat types,

fishing waters and landing sites. Once selected, these should be used ***consistently*** and ***exclusively*** (i.e. the same code, and only that code should always be used to identify that item). Information on *fishing waters* and ***landing sites*** will be particularly important for dividing the marshlands into appropriate sub-catchments for the subsequent catch/effort surveys. As the frame survey progresses, a series of large scale maps should be developed indicating the positions of the home ports sampled along with the waters fished and the landing sites (as coded), relative to any recognizable landmarks (roads, bridges, sluice gates etc).

As far as possible, the frame survey should aim to provide a ***complete enumeration*** (census) of the fishing activities in the marshes, i.e. to list the fishers, boats and gears in all villages in and around the marshes that are actively engaged in fishing. Given the limited time available (seven weeks allocated for a two man team), the samplers should spread their field visits equally around all parts of the marshlands and attempt to visit all of the larger fishing communities and some small ones. If it can be arranged, an aerial survey (by RAF helicopter?) of the marshes would enable any unsurveyed villages or fishing camps to be identified, and the approximate numbers of boats and houses to be counted.

Data Entry Example

In the example data form below, the first respondent Mohamed has one boat and fishes only one 500m gill net all year. Najah has both a 400m gill net and an electric fishing set, which he only ever fishes on separate days (thus entered as separate lines). Mustafa has no boat of his own, but fishes a beach seine net with Najah sometimes, and sometimes fishes three bag nets (code BN) in nearby canal ‘H2’. Sajed has two boats: one wooden canoe (code Cw) and one fiberglass canoe with an outboard engine (code CfE). He fishes gill nets some days, electric fishing other days, and uses both a seine net and spears on dry season days. Najim usually hauls his gill nets in the morning and then does electric fishing before landing his combined catches in the afternoon. He sometimes fishes a seine net or with poison (code Pn), but not on his gill netting/electric fishing days. Basim has none of his own fishing gear, bkut works with Najim. Riyadh fishes a small gill net to feed his family (indicated by ‘Sub’ code for subsistence catch in landing site column).

Frame Survey of Fishing Activities

Document No.: Page: of:					Home village:				
Date:					Latitude:				
Recorder name:					Longitude:				
Name	Boat Type	Boat Length (m)	Gill Nets (m)	Electric Fishing	Seine Net (m)	Spears	Other Gears (name)	Fishing Waters	Landing Site(s) Used

Comments (e.g. usual landing times; non-fishing days; months of highest and lowest fish catches by gear type; marketing of fish; use of temporary fishing camps or expeditions?)

NB: Enter single lines for any gears used concurrently (both on same day)
Enter separate lines for any gears used sequentially (e.g. on alternating days or in different seasons)
For boats, enter number of *active* vessels owned in each type and length category
For gill nets and seine nets, enter length owned (m), or X if not known. For electric fishing and spears, enter X. For fishing waters and landing sites, develop codes for each locality and *use consistently*

Frame Survey of Fishing Activities

DATA ENTRY EXAMPLE

Document No.: *0023* Page: *1* of: *3*	Home village: *Al-Ounas (via Umm Nakhlah canal)*
Date: *25 March 2004*	Latitude: *30° 51' 48.6" N*
Recorder name: *Dan Hoggarth*	Longitude: *46° 40' 40.6" E*

Name	Boat Type	Boat Length (m)	Gill Nets (m)	Electric Fishing	Seine Net (m)	Spears	Other Gears (name)	Fishing Waters	Landing Site(s) Used
Mohamed Halous	*Cw 1*	*6m*	*500*					*H1*	*H1b*
Najah Hussein	*Cw 1*	*5m*	*400*					*H1*	*H1b*
				X				*H1*	*H1b*
Mustafa Muchtar	*--*				*X*			*H1*	*H1b*
							BN 3	*H2*	*H1b*
Sajed Al-Noor	*Cw 1*	*5m*	*700*					*H1*	*H1b*
	CfE 1	*8m*		*X*				*H1*	*H1b*
					150	*X*		*H1*	*H1b*
Najim Khamees	*Cw 2*	*5m*	*X*	*X*				*H1*	*H1b*
					X			*H1*	*H1b*
							Pn	*H1*	*H1b*
Basim Jasim	*--*							*H1*	*H1b*
Riyadh Al-Tameme	*Cw 1*	*5m*	*X*					*H1*	*Sub*

Comments (e.g. usual landing times; non-fishing days; months of highest and lowest fish catches by gear type; marketing of fish; use of temporary fishing camps or expeditions?)

Other gears: BN = Bag net (suspended below culvert); Pn = poison fishing
Most fishers sell their fish in Suq-al-Shayukh market, landing their catches at H1b canal at 8-9am each morning
No fishing on Fridays
According to the chief, gill nets and electric fishing are both used year-round. Seines are used in the dry season only.

NB: Enter single lines for any gears used concurrently (both on same day)
Enter separate lines for any gears used sequentially (e.g. on alternating days or in different seasons)
For boats, enter number of *active* vessels owned in each type and length category
For gill nets and seine nets, enter length owned (m), or X if not known. For electric fishing and spears, enter X. For fishing waters and landing sites, develop codes for each locality and *use consistently*

Proposed Additional Tasks for Year 1 (Presently Unfunded)

If additional funding becomes available during Year 1, the following tasks are recommended:

Capture Fishing

- **Fish Marketing (**Estimated cost: $100,000)

Development and operation of fish marketing co-ops promoting the export of *juri* to Baghdad and outside Iraq and the supply of cheap gears, among other technologies. Assessment of potential of alternative marketing locations, and processing methods, including salting, smoking, freezing, and packing.

- **Promotion of Sustainable Fishing Gears** (Estimated cost: $50,000 – Enough for 400 700m 7-piece gill nets)

Provision of larger, legal-sized meshed gill nets to encourage capture of stocked fish at adult sizes after growth period and to promote acceptance of national fishing laws, particularly within co-management village sites. Legal-sized five centimeter Taiwanese nylon gillnets cost $5-11 per kilogram. Collaborate with Department of Fisheries to purchase discounted nets. Supply only nets and ropes to encourage fishers to construct nets with own floats and weights from existing small meshed nets.

- **Educational Materials to Support Co-Management (**Estimated budget: $50,000)

Develop educational and training materials to assist village co-management efforts and promote uptake in other villages. Encourage educators, artists, graphic designers, and local publishers to collaborate with for guidance from ecological and fisheries experts on the team.

Fish Farming/Aquaculture

- **Design and Construct a Hatchery at the University of Basra** (Estimated cost: $250,000)

The Marine Science Center has assembled equipment in a number of rooms in several buildings to make up a rudimentary fish hatchery and nursery. They do the best they can with what they have, but if the program of stocking is to have the greatest chance tobe successful, there ought to be a new hatchery facility constructed with state-of-the-art technology and equipment. Because of the closed loop (recirculation) requirements of the

University of Basra water supply, advanced technology in biofiltration and high density culture will have to be employed. The team proposes to design a small state-of-the-art, closed-loop hatchery and nursery facility for the University of Basra. A final site would be selected for the new hatchery, and necessary permitting will be secured from both the university and the Department of Fisheries. Equipment will be sourced in the United States and shipped to Basra through Amman, Jordan. The physical structure will be contracted by the university personnel.

