Intervention in Farmer-Managed Irrigation in Northeast Portugal: Results of an Inventory Study

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INTRODUCTION

Tras-os-Montes, a region in Northeast Portugal, has extensive farmer-managed irrigation. The systems which were constructed over the centuries, are managed, maintained and improved by farmers. This paper presents the methodology and results of the first phase of an on-going inventory study. The final objective of the inventory research is to develop a typology of FMIS with the aim to assess the adequacy of intervention strategies. The research focussed on all aspects of irrigation water management. The Uphoff-matrix of irrigation system activities was used as a basis to gather and systematize data on management of FMIS. The research utilized some rapid appraisal methods. During a period of three months, 24 villages in two agro-ecological zones were visited. Besides an inventory of water sources at the village level, data collection focussed on the management of the most important communal systems. Common features as well as diversity in the functioning of communal FMIS had been identified.

Water allocation principles, water availability and water distribution practices are considered determinant elements in explaining the enormous diversity among communal systems and their environments. Mountain areas and high elevation valleys show significant differences in these elements. They can be considered as building blocks for the construction of a typology for intervention purposes. Interventions by groups of water users nearly always bring about changes in these elements. Empirical evidence shows that water users also actively invest in individual irrigation facilities, principally in the high valleys. Currently, a government programme aimed at the improvement of FMIS is being carried out. The diverse reasons, forms and features of intervention by water users as well as the government have been identified. It is concluded that institutional interventions could be improved by taking into account three strategic elements:

- Developing an integrated approach to local irrigation development;
- Linking up this approach with actual interventions implemented by water users and local organizations; and
- Combining the implementation capacity and decision making of local water users and organizations with critical resources made available by state agencies and other institutions in an indirect investment approach.

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Traditional Farmer-Managed Irrigation Systems (FMIS)[24] serve an area of 550,000 ha or 83% of the total irrigated area in continental Portugal (DGRAH, 1987). The importance of farmer-managed irrigation is underscored by its use on small to very small family farms (<10 ha) in the country as a whole and in the northern and central parts in particular.

In the region of Tras-os-Montes (TM), Northeast Portugal, more than 1000 FMIS were identified, serving an estimated area of about 30,000 ha. The schemes are small, being concentrated in two agro-ecological zones: the Mountains and the High Valleys which form the Research Area (Figure 1). Small and very small family farms whose areas are divided in numerous plots constitute the prevailing production units.

The Tras-os-Montes Integrated Rural Development Project (PDRITM), launched by the Government in 1982 has defined the improvement of FMIS as a basic condition for agricultural development in TM. Effectively 116 FMIS had been improved till March 1990 (Portela, 1990). A second phase of this programme is being contemplated over a period of seven years.

The intervention program of FMIS in TM executed by PDRITM, has been set up without detailed knowledge about the complex functioning of traditional irrigation schemes prior to improvement. The research project "Intervention strategies in Traditional Farmer-Managed Irrigation Systems in Northern Portugal"[25]is aimed at getting a more clear insight into the functioning of existing FMIS prior to improvement, the actual intervention process as implemented by PDRITM and the effects which are generated by the interventions. As a component of the research project an inventory study of FMIS is being carried out.

The final objective of the inventory research is to develop a typology of FMIS which can serve as a tool for adequate interventions and to identify relevant elements for designing improved intervention strategies. The paper presents the methodology and the results of the first phase of this inventory research supplemented by post hoc observations and empirical material of case studies. The context wherein FMIS operate is the subject of the next section.

