Tamil Nadu, Odile Oswald is working with staff of Anna University Centre for Water Resources Development to develop an Expert System for diagnosing Tanks. Using concepts from the field of artificial intelligence, Oswald is trying to incorporate some of the cognitive steps by human experts in diagnosing the needs for improving tank irrigation systems. Faced with 30,000 tanks in the state of Tamil Nadu, and a handful of human experts, it only makes sense to look to computers for help.

Innovative example of Action research in Nepal has been initiated by Water and Energy Commissionariat (WECs), in collaboration with IIMI-Nepal, to provide low-input, payoff assistance to remote FMIS areas in the hills bordering the Indrawati river. The idea is to provide limited assistance that will enhance farmers' self-reliance, and contribute to sustainable development. The approach includes Farmer-to-Farmer Training. Farmers from the study area visit farmers from smoothly functioning hill irrigation systems in other districts to learn about the management arrangements that have developed there.

Finally, a brief report on Dambos in the Tessaout Plain of Morocco is presented. The indigenous organizations that have operated and maintained the existing systems are a resource which can play an important role in managing the new, enlarged systems. How to facilitate the transition from pure farmer-management to a situation of joint management, is the subject of a new study being undertaken by A. Herzenni of the Institut Agronomique et Veterinaire - Hassan II.

Large-Scale FMIS in Morocco

Farmer-managed irrigation systems in the Tessaout Plain of Morocco are among the largest in the world, with command areas ranging up to 12,000 ha. Today these large-scale diversion systems, built and operated by farmers for many centuries, are being incorporated into still larger agency-managed irrigation systems administered by regional development authorities (ORMVAs -- "Organisations Regionaux pour le Mise en Valeur Agricole").

The indigenous organizations that have operated and maintained the existing systems are a resource which can play an important role in managing the new, enlarged systems. How to facilitate the transition from pure farmer-management to a situation of joint management, is the subject of a new study being undertaken by A. Herzenni of the Institut Agronomique et Veterinaire - Hassan II.

Since the establishment of an ORMVA in the Haouz Plateau in 1966, it has grown in two stages. First, the original command area around the city of Marrakech was developed. Next, a 40,000 ha section of the Tessaout Plateau, called the Tessaout Amont, was added. This section included a number of large-scale FMIS, some of which retained their basic identity after incorporation, while others were thoroughly reconstructed. Today, work is starting on a third phase of expansion, into the Tessaout Aval, an area of roughly the same size and features (e.g., many large existing FMISs) as the Tessaout Amont. Research on how best to build upon the organizational resources of the new T-Aval area will begin by documenting and understanding the experience of the past decade in T-Amont.
The need for new physical structures in the T-Aval region stems from the diversion of the previous water source. The river formerly supplying water to the T-Aval has been tapped further upstream by a new, largely automated canal which carries water 70 km to the west, to supplement the original Haouz Central command area. The water rights of farmers in the T-Aval will now be met by another new canal from the East. At the same time, the small seasonal rivers (Oueds) in the T-Aval catchment are being harnessed more thoroughly, by building small dams.

About 90% of the land in T-Aval is owned collectively, and nearly all cultivable land is already in production, a good portion of it (ca. 25%) in irrigated olives. Water is often "celibataire" (not tied to the land) so trading of water and land can be done separately. As part of the work to prepare the area for improvements, ORMVA staff are preparing lists of individual water and land rights, so that existing water rights can be ensured under the new project. Physical improvements will be limited to secondary and some of the tertiary canals; in general, the improved canals will follow their existing channels. The standard construction will be elevated semi-circular concrete channels, which are ubiquitous in Moroccan irrigation systems. Existing land tenure patterns will not be directly affected by the project; most of the collectives have land in 2 or 3 different locations, and each member of that collective has land in each place. This situation will remain the same, along with the organizational structure of the collectives. Thus, the ORMVA staff will interact with local leaders who occupy traditional positions of authority within their respective collectives. Other existing organizations, in addition to traditional water associations, include Associations Syndicats Privilèges (ASP) established during the days of the Protectorate (pre-1956). These play an intermediary role between farmers and the ORMVA.