- **Training Course and Study Tour in the United States on the Latest Acquaculture Techniques** (Estimated Cost: $125,000)

Key Iraqi fisheries personnel in the private sector, government, and universities need to be trained in the latest aquaculture technologies. Applicable technologies include closed system biofiltration, recirculating system dynamics, intensive fish culture technologies, predictive high density culture, water quality management strategies, fish transport techniques, and preventative fish health management techniques. These concepts are offered in various forms in two accredited short courses offered by Dr. Woiwode through Sheridan College, Wyoming. All these facets of technology and management could be formulated into one dynamic six day short course, offered through the college.

The team also recommends that the short course be followed with a short study tour of the Idaho trout industry to gain first hand knowledge of the state-of-the-art intensive culture techniques utilized in the trout industry of the United States. The 29-mile long “Magic Valley” in Idaho produces 48 million pounds of fish a year, which is over 80 percent of the United State’s production of rainbow trout. The Magic Valley is driving distance from Sheridan College.

Proposed Tasks for Years 2 and 3

Should the program be extended into succeeding years, the following tasks are recommended for implementation:

Capture Fishing

- **Rehabilitate Marshland Fish Habitats** (Estimated cost: $1,000,000)

The task would focus on floodplain rehabilitation for fish, that is large scale floodplain re-engineering to restore natural diversity of floodplain river habitats and promote reconnection of lateral and longitudinal fish migration routes within marshlands. Engineering activities could include the strategic destruction of dykes in approved areas, filling of channels to reduce lattice effect in floodplains, and re-meandering of linear canals to re-establish natural erosion and deposition habitats.

Impact assessment and restoration of fish passes/fish ladders on dams on the Tigris and Euphrates rivers and tributaries as required to ensure upstream and downstream migration of *shabut* and *kattan* spawners. The Kut dam fish pass was designed and constructed in 1936 by the British. Now that flow conditions have changed significantly, attention may be required to ensure its continued effectiveness. Better enforcement of no-fishing rules around fish passes is expected with the return of government powers in June 2004.

The task would work closely with the Integrated Marshland Management team on the re-establishment of Scirpus and Valisneria plant species to rebuild Barbus spawning habitats in depleted areas.

Aquaculture

- **Upgrade the Design of The Fish Culture Facilities** (Estimated cost: $12,000)

Once constructed and operational, the Model Fish Farm will inevitably have physical changes from the original design. These are often based on site and material idiosyncrasies not able to be foreseen. “As Built” renditions are then developed for future application, to gain resolution and incorporate what we have learned from the implementation of the first Model Fish Farm, to be applied for future Model Fish Farms.

- **Construct Eleven More Model Fish Farms** (Estimated cost: $900,000)

The Model Fish Farm project should be scaled up to include eleven villages spread throughout the marshlands. The selection will be based on criteria developed for the first Model Fish Farm, refined where necessary.

- **Design and Construct Three New Large Scale Hatcheries** (Estimated cost: $850,000)

Three large hatcheries are forecasted to produce the necessary *Barbus spp.* fingerlings for the mitigation and restoration efforts, and for private enterprise culture. These would be located on the periphery of the marshlands, and ultimately owned and managed by the Department of Fisheries.
The design process would be applied to the three new large scale hatcheries, resulting in construction-grade documentation for immediate implementation. Once site selection is completed, the hatcheries should be constructed as soon as is reasonable for their mitigation and restoration activities. The goal will be to produce 25 million advanced fingerlings of *B. sharpeyi* and *B. xanthopterus* per hatchery per year.

- **Train Fish Farmers and Extension Personnel** (Estimated cost: $75,000)

As the fish farm program is being implemented, a series of training programs will need to be implemented. Extension personnel of the Department of Fisheries and the University of Basra should be targeted first and fish farmer education programs subsequently. The farmer programs will concentrate on extensive fish culture techniques and marketing strategies for their product. The extension program will concentrate not only on fish culture techniques but also include technology transfer skills. Private operators of fish farmers in the region, including those clustered in Al-Medinah will be encouraged to attend.

- **Purchase Fish Transport Vehicles** (Estimated cost: $240,000 for two)

The fish transport tank designated in the early phase of this program is a quick fix, with 2-3 ton capacity. Larger capacity fish hauling, countrywide, is required for the longer term. The Department of Fisheries has identified and contracted in Italy for four fish transport trucks, each with 12-ton capacity, but it does not have the funds to purchase them. If funds are available, the team recommends the purchase at least two of these for the department, one to be stationed in Baghdad, the other in Basra.

- **Secure Necessary Chemotherapeutants for the Longer Term Program** (Estimated cost: $12,000)

The latest spawning hormone analogues and anaesthetizing agents are available outside the country. Enough of a supply should be purchased through this program to ensure that all new hatcheries have access to these drugs and these latest technologies for a targeted three year program.

- **Construct a Small Feed Milling and Pelleting System** (Estimated cost: $750,000)

As fish production advances, so will the requirements for quality supplemental feed. Ongoing research at the University of Basra suggest that there are local ingredients available for incorporation into an effective fish feed diet. However, there are no pelleting

systems in the country, and no milling for such products as fish meal. Effective supplemental feed has the potential to double production in the pond based aquaculture systems. We strongly encourage this initiative.

- **Conduct Applied Fish Culture Research** (Estimated Budget: $120,000)

Select areas of fish culture in Iraq require additional research to advance the local technologies. These include:

  - **Stocking Densities and Growth Rates of *Barbus spp.*** These fish are considered not able to be cultured. But the perception among all team members is that with focused applied research, these questions of density, growth, feed, polyculture and economics can be answered, and a vibrant new industry of prime species formed.

  - **Hybridization.** Once the spawning techniques and the early life stage issues are resolved, hybridization can begin. Many species when combined realize hybrid vigor, and this may be the case with the *Barbus spp.* This could hugely affect the economics of production, and is viewed as vital information in regional culture knowledge, techniques and application. This activity was of great interest to the Iraqi aquaculture team, but it will need to be developed cautiously within international codes of conduct to avoid any genetic dilution of the wild Mesopotamian fish stocks.

Fishery Co-management

- **Implement Fishery Co-management Efforts** (Estimated cost: $100,000)

With available funding for Years 2 and 3, the program would extend initial pilot village co-management activities to additional villages as required to ensure stock conservation and create social benefits. It would coordinate, harmonize and manage fishing at sub-catchment and catchment levels, as appropriate. The program would develop regional co-management for associations and for integration by CRIM and the Department of Fisheries. It would also hold annual joint meetings of marsh fishery stakeholders to discuss achievements and plan future activities.

Monitor Fishing

- **Monitor Changes in the Fishing Systems** (Estimated cost: $300,000)

The program would update the frame surveys of fishing activities on an annual basis and continue monthly fishing surveys to assess the effectiveness of the stocking program and guide future management actions. It would also include village-based self-monitoring data from the co-management program in annual fishery assessments.