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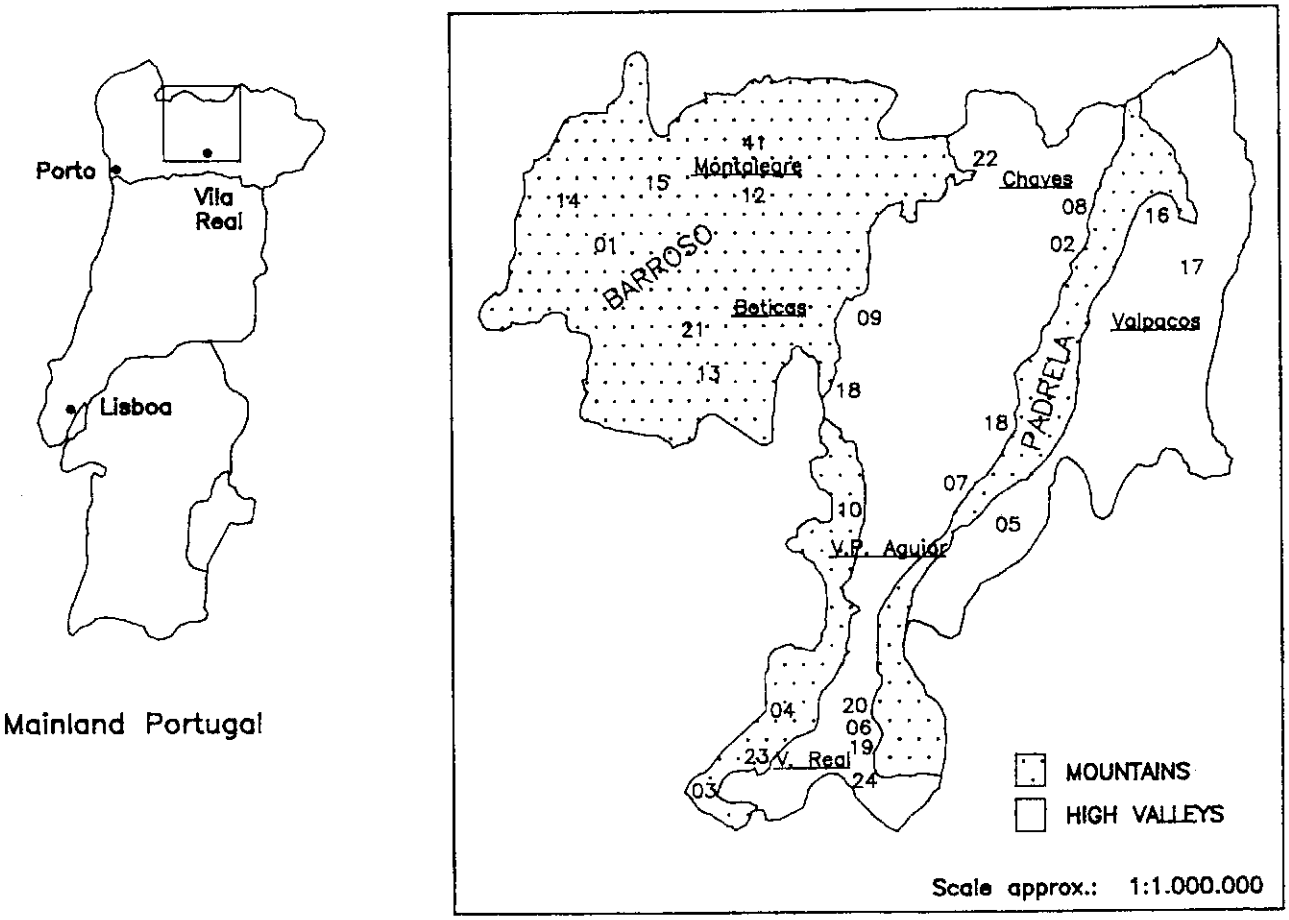
24 The term "Farmer-Managed Irrigation System (FMIS)" will be used for all those schemes which are constructed, maintained and managed by farmers, both collectively or individually. The qualification "traditional" indicates that these schemes generally have a long history. Until recent times, State intervention in "traditional" FMIS has been none or minimal.

25 The paper is a result of this research project. Its execution is a joint venture with the Department of Economics and Sociology (DES) of the University of Tras-os-Montes e Alto Douro (UTAD) in Vila Real, Portugal and the Department of Irrigation and Water Conservation of the Wageningen Agricultural University (WAU) in the Netherlands.

Figure 1. Research area with selected villages



SELECTED VILLAGES

01 CORVA	07 SEIXEDO	13 ROMAINHO	19 ST. MARTA
02 SESMIL	08 TRESMUNDES	14 PINCAES	20 ABOBOLEIRA
03 VILA COVA	09 SOBRADELA	15 FERVIDELAS	21 BOSTOFRIO
04 LAMAS D'OLO	10 ST. MARTA DO ALVAO	16 ADAES	22 SOUTELO
05 COVAS	11 MEIXEDO	17 SANTIAGO	23 GALEGOS DE SERRA
06 BOUCA	12 TORGUEDA	18 VILELA	24 VILALVA

THE RESEARCH AREA

Some relevant differences between mountainous areas and high valleys are shown in Table 1.

Table 1. Differences between mountains and high valleys

Characteristics	Mountains	High Valleys
a) Elevation	800 - 1200 m	400 - 800 m
b) Annual rainfall	700 - 1500 m	500 - 1500 m
c) Irrigated/total cultivated area	56% (Barroso) 40% (Alvao/Padrela)	21%
d) Farm size	77% of farms smaller than 5 ha.	81% of farms smaller than 5 ha.
e) Crop production	Rye/(seed) potatoes rotation. Permanent meadows (lameiros) and forage crops.	Rye/potatoes rotation. Forage crops and some "lameiros." Vineyards and olive trees.
	Communal lands ("baldios") used for grazing and forest.	"Baldios" less important for grazing.
	Cattle raising oriented to produce meat.	Cattle raising oriented for produce milk.