Diversification is taking place from grains into orchards, and particularly olive orchards, which require smaller quantities of water over the entire year. Each of the 13 existing FMIS in the T-Aval area takes water from an intake along a 40 km stretch of the main Oued Tessaout, and commands an area of 300 - 12,000 ha. There are 28 sectors (some systems comprise more than one sector), each of which has water rights which must be respected under the new project. Each system's annual water debit has been calculated based on 30 years data, to see how much water is diverted into the main canal, and then how much water is actually delivered into the outlets. The difference between the two can be great; in one case, the water delivered to the outlets was calculated as 26% the amount diverted at the head of the canal.

The new management structure of T-Aval will rely on the participation of farmers, but the existing organizational structure will need to be adapted to new needs, e.g., water rotations. A 15-day rotational schedule is envisaged in T-Aval, to be implemented with the help of a 2-tier committee structure which would cross-cut existing organizations and would include both farmers and agency officials. Since farmers are generally more willing to take agricultural risks than are the agency field staff, some compromises will have to be made regarding timing of deliveries and extent of irrigated areas. National legislation governing the rights and duties of water user organizations is currently being implemented and will help strengthen the role of these committees. The Tessaout Plain is not the only area in Morocco where large indigenous canal systems are found, but it is one of the few places where these systems have thus far remained under farmer-management. That
situation is fast changing; the irrigation traditions of the Tessaout are being transformed, but important elements—both physical and organizational—will contribute to the working of the new expanded irrigation system.

- David Groenfeldt (based on a recent visit hosted by Rachid Abdellaoui and Abdellah Herzenni)

Bhutan Irrigation

Bhutan is a small landlocked Kingdom in the eastern Himalayas covering some 46,000 km² nearly all of which is mountainous. The topography becomes increasingly rugged northward from the lower foothills and includes large, south flowing rivers. Communication is difficult and even though a road system is being developed the 4 1/2 to 5 months of monsoon weather in the summer and snow and ice on high passes during winter make travelling extremely difficult. Although the country is located in the subtropical zone, the climate is diverse and varies from subtropical to tundra.

Physiographically there are many similarities with Nepal and Northern Indian Hill regions. In other ways however Bhutan is quite different. With a population of only 1.2 million, it is the least densely populated country in Southern Asia, but since the cultivable area is extremely limited there is considerable pressure on useful farm land. The average farm size is only 0.5 ha. Bhutan is considered to be one of the least developed countries and although it enjoys a long history, until recent times has been kept largely isolated from the rest of the world. The initial step toward modernization took place in 1950 and the first five year development plan began from 1961.

Agriculture, which mainly involves subsistence type farming, employs 95 percent of the population, and half the GDP and over a quarter of total export earnings. Bhutan is just beginning its 6th Five Year Plan. In this plan of "selective development" agriculture will play a major role. The long term goal of the agriculture sector is "to maximize the contribution of agricultural development to national self reliance and overall economic growth within a context of sound conservation".

Of Bhutan's total land area, only 3% is cultivated and with an annual population growth rate estimated at about 2% the pressure on arable land is increasing. Irrigation is an essential input in the drive to intensify agricultural production and an area of relatively major investment for the Royal Government of Bhutan (RGOB).

The potential for comparatively large scale development has been very limited and confined almost entirely to a few locations in the southern foothills. These schemes tend to be agency/centrally planned and have often included the clearing of forest areas and the settlement of people from both the immediate vicinity and/or from mid-hill areas of the country. Such developments have been severely handicapped by the combination of unfavorable geological conditions and extremely high, intensive rainfall common to this part of the country.

The current Five Year Plan questions the rationale of further extension of irrigation facilities in such areas and points towards available resources being diverted to research and development of other agricultural systems better suited to the agro-ecological conditions. Nevertheless it is clear that given adequate resources, a much higher level of success could have been