Action Plan Summary

Year 1 (Funded)	Year 1 (Unfunded)	Years 2-3
Task 1. Barbus restoration 1. Secure broodstock 2. Fish transport tank 3. Upgrade MSC hatchery facilities 4. Select fish stocking sites 5. Aquaculture training (at UB) 6. Culture Barbus fingerlings 7. Stock fingerlings to 3-6 sites	• Design and construct new hatchery at MSC • US aquaculture training and study tour	• Design and construct 3 extra large scale hatcheries • Buy 2 fish transport trucks • Buy spawning hormones etc • Feed mill and pellet system • Fish culture research
Task 2. Fishery co-management 1. Tribal boundaries map 2. Co-management training 3. Stakeholder analysis 4. MOU authorizing village rules 5. Select co-management sites 6. Design facilitation strategy 7. Village activities (12-15 sites) 8. Write village management plans 9. Publicize in villages 10. Monitor enforcement etc 11. Report outcomes	• Educational materials to support co-management	• Extend co-management to more villages • Develop sub-catchment management fora
Task 3: Aquaculture Enterprise 1. Design model fish farm 2. Select model fish farm site 3. Construct model fish farm 4. Provide training to farmers		• Upgrade design of MFF • Select sites and construct 11 extra MFF sites • Fish farmers training
Task 4: Fishery Monitoring 1. Frame survey of fishing activities 2. Training in data collection etc 3. Mapping of frame survey data 4. Design survey and data collection forms 5. Develop database 6. Provide training in database use 7. Develop MOU with FD & BU 8. Purchase sampling equipment 9. Collect data twice monthly 10. Enter data into database 11. Analyze results and report		• Continue fishery monitoring and annual analysis • Repeat frame survey annually as fishery becomes re-established
	Fish marketing	
	Promotion of sustainable gears	
		Rehabilitation of marshlands fish habitats • Floodplain reengineering • EIA and restoration of fish passes / ladders ▪ Re-vegetation of key spawning habitats

5 EXTEND PRIMARY HEALTH CARE SERVICES

Photographs

The relatively well-stocked pharmacy at the public clinic in Al-Chibayish which still lacks the commonly demanded medicines like antibiotics

A common site in marshlands villages: an abandoned clinic which ought to be serving at least 10,000 people

A large, recently refurbished clinic near Prosperity River with a blood pressure measurer as its sole piece of medical equipment

A nursing assistant with sonogram equipment in a small, back room in the Al-Chibayish clinic

5 EXTEND PRIMARY HEALTH CARE SERVICES

Background

The marshlands have always been one of the most remote areas in Iraq, historically outside the general control of the government and with a record of the fewest and least developed services provided. During the 1990s, medical services were virtually non-existent in much of the region, largely the consequence of a deliberate national policy to persecute the local population. Nowadays, throughout the marshes, the situation has not dramatically improved. Medical services are very limited, with only a few hospitals in the surrounding area and clinics offering no more than the most basic health care. Demanding cases have to be taken to the cities. Most clinic buildings are abandoned or in a state of bad disrepair. Only clinics in the marshes are still operational, but they provide only the most basic medicines and with few qualified personnel. They are likely to have a doctor's assistant and/or male nurse. As a result, women are likely to shun the clinics.

The most effective public health centers are those in Al-Chibayish between Central and Hammar marshes, Al-Turaba near Hawizeh marsh, and Al-Hassan near Hammar marsh. The first clinic is in the largest town in the marshes, serving about 12,000 people. The latter two were refurbished and re-established by the AMAR International Charitable Foundation, opening in June or later. The Al-Chibayish clinic has a doctor, dentist, nurses, and assistants. The AMAR clinics are staffed with a variety of medical specialists, including doctors, nurses, midwives, and assistants. However, all have problems being able to secure medicine. The three facilities are supplied from government warehouses, finding the medicine from private sources to be too costly. All lack the medicine most in demand: antibiotics. The stock in the pharmacy in AMAR's clinic in Al-Turaba was noticeably reduced between June 2003 and February 2004.

Objectives

Objectives of the public health activity are to:

- Initiate a sustainable healthcare service in collaboration with MoH, NGOs and local people;
- Provide immediate curative and preventive care for the most unserved or under-served population groups;
- Initiate health education activities;
- Monitor the impact of reflooding on the health of the local population, particularly with respect to re-emerging diseases like malaria and schistosomiasis; and

- Support currently available health care services in selected sites (population aggregations).

Field Visits and Technical Team Members

During the month of February, the public health team visited sites to explore the state of public health services and identify candidate locations for program efforts. Field visits were made by a team of experts in public health. The first visit was made to the marsh area to the east of Misan on 12 February 2004. The second was made to the marsh area that extends across the common land of Basra and Misan governorates alongside Prosperity River on 17 February. A third visit was made to the marsh area that extends from Al-Medinah to Suq Al-Shayukh (including Al-Hammar and adjacent marshes). The visits involved discussion with the local population in settlements and at local health facilities, whether operational or not. The meetings and discussions were with many different kinds of people, including tribal sheikhs, officials, doctors, women, and older children. There was, furthermore, an in-depth assessment of other environmental conditions relevant to the life and health of people.

The technical team included:

Dr. Ali Nasir Muthanna, AMAR International Charitable Foundation
Dr. Omran Sukkur Habib, University of Basra
Dr. Ali Nasir Muthanna, AMAR International Charitable Foundation
Dr. Alaa Hussain Abd, AMAR International Charitable Foundation
Dr. Peter Reiss, Program Director

Current Health Situation

Hawizeh Marsh

Apart from Al-Turaba, which has a reasonably operational health center, most of the other settlements have either very poorly-functioning health centers (e.g. the Al-Khair health centre along Prosperity River and Abu-Khassaf village, very close to the western edge of Hawizeh marsh) or abandoned health centers (the Al-Muaial villages). Most people access healthcare services in the urban centers with considerable difficulty (e.g. Al-Kahlaa, Qalat Salih, Al-Majar, Al-Adil and Al-Amarah).

None of these urban centers is closer than ten kilometers from any of the rural settlements visited. Although the nutritional status was apparently reasonable, the overall health status indicators are expected to be below standard. A baseline data on the overall health status indicators and nutritional status indicators would be useful to measure the impact of the services provided.

The rural villages are connected to the main urban centers and to each other in most instances by a network of paved roads or leveled roads. Supplies of purified water and sewage systems are not available or, if they once existed, are no longer operational. Electricity is available but extremely intermittent in most areas. It is not available in the village of Abu-Khassaf which the team visited and considered as a site for clinic

refurbishing. Schools are available in major population aggregations, but they are neither adequate in number nor in grades. Many children do not attend school, and many of those that do attend do not pursue their education beyond primary level.