Besides the specific physical and local environment, FMIS operate in a broader socio-economic context from which we want to highlight the following points:

1) TM is commonly presented as the most depressed area of Portugal. It has an underdeveloped social and economic infrastructure (education and health facilities, roads, markets etc.).

2) The limited employment opportunities in TM outside agriculture. In 1982, still more than 70% of the labor force was engaged in agriculture (WB, 1982).

3) These factors have contributed decisively to the massive emigration from the rural zones since the late 50's. According to preliminary data of the 1989 census, in the last ten years, the population of TM diminished by more than 50,000 persons, which is more than 10% of the total population. In some rural zones, decreases of up to 30% have taken place in the same period. This massive emigration has profound influence on the management of farms and irrigation systems (See section 6).

The role and importance of irrigation in farming cannot be separated from overall household objectives and strategies. Some general features are:

- Making the best use of the fragmented plots and diverse land qualities and microclimates within the same farm. This explains in part the polycultural character of farms and the integration of agriculture and cattle raising. It also explains the very intensive land and labour use on the best accessible, most productive land with irrigation facilities.

- Production for household consumption (agriculture) and market (cattle raising).

- Negligible dependence on external inputs (i.e. from outside the farmers community), markets and resources for farm operation. Exchange relations of resources (principally labour but also irrigation water) between farming households are crucial in the operation of farms.

- Multiple income activities and seasonal emigration of farming household members to supplement income, to improve living conditions and to invest in the farm (land, cattle, machines, irrigation facilities).

Two climatic factors determine the need for irrigation. In the dry summer, large water deficits occur (up to about 200 mm/month). A crucial factor in irrigation development which justifies the distinction between the two agro-ecological zones, is the water availability which is significantly higher in the mountainous areas than in the high valleys. Also the production orientation is a determinant factor to assess the relative importance of irrigation. In the high valleys where milk production is dominant and as a consequence more and better cattle feedstuffs are required, irrigation of annual forage crops is very important. In the winter period (night) frosts occur frequently (60-80 frostdays/year). Irrigation of natural meadows ("Rega de lima") is very important, specially in the mountain areas, not only because of frost protection but, from the farmer's viewpoint, also because of the manuring value of the water and management of the meadows (control of vegetative growth and flora composition).

METHODOLOGICAL ASPECTS

From the objective of the inventory study, namely the development of a typology for adequate interventions and strategies, it follows that the research needed to be focussed on the actual functioning of FMIS, both those which have had interventions of external assistance and those which have not. The nature and effects of actual interventions need to be taken into account to identify relevant elements of improved intervention strategies.

The Uphoff-matrix of irrigation system activities was used as a basis to gather and systemize data on management of FMIS at the village level. Two questionnaires were developed and tested for this purpose: one to provide an inventory of all water sources and irrigation facilities at the village level, another to provide specific, detailed information on the functioning of the most important communal system. A communal system here is defined as the FMIS to which all or at least the majority of the households in a village have use access in the summer period.

In the first phase of the inventory work, 24 villages were visited in threemonths (January till March 1992). The research had clear aspects of a rapid appraisal. Each visit consisted of two days. This was considered as a compromise between depth and speed. Field work was mainly carried out by two teams, each consisting of a Dutch and a Portuguese researcher.

The criterion of selection of the villages was to have a sample of villages which is fairly representative of the research area. Selections were stratified to include systems which had and did not have external assistance interventions. Systems from both ecological zones were included in the research as well. However, Mountain systems and intervened systems are over represented. The selected villages are shown in Figure 1.

The method of data collection and processing concerning a village and the local communal system consisted of:

1) gathering secondary data about the village (physical, meteorological, demographic, agricultural etc.);

2) field visits which included semi-structured interviews with representatives of village organizations and farmers, field observations and a walk-through of the communal system; and

3) writing a field visit report consisting mainly of basic village information, a sketch of the communal irrigation system, the results of the two questionnaires (inventory of water resources and irrigation facilities at the village level, detailed information on the communal irrigation system).

In the next three sections, the most important findings of the inventory study will be summarized. It is worth stressing that this research work is still going on. Obviously, refinements or even reformulations of data interpretation might occur.

GENERAL ASPECTS OF FMIS

Generally, a multitude of water resources and irrigation facilities exists within a village. Water sources include small streams, springs, galleries (called "minas", from the Arab influence) shallow wells and deepwells. When summer is progressing, water availability becomes very reduced, especially in the high valleys (scheme flow becomes generally: <<5 1/s).

In this paper, we will first focus on communal systems. In the sample, irrigated areas (summer and winter included) have a range of two to 35 ha per system, the range for water users ranges from eight to 80 per system. Besides the communal systems many smaller groups, family and individual irrigation facilities can be distinguished at village level whose importance on the whole often may surpass that of communal systems, especially in villages situated in the High Valleys.

(Summer) irrigation perimeters are always located nearby the villages. Often they form an authentic man-made terraced landscape with numerous walls. Plots are small (most frequently 0.05-0.1 ha) with extremes of 5m2 to 0.5 ha), often irregular shaped with varying slopes. The plots are constituted by man-made soils which are heavily manured for hundreds of years. These plots are cultivated very intensively in a way that can be best compared to gardening.

In TM almost all irrigation water is applied by gravity methods, namely a special type of controlled flow irrigation (often locally called "rega por embelga") on sandy soils and furrow irrigation on more heavy soils. These methods require considerable skill and labour. Low flow rates imply a very intensive labour use in field irrigation (20-80 hours/ha for one irrigation turn). Application efficiencies are mostly near 100%. (de Castro Rego et al. 1990), which suggest underirrigation. Irrigation intervals in many schemes are too long from an agronomic viewpoint (up to 30 days).

From the analysis of data of the 24 systems some general features related to the construction and management of FMIS can be deduced.

- *Simplicity of irrigation facilities.* An irrigation system consists normally of a diversion structure at the water source, canal and in most cases reservoir. Water distribution structures are absent.

- *Simplicity of operation.* With some exception, waterflows are not divided, so the water user is using the whole flow in the system when it is his or her turn.

- *Few head-tail problems.* Many farmers have small parcels scattered around the irrigation perimeter. Individual water sources often supplement the communal scheme supply.

- *Collective resource mobilization* needed for operation and maintenance is minimal. Normally, water users participate in the collective maintenance efforts only during one day before the summer irrigation starts. At the individual water user level, on the other hand, a considerable amount of labour is needed for operation, routine maintenance, water application and sometimes source and canal patrolling in order to prevent water theft.

- *Absence of formal water users organization.* The day-to-day functioning of irrigation is informally organized. The importance of local leaders, interest groups and organizational issues comes to the surface in strategic moments (e.g. facing the beginning of the summer irrigation period) and for strategic decisions concerning the future of the scheme (e.g. improvement of scheme facilities, change of water allocation).

Aside from these common features, an enormous diversity exists in the functioning of FMIS, an issue that follows.

DIVERSITY IN FMIS: KEY ELEMENTS

An analysis of the data of the communal systems inventoried shows that the diverse functioning of FMIS is most clearly related to the water allocation and distribution[26] in the schemes. The development of irrigation is linked to the development of property rights which define user access to water.

In TM, the traditional irrigation systems were constructed over the centuries by farmers. Most frequently based on the contribution of the systems, farmers claimed user rights of water. These original water rights have changed by inheritance, marriage, buying/selling of land and/or water, negotiations and the external socio-political process. In other systems, the relation between resource contribution and access to water is less explicit, e.g. only separating those who are and are not entitled to use water from a certain source.

In the very heterogenous physical and socio-economic environments of TM, the historical process of irrigation development has resulted in different water allocation principles and water distribution practices in farmer-managed irrigation.

The following water allocation principles in communal schemes during the summer period[27] are found in Table 2 [28]:

[26] Allocation means the assignment of rights of access to the water among users, while distribution refers to the physical distribution of water among the users (Martin et al. 1987).

[27] Water allocation in FMIS has also clear temporal and spatial dimensions. Generally, water allocation principles are different in the Winter (October-March) and the Summer (June-September). The same applies to the transition period between Winter and Summer. During these periods, in most schemes the free-to-take or/and the "first come, first serve" type of water allocation are gradually applied. These temporal changes are clearly related with water availability and the importance of permanent meadow irrigation. In the Winter, other plots (with permanent meadows) are irrigated by less right holders.

[28] From the table, it seems clear that time shares systems are in the absolute majority. However, posterior empirical evidence shows that in this sample time share systems are over represented in relation to systems with other water allocation principles. In the paper also this posterior experience is incorporated.