Central Marshes

Our visit did not cover all parts of the central marshes, but it involved almost all of the most relevant part of this marshland: the population occupying the banks of Prosperity River. Apart from the small modern residential site in Al-Khair administrative unit, the population lives either in aggregated settlements or is scattered along the river's margin. They live in houses that lack basic services. Exceptions are those who live at or close to the southern end of the river in Al-Huwair and just to the north of it, where a main health centre belonging to the Ministry of Heath and supported by AMAR is operating. Two other small health units are situated north of Huwair. People are engaged in agriculture, fishing, animal rearing and other jobs. They are worried about their future and the uncertainties surrounding the marsh reflooding.

The Western Marshes (Al-Hammar and Adjacent Areas)

Most of the population in this part has the same characteristics and problems elsewhere in marshlands. They lack adequate healthcare services and adequate education. Many of them expressed their worry about the future of their land given the present pattern of reflooding the marshes.

ACTION PLAN 5

EXTEND PRIMARY HEALTH CARE SERVICES

Task 1: Establish Primary Health Care Clinics in the Marshes

Medical services throughout the country has suffered from an absence of attention and resources for more than a decade Today, the situation is in disarray as supplies are short, equipment unavailable, and qualified personnel absent. The conditions are even worse in the marshlands where neglect was passive than deliberately destructive. Although the major focus of the Iraq Marshlands Restoration Program is both ecosystem management and economic development, it would be unrealistic not to include an activity specifically targeted at one of the greatest problems facing Marsh Arabs: substance or non-existent primary health care. It is necessarily an essential element of this assistance program.

Efforts of the program will concentrate on re-establishing three to four primary health clinics in the marshlands to help as many underserved or unserved people as people, finding the present funding constraints.

Objectives

The objectives of Task 1 are to:

- Improve the public health of the Mash Arabs by providing primary health care services; and
- Devise strategies for sustainable health services in partnership with the Ministry of Health and NGO providers.

Implementation Steps

1. Identify appropriate locations for program-sponsored clinics

The technical team will complete the selection of sites. Some candidates are mentioned below in Step 3. The following points will be taken into consideration for final site selection:

- The size and distribution of the population must be sufficient to justify the investment.
- There must an acceptable level of local supporting services, including roads, electricity, transportation, and proximity to alternative sources of care.
- A health care center is likely to be more effective if it is located in a stable area.
- There is a need for confidence in obtaining outside resources for reliable capital investment, recurrent cost, and sustainability of facilities, whatever the source, beyond the program's life.

- The choice is compatible with the policies of the Ministry of Health, i.e., primary health center ought to serve 5,000-20,000 people.

- The clinic is preferably situated in an area that is receiving other program efforts, so as to intensify the impact.

2. Develop a memorandum of understanding among the Ministry of Health, NGO providers, local population, and the program

The successful implementation of the task and the likelihood of its sustainability depend on a common understanding by major parties of the roles they play and responsibilities they have. Commitments made by the parties in any specific location are expected to be honored, and, if not, the effort may be terminated. The program will work with all major stakeholders to clarify their commitments from the beginning. The Ministry of Health will be encouraged to provide personnel and medicine. The NGOs will provide medical expertise and other technical and strategic support. The local communities will be asked to provide security and other assistance. The program will supply equipment, medicine, and other needs.

3. Support Clinics in the Marshes

The program will establish three to four clinics, supplying or arranging for supplies, equipment, and staff. It is the preference of the program not to restart clinics in buildings which are in very bad disrepair. Funds are limited, and it would not be cost-effective to use resources for major construction or rehabilitation.

A good candidate for a program-sponsored clinic is the barely operational, health center in Al-Khair sub-district. The 12 room center was refurbished two years ago by the Ministry of Health and supplied with office furniture in the past few months. The physical state of the building is excellent, but it lacks qualified medical staff and equipment. It serves a large population along the Prosperity River.

Initial services could include, among others:

- Treatment of common illnesses and injuries
- Immunization of children and pregnant women
- Midwifery services
- Basic laboratory services
- Referral arrangements for further care to hospitals in the area
- Veterinary services, tied into the Livestock and Dairy Production activity

Second location is in Al-Chibayish town, the largest settlement in the marshes, serving an area which extends from the northwest of Al-Medinah to Al-Tar. The area has about 20,000 people and is presently served by a small hospital and a health centre, both located in the town. The two facilities lack adequate equipment, adequate supplies, and staff (mainly doctors). They have limited facilities for transportation, field visits, and air conditioning systems. At the same time, they are in better condition that most other facilities in the

marshes. The attraction of this clinic is its central location, present good physical state, and ability to serve as a hub for a large geographical area. Al-Chibayish will also be the initial site for other program efforts, including fish farming and constructed wetlands, increasing its visibility and overall impact.

Initial services could include, among others:

- Outreach care for remote, unserved populations
- Additional medical support
- Extended laboratory services
- Equipment (ECG, lab machines…etc), furniture, air cooling systems and perhaps an ambulance
- Veterinary services, tied into the Livestock and Dairy Production activity

A third possible site is in the village of Abu Khassaf, on the edge of Hawizeh marsh, southeast of Al-Kahlaa town. Abu Khassaf is an large settlement of longstanding residents and newly returned exiles from Iran. The people appear to be among the poorest found in the marshes. The area has few, if any, services. It lacks water and electricity (presently under negotiation with local council in Al-Amarah and CPA-South). The existing clinic is barely operating because of poor staffing and supplies. It received few visitors each day, none women.

As in Al-Khair, initial services could include, among others:

- Treatment of common illnesses and injuries
- Immunization of children and pregnant women
- Midwifery services
- Basic laboratory services
- Referral arrangements for further care to hospitals in the area
- Veterinary services, tied into the Livestock and Dairy Production activity

A fourth possibility is the health centre in Al-Turaba which has been operating since June 2003 with the support of AMAR.

Initial services provided by the program could include:

- More regular and effective prenatal care.

At any clinic sponsored by the program, an additional effort will be the monitoring of the impact of reflooding on the health of the local population.

4. Monitor and Evaluate the Effort

The effectiveness of the health care services needs to be monitored throughout the first year to identify implementation issues and determine its success. Examples of indicators that may be used include:

- Number of daily users of health services;

- Frequency and nature of repeat visits;
- Number of children immunized out of total eligible children in the target population;
- Frequency of use of each service; and
- Opinion of patients about the health care provided.

Technical Assistance

Technical expertise for Task 1 include:

- Community health experts to be provided by AMAR – 200 days in a technical pool
- Medical staff the clinics, to be decided in consultation with the Ministry of Health

Deliverables

The task has the following deliverables:

- Three to four operational health centers providing primary health care
- Strategy for sustainable health services with major stakeholders

Proposed cost: $200,000

Task 2: Introduce Health Education Activities

As part of the health services provided in the clinics, the program will develop and extend a limited preventative health care effort for people in the area.

Proposed cost: $10,000

Proposed Additional Tasks for Year 1 (Presently Unfunded)

If additional funding becomes available, the following tasks are recommended:

- **Expand the Number of Primary Health Care Clinics Centers** (Estimated cost: $500,000)

Then the program could expand the number of clinics quickly drawing on its strategy and links to the health sector in Iraq.