Table 2. Summary of water allocation and water availability in the communal systems of selected villages

Village (for location see Figure 1)	Water Allocation Principles	Water Availability Scheme source flow	Agro Ecological Zones*	PDRITM Intervetion ended in:	Remarks/Interventions in system by Water Users (indicated only the most important)
01. Corva		5-15 litre/sec	M	1992	Conflict with Neighbour Village.
02. Sesmil		0-0.5 litre/sec	HV	1983	Change in Water Rights (1983-85)
03. Vila Cova		5-15 litre/sec	M	1986	
04. Lamas d"Olo		0-0.5 litre/sec	M	1990	
05. Covas		0-0.5 litre/sec	HV		
07. Seixedo		0-0.5 litre/sec	HV		Improvement by water users
08. Tresmundes	Time shares in August 1992	0-0.5 litre/sec	HV		
09. Sobradela		0-0.5 litre/sec	HV		Improvement by community
10. St. Marta do Alvao		1-5 litre/sec	M	1989	
15. Fervidelas		1-5 litre/sec	M	1992	
16. Adaes		0-0.5 litre/sec	HV		Improvement by water users
18. Vilela		0-0.5 litre/sec	HV		
19. St. Marta		0-0.5 litre/sec	HV		
20. Aboboleira		0.5-1 litre/sec	HV		Upstream of Bouca (6)
21. Bosto Frio		5-15 litre/sec	M		Improvement by community
11. Meixedo		0-0.5 litre/sec	M		1991 changes in water allocation type 2 to 5
12. Torgueda	Equal shares	1-5 litre/sec	M		Past changes in water allocation type 1 to 2 Improvement by community
17. Santiago	Parcel based	0-0.5 litre/sec	HV	1989	Discussion of water allocations type 3 to 1
24. Vilalva	Free-to-take	0.5-1 litre/sec	HV	1991	Discussion of water allocation type 4 to 1
06. Bouca	First come, first served	0-0.5 litre/sec	HV		Pasrt changes in water allocation type 1 to 5
22. Soutel		0.05 litre/sec	HV		
13. Romainno	Multi level 5	15-25 litre/sec	M	1989	Discussion of simplification water allocation
14. Pincaes	Multi level time parcel	15-25 litre/sec	M		Improvement by commission of "Baldio"
23. Galegos	Multi level time parcel				Improvement by community

* HV: High Valleys
M: Mountainous Areas

1. *Time shares*. The water user is entitled to use the whole scheme of flow for certain time period in a fixed irrigation interval. Rights are unequally divided between water users but are linked to land area.

Water right holders have, in principle, the freedom to irrigate as they like. In practice however, the scatteredness of one's plots in the scheme and the obligation to put the water at the beginning of the time period of the next water user at the entrance of his parcel, can seriously limit this freedom. Because of the fragmentation of land and water rights, in some schemes water right holders have their total time share also fragmented in small periods during the irrigation interval. This has consequences for the organization of labour resources on the farm.

2. *Equal shares*. Every social unit or household in the village is entitled to use the whole scheme flow for a period of time which is equal for every water user. The water users can do with their water whatever they like. To make use of this right, one has to participate in the maintenance of the scheme and/or to contribute to certain tasks of common interest. In some cases, one has also to be resident in the village. As a consequence, emigrants lose the water right till they return to the village. In other cases, even village inhabitants without land are entitled to the same share which can then be transacted then.

3. *Parcel based*. The owner of a specific parcel is entitled to use the whole scheme flow until his parcel is irrigated "sufficiently." In this context, "sufficiently" is a socially negotiable concept. One cannot continue irrigating indefinitely, arguing that the parcel still needs more water.

Comparing this type of water allocation with the former types, some interesting differences appear. In time-based allocation systems the right holder can use the water on whatever crop he likes. In the parcel-based allocation, irrigation of meadows is not permitted because the irrigation method of meadows (contour ditch irrigation or wild flooding) uses much more water than the irrigation methods of food crops. Thus meadow irrigation would prejudice other water users without meadows. Another implication of the parcel-based allocation principle is that the irrigation interval changes with the discharge at the source. When water scarcity is increasing with the progression of the summer, the interval can increase from 8-15 days to more than a month.

4. *"Free to take"*. The owner of a parcel, which can be served by the water source or irrigation canal, has the right to use the whole scheme flow whenever he or she wants. No rules exist. In practice, owners of plots at the head-end or owners of pumps profit most from the water. However, this allocation principle in the purest form does not occur frequently. This principle is frequently found among systems which depend on the same surface water source. It can often lead to conflicts (e.g. Corva).

5. *"First come, first served."* "Free to take" but it is normally arranged with agreements. One basic rule exists: as long as one person is irrigating, he or she will be respected. The other water users wait until that person is finished. This principle has some characteristics of a demand system, but households with more resources than others (e.g. labour force to wait for the water) apparently profit more. Also, restrictions on irrigation

of meadows in the summer exist for the same reason as explained in the parcel-based principle.

6. *Multi-level types of water allocation.* FMIS also have different allocation principles at various levels of some schemes. Irrigation systems have been found with very complex water allocation arrangements (e.g. Romainho). Within this category, most frequently a two-level distribution is found in which water is distributed to groups of water users on time basis and within the group from parcel to parcel. These multi-level types probably did not exist when the schemes were constructed but its emergence was apparently a consequence of an ongoing fragmentation of land and water rights.

Water allocation principles offer differential degrees of flexibility and rigidity of water use at the farm and parcel levels (van den Dries, 1992). Restrictions on crop choice, plots, exchange and commerce of water, are mainly determined by the water allocation principle in the system under consideration. The same is valid for irrigation variables at plot level (e.g., fixed or variable irrigation intervals). The water allocation principle in combination with water availability is a crucial element in farm household decision making concerning land use (crops, plots, intensity) and resource management and allocation (labor, inputs) on the farm.

WATER DISTRIBUTION

In general one could state that distribution practices have been developed to meet the requirements of the different water allocation principles but water distribution is necessarily complex in the diverse micro-environments of TM. Discharges from water sources are often too low to irrigate directly. Conveyance losses in the canals are often too hihg to enable water storage. Through sale and inheritance, water rights become fragmented which is associated with division and scatter of parcels.

In many cases, the result of these factors is that water for an individual water user becomes almost unmanageable, e.g. it is impossible to irrigate a single parcel in, say, half an hour, especially if it is located 800 m from a water source with a discharge of 1 /1s and with an unimproved earthen canal. Water would never reach the plot.

Another effect of the fragmentation of plots and water rights is that relative water scarcity increased. Formerly one landowner had more flexibility to make a plan for the summer period, which plots to sow with what crop, individually taking in account his prospects in relation to water availability (H. Bleumink and M. Kuyk, 1992)

In recent times, water users have developed a set of complex group mechanisms, rules and practices to distribute the water and to manage irrigation. These are products of history and tailored to the specific local situation and conditions of each irrigation system. This makes the management of these systems a local art.

Water distribution is not an independent tradition on its own but is part of the local complex of social relations, agricultural strategies, water availability and water rights. It is in this complex that interventions to assist farmer managed irrigation systems occur. Without some understanding of these inter-relationships, interventions are likely to create uninteded effects.

INTERVENTIONS IN FMIS

One may say that FMIS in TM are relatively successful in achieving the objectives for which they were created. This is apparent given their long existence and continuing use, which demonstrate their sustainability and resilience to change.

FMIS are dynamic systems which respond to the changing needs of users. Farmers try to adapt, change and improve their schemes. Attempts to overcome constraints in the environment and rigidities in the functioning of the schemes are often made by farmers.

If the schemes do not or cannot respond satisfactorily to the needs of water users, farmers also look individually or in small groups for opportunities outside the communal schemes in order to develop their own water resources and strategies to obtain water.

Evidence shows that water users themselves actively intervene in irrigation development, both inside and outside the communal systems. In this paper we will distinguish the following types of interventions.

Adaptation. Within the limitations and rigidities of a particular system, water users try to make the most out of generally small quantities of available water. Many strategies can be distinguished. Water distribution is made more flexible through exchange of water turns, or more broadly, the exchange of different resources (e.g. labour against water etc). Water users explore opportunities to make individual or group arrangements among them within the limits set by the management principles and physical constraints of the systems. Water and/or land of emigrants is used by other water users through various arrangements. A range of local agronomic practices are used for adaptation to, or escaping from, various degrees of water scarcity. This interplay has developed into another local art form. Examples of such adaptations are crop combincations, rotations, varieties, sowing and harvest times, and plant densities.

Changes in Water allocation principles and water distribution practices. In some schemes, examined in the inventory, farmer communities have changed management practices and in other schemes discussions are taking place to change the actual water allocation principles (see Table 2). It is understandable that these changes are the outcome of a complex social process because this type of change involves changes in social relations and resources which farming households control. For some groups of water users actual water allocation and distribution is more beneficial than for others. Usually long time periods are needed but changes nevertheless occur. In the village of Sesmil, the improvement of the communal systems by PDRITM was used as an opportunity by a group of water users headed by a local leader to change the distribution of water rights through linking the new distribution of water rights to the labour contribution of water users in the improvement works.

Events such as transactions and division by inheritance of land and/or water are equally used as opportunities for change.

In some systems observed, water allocation and distribution is viewed by an increasing number of water users (principally young people) as too complicated. In Vila Cova young water users are regularly consulting older farmers about the periods they have access to water. Besides being complicated, the actual water distribution is very time consuming. Some water users have numerous short turns for fragmented holdings which are sometimes spread over 11 days (which is the irrigation interval).