- **Expand Efforts to Provide Health Education** (Estimated cost: $25,000)

Available funds will only permit a small number of implementation sites, although much of the up-front work will establish implementation plans that can be further developed and expanded. Additional health education programs could be implemented in new and adjacent sites.

Proposed Tasks for Years 2 and 3

Should the program be extended into succeeding years, the following tasks are recommended for implementation:

- **Expand the Number of Primary Health Care Clinics Centers** (Estimated cost: $2,000,000)

Then the program could expand the number of clinics quickly drawing on its strategy and links to the health sector in Iraq to cover most of the marshes.

- **Expand Efforts to Provide Health Education** (Estimated cost: $100,000)

Available funds will only permit a small number of implementation sites, although much of the up-front work will establish implementation plans that can be further developed and expanded. Additional health education programs could be implemented in new and adjacent sites.

6 DEVELOP CONSTRUCTED WETLANDS FOR DOMESTIC WASTEWATER TREATMENT

Photographs

A common site in Al-Chibayish: a cesspool which takes the outfall for all household waste and a pipe with drinking water running through it

A septic tank in Al-Chibayish made of reed stems, which retains larger suspended solids, dissolved material going directly into ponds adjacent to the houses

Covered half cubic meter containers for drinking water that is trucked to Al-Chibayish for 750 dinars sit outside many houses

The proposed site for the constructed wetland in Al-Chibayish along the Euphrates riverbank in the lowest part in the town, facilitating in-flow

6 DEVELOP CONSTRUCTED WETLANDS FOR DOMESTIC WASTEWATER TREATMENT

Constructed wetlands are engineered systems that are designed and built to use the natural processes involving wetland vegetation, soils, and their associated microbial assemblages to assist in treating wastewater. They are designed to take advantage of many of the processes that occur in natural wetlands, but they do so within a more controlled environment. In general, most types of constructed wetlands remove high amounts of organics (BOD_5, COD) and suspended solids through sedimentation, filtration, and microbial degradation. Removal of nitrogen and phosphorus varies among types of constructed wetlands, but generally it is not high as high as for suspended solids and bacterial reduction. These systems have proven effective in improving water quality all over the world.

Constructed wetlands offer a cost-effective solution for pollution removal from wastewaters and the subsequent reduction of pollution in receiving water bodies, such as rivers or marshlands. Constructed wetlands do not require highly skilled personnel, and the operation and maintenance requirements are very low. In most cases, the constructed wetland operation does not require any electric power. Among the many types of constructed wetlands which are currently used for wastewater treatment, free surface flow constructed wetlands would fit best for marshlands areas of Iraq. The construction requires only limited amount of earthwork and the operation and maintenance is very easy. These systems do not require any electric power – the only exception may occur in very flat locations where a gravity sewer system may loose elevation and then it is necessary to pump the water either into or out of the constructed wetland. The free water surface (FWS) also does not contain any mechanical parts that could be broken during the operation.

A typical FWS constructed wetland consists of a shallow basin constructed of soil or other medium to support the roots of vegetation and a water control structure that maintains a shallow depth of water of usually 20-60 centimeters. Dense emergent vegetation covers significant fraction of the surface, usually more than 50 percent. Besides planted macrophytes natural assemblages of volunteer re-growth from native seed banks are usually present. Flow is directed into a cell from the inlet or upstream embankment, and is intended to cover all portions of the wetland until it reaches one or more outlet structures. The shallow water depth, low flow velocity, and presence of the plant stalks and litter regulate water flow and, especially in long, narrow channels, ensure plug-flow conditions. One of their primary design purposes is to contact wastewater with reactive biological surfaces. FWS wetlands look and act much like natural marshes. They function as land-intensive biological treatment system. The most commonly used plants are the cattail (*Typha* spp.), common reed (*Phragmites australis)* and bulrush (*Scirpus* spp.).

ACTION PLAN 6

DEVELOP CONSTRUCTED WETLANDS FOR DOMESTIC WASTEWATER TREATMENT

Task 1: Design and Build Constructed Wetlands for Wastewater Treatment

Towns and villages in the marshlands lack wastewater treatment facilities. In the larger towns of Al-Chibayish and Hammar City, people have small outdoor toilets with pipes that directly go into cesspools or covered pits adjacent to the houses. During periods of rain or high use, the pits back up and sewage can enter the house. Cesspools offer few advantages since they are filled with raw sewage, have severe odor problems and are a health hazard. In addition, the small ponds are found throughout the villages and are filled with common reeds (*Phragmites australis*), which is predominantly used as fodder for animals. These ponds apparently receive high amounts of wastes produced in the village through runoff. However, these ponds may be only temporary during winter and most probably would dry during the dry season. Therefore, the use of these ponds as treatment units is not possible.

Pipes carrying drinking water often run directly through the pools of wastewater. There are many instances of leaks, and people often complain of diarrhea and other illnesses. Flies and mosquitoes are endemic. People do not drink the water supplied by the municipality, since treatment is unreliable; machinery is broken and chemicals are not available. This piped water is used for washing. People drink water which is trucked in privately, paying about ID 750 for a half cubic meter. In front of each house, there are one or more metal cylinders containing the family's potable water.

The conditions in marsh villages are much worse. Several sites in the marshlands were visited and assessed for placement of a constructed wetland for wastewater treatment. There is no public water supply. As a result, production of wastewater is low and in some cases practically zero. The water for day-by-day use from bathing and washing dishes is taken directly from the marshes and is released there, as well. In addition, houses do not have toilets. People go away from their houses to defecate and often use soil pits.

Objectives

The objectives of the task are to:

- Improve public health in the marshes through the use of low-cost constructed wetland technologies; and

- Reduce the overall level of pollutants entering the marsh waters by treating the wastewater on site.

Implementation Steps

1. ***Identify sites within the marshlands for placement of constructed wetlands for wastewater treatment***

Constructed wetlands need a reliable water supply to individual houses to permit the waste to flow to the site. The sites for constructed wetlands require the following:

- Access to a public water supply
- Toilet facilities in each house
- Available source of electricity (not required, but helpful if pumping is required)
- Population to be served no more than 5000 people for a single system
- Available land for constructed wetland placement

The program will work closely with the governorate offices of the Ministry of Public Works and with the local population to select appropriate sites that meet the basic engineering requirements. Local agencies will need to carry out rapid surveys to provide information on the following, which will be a basis for selection:

- Locality (name, region, responsible person, responsible regional or/and local office, topography, dominant native plant species that could be used for plantation, soil availability and quality)

- Population (total, number of people potentially connected to the system)

- Public water supply (does not exist, limited, widespread, quality of the network)

- Existing collection of household wastewater (does not exist, adjacent ponds if any, septic tanks, bathrooms and kitchens separate)

- Toilets in houses (yes, no)

- Available land (size, location with respect of connected houses, ownership)

- Recipient (type, distance from the potential constructed wetland, elevation in comparison to constructed wetland site)

After visits to several towns and villages, Al-Chibayish was selected as a good location for construction of the first demonstration system. The technical team will survey the entire marshland to identify other appropriate locations, understanding that most will not be suitable because of insufficient wastewater flow.

2. ***Build demonstration constructed wetlands in towns and villages that meet the given criteria***

The total number of people living in and around Al-Chibayish is about 18,000, although the population of the town is between 4,000 and 5,000. The town has a system of public water supply with water-works facilities that treat the drinking water. The technology consists of

coagulation, pressure filters, and chlorination. However, most of these stations do not work successfully because of mechanical failure of pressure filters. There is a lack of maintenance as stations generally look relatively new and in good condition. The current water treatment is mostly based only on chlorination, which does not provide an adequate quality of drinking water. The facilities have problems to receive regular and sufficient amounts of chlorine to provide a continuous treatment. Households rely on water stored in metal containers, which is trucked in. This system works reliably, but the capacity is not sufficient to provide water for the whole city.

Drinking water is conveyed through a piped system which lays on the ground throughout the town. These pipes often leak water. The pipes are laid through ponds contaminated with wastewater from houses. Houses are equipped with outdoor toilets, and the outfall goes into crudely built septic tanks. These septic tanks are actually baskets made of reed stems so they can retain larger suspended solids, but all the dissolved material goes directly to ponds adjacent to the houses. The household's other wastewater, from washing and other needs, is collected and discharged outside the houses, percolating into the soil.

After two visits, the team decided jointly with the local office of the Ministry of Public Works and the village elders that Al-Chibayish town would be a prime location for the program's first constructed wetland. The site would effectively serve all of the town's 5,000 residents. It will permit the creation of two cells of two and three hectares, separated by an existing ditch which can serve as a discharge recipient. The area is conveniently located next to the Euphrates riverbank and is the lowest part of the village.

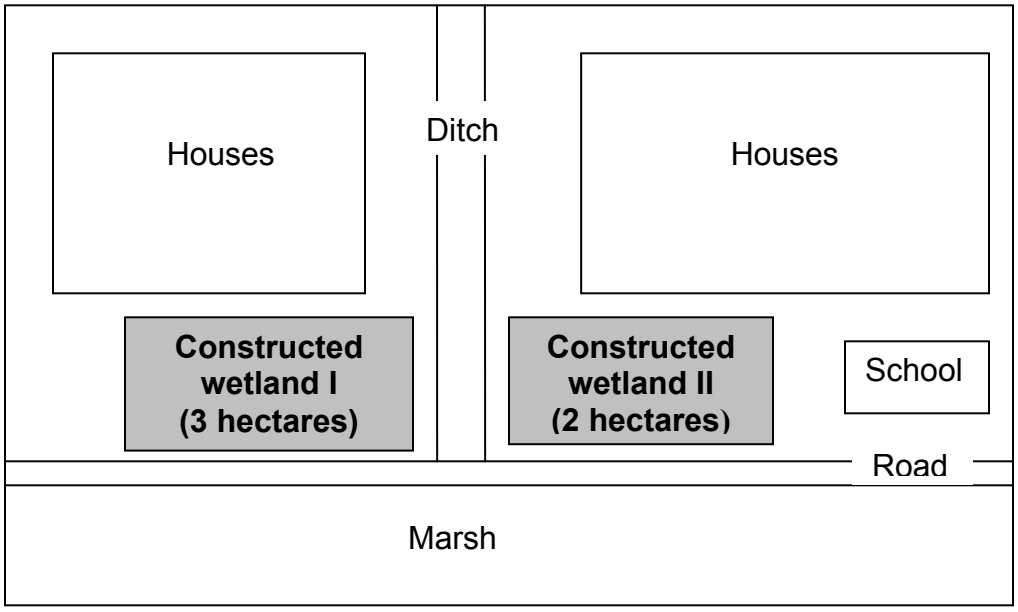
The sewer engineering will require the following:

- A combination of all wastewater sources from the houses which will then be connected to the newly constructed sewer network
- To fix drinking water pipes and make sure they do not leak water and they are not placed through the local ponds contaminated with wastewater and/or surface runoff
- Drain the local ponds and trenches so these cannot be a source of health problems (drainage could be effectively connected with the newly constructed wetland)

Eng. Ali Shaheen, director of the Al-Nasiriyah governorate office of the Ministry of Water Resources has offered to conduct a survey of every house in the town in order to prepare a map for the connections. The Al-Chibayish office of the Ministry of Public Works is carrying out an investigation of the ownership of the land and has promised to make arrangements for its use by the program.

The constructed wetlands will be of a free water surface (FWS) type. These systems have proven to be very successful around the world, including areas in subtropical and tropical climate. It is recommended that a septic tank or sedimentation tank be built immediately before the water enters the wetlands. The septic tanks must be cleaned regularly. The frequency of cleaning will depend on the amount of sludge accumulated in the tank. At present, it is not possible to determine that frequency because the amount of wastewater

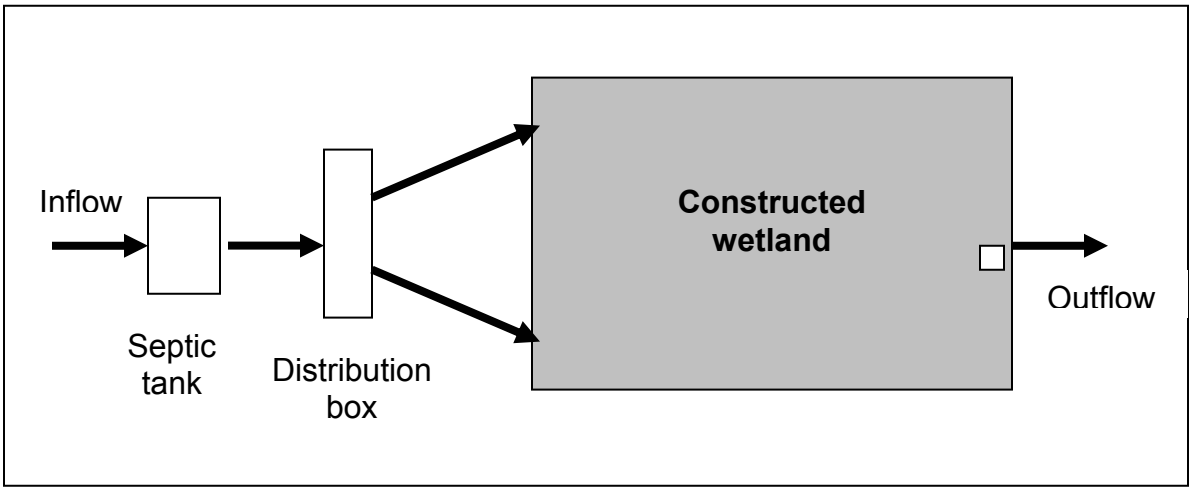
Figure 6.1
Schematic Drawing of the Al-Chibayish Site



and associated solids is unpredictable. This will be added to the operation & maintenance manual after first period of operation.

The FWS constructed wetland requires a good distribution of the wastewater along the inflow profile. Therefore, it is necessary to include a simple distribution box that would ensure water distribution to at least two points along the inlet profile.