Improvement of irrigation facilities. The largest physical constraint in many irrigation schemes in TM is the scarcity of water at the scheme and field levels. Numerous partial improvements of irrigation facilities implemented by farmer communities themselves have been found. Two types of improvements can be distinguished. First, attempts to limit losses in the canals and reservoirs by means of lining and secondly, to get more water by developing existing and new water sources. These improvements in many cases are supported by local organizations such as the "Junta de Freguesia" (the political-administrative unit of the Portuguese government at the lowest local level) or the "Commissao de Baldios" (Management Commission of Communal Wasteland).

Individual Water Resources Development. For many years, farmers developed their own water resources, such as springs, wells and galleries. Two developments have enormously accelerated in some regions, in the high valleys where the search ror water and the development of private water sources especially is intensifying. These are the impact of emigration and the availability of modern technology.

One of the impacts of returning emigrants, principally in the 70s and the early 80s, was that they brought back with them capital used for investments in water source development on an individual basis. At the same time, new technology became available that supported this type of development.

Long PVC tube lines made it feasible to transport small quantities of water from long distance water sources to the best plots near the villages. This supplemented available water from the traditional systems and/or decreased dependence on the traditional communal systems. This stimulated the creation of small enterprises to develop water sources and to dig trenches for the tubes. Other technologies used widely in TM to reinforce available water quantities is the deep tubewell and electric motor pump. The development of sources for drinking water and the construction of supply lines to homes is also quite recent. The dynamics of the rush for the exploitation of water sources has even led to situations in certain villages in which existent irrigation schemes are being undermined and the available water for these schemes is diminishing.

This is happening in some cases to such a degree that some communal systems virtually have become defunct. This problem is further aggravated by two factors. One is the effect of emigrants who spend holidays in August in their villages. The population of a common village will sometimes double or triple during this period. The combination of this sudden population increase and more demanding water consumption habits leads to high requirements during one of the driest months of the year.

State Interventions

An important development since 1982 has been the involvement of the Portuguese government in irrigation development in Tras-os-Montes, financed by World Bank loans and structural adjustment funds of the European Economic Community. The government-supported programme for irrigation development consists of two components.

1) *Improvement of traditional irrigation schemes.* The PDRITM intervention program for improvement of communal FMIS aims at developing intensive dairying based on increased forage production. The type of intervention is conceptually not very different from the initiatives which the farmer communities already by themselves have undertaken.

   Contrary to some other rehabilitation programmes worldwide, it respects the existing local situation with its intricate complexities. So, the interventions don't change the functioning of the irrigation schemes but focus on the improvement of the physical infrastructure of the schemes, essentially by limiting water losses by lining of canals and reservoirs. Improvement will only be implemented if at least two-thirds of the water users agree and subscribe to the respective protocol. Direct resource contributions (labor or other) of the water users are also required (5 to 20% of the value of the total investment).

   The implementation process and the effects of the interventions of the PDRITM programme for improvement of traditional irrigation systems are extensively documented (Portela et al. 1985, 1987, 1990). In this paper we will summarize the most important conclusions:

   - Surveys indicate that water users agree that the PDRITM interventions produced multiple benefits both at farm and village levels. (These are mainly diminished summer water scarcity and less labor required for operation and maintenance.)

   - Design errors are identified by water users in some villages (principally in the mountain zone). Canals were sometimes designed for supplementary irrigation or were substituted by tubes. These canals and tubes disrupted winter irrigation (which has to be done with larger raters of discharge with often more silted water). This reportedly reduced the yields of permanent natural pastures.

   - Government interventions have had generally modest impacts which have mainly been small increases of water availability at scheme source level.

- The selection and prioritization of schemes for intervention is not very systematic and is subjected to pressure of political power groups. Selection criteria are more based on the convenience of the implementing agency. Actual water management and the productive potential of a scheme plays a minor role. It can be shown that a standardized type of intervention, namely the improvement of irrigation facilities, leads to different results in irrigation schemes which have different water allocation principles (van den Dries, 1992). This leads to differential production effects from incremental increases in water in the various schemes.

- Water users are usually not involved in the planning and design phases of the intervention. This leads to conceptual errors in the design and to unnecessary problems and delays in the implementation phase.

2) *Construction of new small-scale irrigation systems.* The most salient aspects of newly constructed systems are:

   - The process of planning, design and construction of the scheme is essentially an external intervention with nearly no participation by future water users.

   - There is an increase in summer time water availability through the construction of small dams and storage tanks (in the order of a million m3 per scheme). In this sense, the intervention responds to one of the most commonly felt needs of farmers, more water.