Figure 6.2
Schematic Diagram of the Constructed Wetland Design



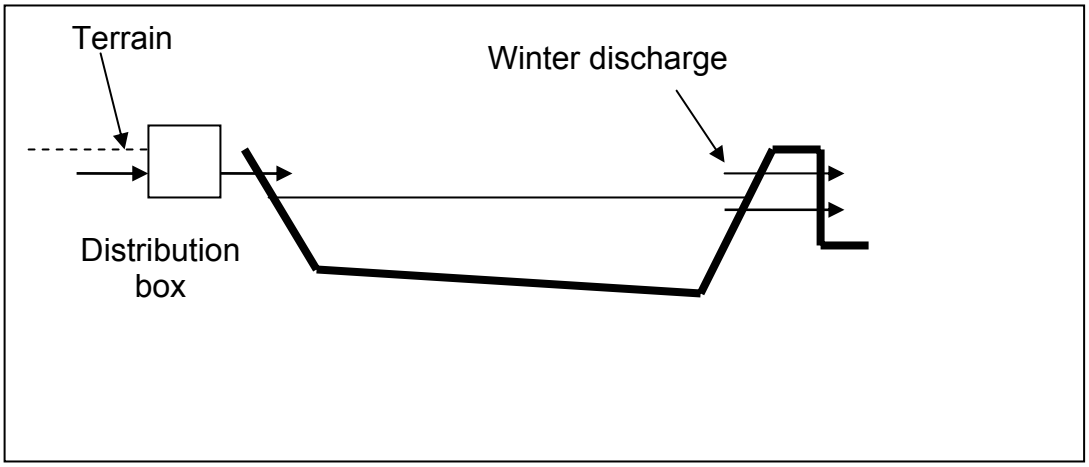
The schematic presentation of the wetland is given in the Figure 6.3. There are two options for the constructed wetland elevation, which will depend on the elevation at the end of sewer network. The sewer network must be operated on a gravity basis, and the placement or elevation of constructed wetland will be determined by the sewer network. A local topographic survey will determine whether the water should be pumped to the septic tank out of the constructed wetland. Ideally, pumping will not be necessary.

If the end of the sewer system is high enough, the existing ground level may serve as a bottom of the constructed wetland. However, this is very unlikely, and some earthwork will probably have to be done. The soil from the bottom excavation could be used for embankments.

According to the information from town residents, the water level in the village during the wet season could be high and so the volume of water directed from ponds to the constructed wetland could be high. Therefore, the team recommends the building of a flow structure with two discharge levels. The upper discharge will be used for wet season, the lower one for the dry season. The upper discharge should maintain the water level in the wetland at 60 centimeters; the lower discharge, which will be in operation for most of the year, will keep the water level at 40 centimeters. It is expected that during the summer the discharge will be very low due to high evapotranspiration.

The wetlands will be planted with common reeds (*Phragmites australis*) from seeds or rhizomes. The growth of reeds could be noticeable immediately after the wetlands are built. Another option is to use reed transplants from natural locations, which may accelerate the operation of the constructed wetland. A decision will be made during construction.

Figure 6.3
Diagram of Constructed Wetland Positioning.



As a component of this effort, the local population will be instructed in the constructed wetland approach to encourage proper maintenance of the system. This is will be done through the public health care activity.

3. Determine the impact of constructed wetlands on water quality and health improvement

In order to assess the treatment performance of the constructed wetland, it is necessary to measure quality of both inflowing and outflowing water. The basic parameters should include bacteria (fecal and/or total coliform bacteria), dissolved organic matter (BOD_5 - biochemical oxygen demand and/or COD, chemical oxygen demand). To evaluate the impact of the constructed wetland on removal of inorganic nutrients, nitrogen (ammonia, nitrite, nitrate, organic N), and phosphorus (total, orthophosphate) need to be analyzed.

A composite sample of inflow and outflow will be taken on a regular bimonthly interval. Since the constructed wetland is likely to have a beneficial effect on health situation, it is desirable to survey bacteriological parameters more frequently.

Target values are the following:

- BOD_5 30 mg/l
- COD 80 mg/l
- Suspended solids 30 mg/l
- FC 10^4 CFU/100 ml
- TC 10^4 CFU/100 ml

Table 6.1
Draft Monitoring Protocol for Each Sampling Location

Parameter	Unit	Date	Date	Date	Date	Date	Date	Mean
BOD5	mg/L							
COD	mg/L							
Suspended solids	mg/L							
FC	CFU/100 ml							
TC	CFU/100 ml							
NO3-N	mg/L							
NO2-N	mg/L							
NH4-N	mg/L							
TKN	mg/L							
TP	mg/L							
PO4-P	mg/L							

FC = fecal coliforms, TC = total coliforms, CFU = colony forming unit

Technical Assistance

Technical expertise for the activity is required as follows:

- Constructed Wetlands Experts (Expatriate) to design the system, develop the tender for the local construction company, and develop criteria for monitoring – 45 days
- Pollution and engineering experts (Iraqis) to oversee construction – 150 days
- Community Health Experts (Iraqi) to conduct monitoring on changes in public health – 30 days
- Iraq construction company, selected through open competition, to install household piped connections and earth movements, as required – level of effort to be determined under the terms of a subcontract

Equipment and Construction Costs

The following are anticipates costs for the Al-Chabayish site:

Sewer network including drainage of ponds and survey	$40,000
Septic tanks (50 m^3 each)	5,000
Distribution box	500
Earth work	3,000
Outflow structures	1,000
Planting	500
Total	$50,000

Proposed cost: $260,000 for 3-4 sites

Task 2: Train Iraqi scientists and engineers in the design, operation, maintenance, sampling, and evaluation of constructed wetlands

The constructed wetlands technology for wastewater treatment is likely appropriate throughout Iraq. Therefore, more detailed information about the construction, operation and maintenance of these systems will be required. The program will prepare training materials, schedule training courses, help select participants, and conduct the short courses.

Technical Assistance

Technical expertise for the activity is required as follows:

- Constructed Wetlands Experts (Expatriate) to design the system, develop the tender for the local construction company, and develop criteria for monitoring – 10 days
- Pollution and expert (Iraqi) to oversee construction – 25 days
- Community Health Experts (Iraqi) to conduct monitoring on changes in public health – 10 days

Proposed cost: $15,000

Proposed Additional Task for Year 1 (Presently Unfunded)

If additional funding becomes available, the following task is recommended:

- **Expand the Number of Constructed Wetland Sites** (Estimated cost: $250,000)

The number of constructed wetland sites can be expanded to an additional three to four sites.

Proposed Tasks for Years 2 and 3

Should the program be extended into succeeding years, the following tasks are recommended for implementation:

- **Expand the Number of Constructed Wetland Sites** (Estimated cost: $1,000,000)

During successive years, constructed wetlands can be expanded to cover most, if not all, of the suitable sites in the marshlands. The program will draw from the survey conducted during Year 1 to identify appropriate locations which meet the technical guidelines.

FUNDED AND UNFUNDED PROGRAM BUDGETS

FUNDED AND UNFUNDED PROGRAM BUDGETS

Proposed Iraq Marshlands Restoration Program Budget (Funded)

Program Management

• Program Management and design	415,000
• Security Arrangements	300,000

National-Level Activities

Strategic and Comprehensive Marshlands Planning

• Strategic Plan for Involved National Ministries and Regional Offices	100,000
• Comprehensive Restoration Strategy for GOI and Donors	250,000

Hydrologic and Hydraulic Modeling

• Hydrologic Model of the Tigris-Euphrates Basin	450,000
• Hydraulic Model of Hawizeh Marsh	50,000

Capacity-building in Marshland Management and Restoration

• Water and Soil Laboratory in Ministry of Water Resources in Baghdad	250,000
• Upgraded Laboratory Capacity at University of Basra	50,000
• Integrated Marshlands Database	100,000
• Short Courses and International Study Tours	280,000

Marshlands Activities

Integrated Marshland Management

• Assess the Nature and Distribution of Flooding on the Landscape and Hydrologic Conditions Using Satellite Imagery and Hydrologic Records	135,000
• Develop Protocols for Assessing Ecosystem Functioning and Monitor Reflooding	285,000
• Develop an Integrated Marsh Management Plan	100,00

Agricultural Production and Agribusiness

• Develop Soil-Water Kits to Improve Land and Irrigation Planning	25,000
• Carry Out Large-Scale Crop Demonstrations for Field Crops and Horticulture	100,000
• Establish Date Palm Nurseries for Growing and Distributing Off-Shoots	100,000

Livestock and Dairy Production

• Extend Veterinary Services to Marsh Communities	100,000
• Introduce Forage Crop Cultivation to Improve Livestock Nutrition	50,000
• Provide Educational and Income-Generating Opportunities for Marsh Dwelling Women and Girls	50,000

Capture Fishing and Fish Farming

• Produce *Barbus Spp.* for Stocking into the Marshlands	75,000
• Co-manage Activities with Fishermen to Protect Local Stocks	65,000
• Develop Aquaculture Enterprises	125,000
• Monitor Fishing Systems	60,000

Public Health

• Establish Primary Health Clinics in the Marshes	200,000
• Introduce Health Education Activities	10,000

Constructed Wetlands

• Design and Build Constructed Wetlands for Wastewater Treatment	260,000
• Train Iraqi Scientists and Engineers in the Design, Operation, Maintenance, Sampling, and Evaluation of Constructed Wetlands	15,000

Total	**$4,000,000**

Proposed Additional Marshlands Tasks for Year 1 (Unfunded)

National-level Activities

• Master Plan for Water Resources in Iraq	$3,500,000
• Soil and Water Laboratory in the Ministry of Water Resources	$250,000

Integrated Marshland Management

• Monitoring Additional Reflooded Marsh Sites	$450,000

Agricultural Production and Agribusiness

• Restoration of the Date Orchards	$300,000
• Rural Finance Program	$1,000,000

Livestock and Dairy Production

• Expand the Number of Veterinary Service Centers	$250,000
• Expand Alfalfa Demonstration Plots	$100,000
• Expand Efforts to Assist Women and Girls in Education and Income-Generation	$100,000

Capture Fishing and Fish Farming

• Development and Operation of Fish Marketing Coops Promoting the Export of *jury*	$100,000
• Promotion of Sustainable Fishing Gears	$50,000
• Educational Materials to Support Co-Management	$50,000
• Design and Construction of a Hatchery at the Marine Science Center, University of Basra	$250,000
• Training Course and Study Tour in the United States on the Latest Aquaculture Techniques	$125,000

Public Health

• Expand the Number of Primary Health Clinics in the Marshes	$500,000
• Expand Efforts to Provide Health Education	$25,000

Constructed Wetlands

• Increase the Number of Constructed Wetlands for Wastewater Treatment in the Marshes	$250,000
Total for Additional Marshlands Tasks in Year 1	**$7,100,000**

Proposed Marshlands Tasks for Years 2 and 3 (Unfunded)

National-level Activities

• Water Resources Planning Support	$500,000
• Hydrologic Modeling	$250,000
• Integrated Database Management and GIS Facilities	$200,000
• Short Courses and International Study Tours	$300,000
National-level Subtotal	*$1,250,000*

Integrated Marshland Management

• Monitoring Reflooded Marsh Sites	$500,000
• Evaluation of the Impact of Marsh Restoration on the Local Population	$200,000
• Eco-tourism Ventures Based on Marsh Wildlife and Cultural Importance	$1,000,000
Marshland Management Subtotal	*$1,700,000*

Agricultural Production and Agribusiness

• Expanded Demonstration Field Crop and Horticulture Program for More Villages and More Types of Crops	$400,000
• Cooperatives or Business Associations for Production and Marketing Date Palm or Other Horticultural Crops	$200,000
• Marketing Information System to Improve Decision Making Regarding Production and Marketing	$100,000
• Extension Materials Based on the Demonstration Programs to Transfer New Technologies or Crops Introduced by the Program	$200,000
• Training Courses Targeting Farmers, Extension Personnel, and MOA District Managers	$200,000
• Comprehensive Analysis of Irrigation and Drainage In Hawizeh and Hammar Marshes Following Reflooding	$500,000
• Investment in Cold Storage or Other Post Harvest Facilities Targeting Former Marsh Dwellers	$250,000
• Marketing Research and Training Program	$300,000
Agriculture Subtotal	*$2,150,000*

Livestock and Dairy Production

• Stimulating Private Sector Provisions of Veterinarian Services	$200,000
• Expanded Efforts to Assist Women and Girls in Education and Income-Generation	$500,000
• New Technologies for Household Dairy Processing	$250,000
• Strengthening Burgeoning Private Sector Initiatives in Dairy Processing	$500,000
• Livestock and Dairy Market Operations Improvements	$500,000
Livestock Sub-total	*$1,950,000*

Capture Fishing and Fish Farming

• Rehabilitation of Marshland Fish Habitats	$1,000,000
• Upgrading he Design of Fish Culture Facilities	$12,000
• Construction of Eleven More Model Fish Farms	$900,000
• Design and Construction of Three New Large-Scale Hatcheries	$850,000
• Training Fish Farmers and Extension Agents	$75,000
• Purchase of Fish Transport Vehicles	$240,000
• Securing Necessary Chemotherapeutants for the Longer Term Program	$12,000
• Construction of a Small Feed Milling and Pelleting System	$120,000
• Applied Fish Culture Research	$120,000
• Implementation of Fishery Co-management Efforts	$100,000
• Monitoring Changes in the Fishing Systems	$300,000
Fishing Subtotal	*$3,729,000*

Public Health

• Additional Health Clinics in the Marshes	$2,000,000
• Expanded Efforts to Provide Health Education	$100,000
Public Health Subtotal	*$2,100,000*

Constructed Wetlands

• Additional Constructed Wetland Sites	$1,000,000
Total for Marshlands Tasks for Years 2-3	**$13,879,000**