   Not much experience is yet available woith construction of new small-scale schemes but PDRITM will in the future focus on these type of schemes more and more.

We will now address the question of which elements can be considered as building blocks for intervention strategies as a model for assistance programs.

BUILDING BLOCKS OF A MODEL FOR INTERVENTION STRATEGIES FOR FMIS

The inventory study shows clearly the existence of different development patterns of farmer-managed irrigation, some bing communally and others being individually managed.

In some places these tendencies are parallel developments, in other places individual irrigation development undermines communal systems which consequently lead to a decline in performance and sometimes to a complete abandonment of communal schemes. This last phenomenon is occurring most clearly in the zone of the high valleys. In the mountain areas farmers invest also in individual irrigation facilities. However, communal systems are still the most important type at the village level. These patterns are clearly related to the balance between water needs of the farmers and local water availability.

In future institutional interventions, these development patterns need to be considered in each locality. This points to the necessity of consultation with the farmer community to develop an integrated approach to local irrigation development. As an outcome of this approach a whole range of interventions need to be considered, not only improvement of the physical infrastructure of communal systems Such an integrated approach implies that intervention doesn't need to be limited to one village but can be extended to a catchment area in the case where various irrigation systems depend on the same surface water resource or even to a whole region where groundwater development is relevant. One constraint on development at the level of a resource area is the obsolete Portuguese water legislation and deficient application (Matos Ferreira, 1989).

A typology of FMIS for intervention purposes in communal systems can be constructed on three fundamental principles, or building blocks. These are allocation principles, water availability and water distribution practices. This typology can contribute to defining the contents of intervention (what to do). These elements are operational in the sense that they can be changed. As mentioned above, interventions implemented by water users themselves nearly always concern changes in these elements. They can also be linked to (certain) contextual and environmental factors (e.g. agro-ecological, production orientation etc.) related to regional planning purposes. Institutional interventions by state agencies, collective organizations can contribute to realizing these changes.

Another relevant question is the implementation process of interventions ("the who and how" questions). The fact that farmer communities, in many cases supported by other local organizations, actively intervene in irrigation development is of crucial importance. It is an indicator of the capacity and decision making of water users and their organizations to create and change things. It represents a potential that is actually not used by external interventions. We think that this resource can be combined with external efforts to improve interventions through an approach similar to what Coward has called, "*the indirect investment approach*". Through indirect investment, critical resources are provided by state agencies to local irrigation groups to create and improve those locally owned and managed systems (Coward, 1985).

CONCLUSIONS

Inspite of its "*rapid appraisal*" nature, the methodology used in this inventorysutdy has given satisfactory results. However, qualifying information of different actors needs to be strengthened. Because of the quantity of information gathered more time needs to be spent for data processing and analysis. The difference in professional background (irrigation engineers vs. agronomists/sociologists) and experience was not an obstacle but, on the contrary, a stimulus for collaboration.

The inventory study proved to be powerful tool in gaining insights into FMIS, their management features, problems, potentialities and the environments in which they are located. It permitted identification of what was going on in the traditional irrigation sector of the mountain zones and high valleys and identification of important problems to focus on. The inventory study was very useful for the selection of case study sites in accordance with identified research priorities.

It is our conclusion that if groups of water users (who ultimately are the risk-takers of irrigation investments) are given their due status and roles they can make themselves accountable before external actors and can productively contrinute their own local knowledge and resources.

The irrigation infrastructure of a village forms a complex network of different water sources, reservoirs, canals and fields dispersed around the village territory, which at the first sight gives an impression of chaos. One is struck with the simplicity and practicality of irrigation facilities, their operation and the very informal day-to-day management. It looks as if a secret covenant is putting everything in order. In reality FMIS and their functioning is the concrete expression of accumulated collective experience and the outcome of a historical process with its dynamic dichotomies of adaptation vs change, observation vs action, confronting constraints vs realizing potentialities and opportunities - all in an arena with different actors in a locally-unique physical environment.

Three key factors are considered determining elements in explaining the enormous diversity among communal systems and their environments. Water allocation principles, water availability and, to a lesser degree, water distribution practices have been identified as basic building blocks for the construction of a model for intervention purposes. Interventions by groups of water users or government agencies always involved change in one or more of these elements.

In our opinion to optimize the benefits of external interventions for the development of farmer-managed irrigation, the following strategic elements are important:

- Developing an integrated approach to local irrigation development.
- Linking this approach with actual interventions implemented by water users and local organizations.
- Combining the implementation capacity and decision making of local water users and organizations with critical resources made available by state agencies and other institutions in an indirect investment approach.

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