Water Management in the ‚Moral Hazard Trap'
The Example of Irrigation[1]

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Abstract

In a world of growing water scarcity, a key challenge consists in efficieny improvements in irrigated agriculture. Common reactions to this challenge focus on technical, financial and/or organisational improvements. While such efforts may be well justified in many cases, they often run the risk of overlooking some of the major causes for inefficiencies in the first place. These problems relate to the fact that efficieny deficits may be well in the interest of most of the influential stakeholders involved. It is here, where so-called "Principal-Agent" problems and the related "Moral Hazard"situations deserve attention, since they open doors to rentseeking and corruption.
This paper, which refers to initiatives in the context of irrigation sector reforms in Andhra Pradesh, India, in the wake of the Farmers' Management of Irrigation Systems Act (FMISA) of 1997, does not aim at reflecting the actual situation of irrigation in Andhra Pradesh. Instead, referring to the situation at the end of the 1990s, it seeks to illustrate how concepts of "Principal-Agent" theory may be applied in practical cases where efficient and effective irrigation management is seriously hampered by deficient exchange relationships between the relevant stakeholders. The paper analyses the institutions for irrigation fee collection and water delivery in the Sriramsagar irrigation scheme and shows how some of the reform initiatives were geared to resolve substantial Moral Hazard dead locks.

1. Introduction

Irrigation reforms launched in the Indian state of Andhra Pradesh in the second half of the 1990's produced a rather astonishing result[2]. With the firm establishment of water user associations (WUA's) and some further reform steps in 1997 in the Kakatiya canal reach of the Sriramsagar irrigation scheme, the actally irrigated area increased from 37,450 hectares in 1996 to 95,900 hectares one year later, reaching 135,600 hectares in 1998 (Maruti 1999). What had happened? How was that tremendous "achievement" possible? Did farmers' increased motivation in the wake of the taking over of certain management responsibilities result in such enormous increases in irrigation activities?

A number of explanations for this tremendous expansion in area irrigated were put forward: Land use records were updated during this period and made much more inclusive. Also, in many cases, only one single irrigation provision in tail end areas led to such areas being reported as "irrigated areas", inflating the figures by ignoring the quality of irrigation service received by users. And finally, because little or no maintenance had been done in the

[1] Paper presented at World Water Week 2005 in Stockholm, seminar on 'Corruption in the Water Sector: How to fight it?'
[2] The statements in this paper relating to irrigation sector reforms in Andhra Pradesh, India, in the wake of the Farmers' Management of Irrigation Systems Act (FMISA) of 1997, refer to the situation by the end of the 1990's and draw on Svendsen and Huppert (2000).

Sriramsagar project before, the impacts of water users clearing blockages were exceptionally large. However, local officials of the State “Irrigation and Command Area Development Department” (ICADD) estimated that revisions of the revenue records were the most important source of the increase.

In case this observation is correct, one may assume that the following process took place after the creation of WUA’s:

Before the reform, irrigation fees were collected by “village revenue collectors” for a certain canal reach on the basis of types of crop and area irrigated. The collected sum of revenues had to be handed over to the revenue department. Water users did not have access to revenue records and hence could not verify the amounts handed in by the collectors. At the same time, the revenue department did not have the means to monitor and control closely the crops and areas irrigated in a certain period and hence the amounts collected. This structural deficit opened doors to opportunistic behavior of the village revenue officers. They were faced with the temptation to hand in amounts of money substantially lower than the amounts actally collected, without running the risk of being held accountable - a temptation not easy to resist given the poor salary level of irrigation staff. Hence, the area irrigated as documented by the revenue records did not at all reflect the area irrigated in reality. With the establishment of WUA’s, the water users gained access to the revenue records. More importantly, the reformers had implemented several steps to modify the incentives relating to irrigation fee assessment and payment. The most important was tying WUA maintenance grants to the area registered with the Revenue Department. Consequently, the WUA was keen to have the actually irrigated area on the tax roles and get the full amount of the grant it was entitled to receive. The benefit for the Traesury was an increase in revenue to the state. The enormous increases in area irrigated following the creation of WUA’s turned out to be due to increased efforts of the water users only to a minor extent. Instead, they were mainly the effect of institutional changes that closed doors to corrupt practices of some of the involved stakeholders.

Problems like these are common in large irrigation systems where the institutional set-up leaves room for opportunistic behavior, and where there is little risk of discovery and sanctions being imposed. Ul Hassan (1999) reports from large irrigation schemes in Pakistan that ”Financial indiscipline in terms of corruption in the management of canal systems has emerged as the most important issue that has led to a widespread mistrust between the canal managers and the farmers”. He refers to Bandaragoda and Firdousi (1992) who found

corruption to be widespread in the assessment and collection of revenues, construction and maintenance works related to irrigation and drainage, and water allocation and distribution.

One important lesson can be drawn from the reform experiences in Andhra Pradesh. Faced with system inefficiencies in irrigation, it is of utmost importance to analyse the incentive system which influences the behavior of the various actors.

Irrigation management often suffers from adverse motivational structures inherent in the organizational design of the irrigation system. This is a fact often overlooked when analyzing the causes of suboptimal performance of irrigation schemes.

Repetto (1986) states: “

“To a large extent, the current emphasis on management as the critical problem in public irrigation reflects acceptance of the long-dominant engineering perspective. Most engineers, who still run virtually all irrigation agencies, conceptualize irrigation projects as hydraulic systems designed and built to operate in certain ways. If they don’t actually operate that way in practice, then, according to the engineers „they are not being managed properly“. However, seen not as hydraulic but as socio-economic systems, those same irrigation projects are designed to operate in quite a different way – in accordance with the principles of rent-seeking – and in fact, they do so“.

The aim of this paper is to draw attention to a particular range of problems – the so-called “principal-agent problems”. These are particularly common in medium and large scale irrigation systems all over the world and result in highly dysfunctional motivation patterns on the part of the key players. Such problems invite rentseeking behavior and corruption, and tackling such problems is a delicate matter. This is why they tend to be ”overlooked” in problem analyses, despite their visibility in everyday system operations. It is important to emphasize that structural problems like these will encourage opportunistic behavior whereever they occur – independent of the regional or cultural context in which a particular organization operates. Hence, it is essential to be aware of such problems and to devise ways how to circumvent or counteract them.

The paper first explains the characteristics of principal-agent problems, concentrating on so-called “Moral Hazard” problems. Following this, the significance of such problems in the irrigation sector is highlighted with reference to some examples and, finally, suggestions are made for coping with these problems.

2. The nature of Principal-Agent problems

Recent discussions on irrigation management refer to the nature of irrigation water delivery and system maintenance as service provisions and not simply as the performance of technical tasks (Huppert 1989; Svendsen, 1994; Huppert and Urban 1998; Malano and van Hofwegen 1998; Huppert et. al 2001). Such irrigation services can only be understood in terms of *interactive processes* with a variety of contributors. *Multiple actors* have to invest money, time, physical and mental effort, attention, and other suitable resources into a process that eventually generates the desired result, for example the water delivery and the maintenance of an irrigation system. If we look at irrigation water delivery and maintenance in terms of interactive processes of service provision and exchange, it becomes easier to understand why some irrigation systems do not perform well – even though up-to-date technology and sufficient budgetary allocations have been provided. Such inputs may be important ingredients to irrigation management. Yet, they will be wasted, unless their use is organised in a way that prevents the actors from 'abusing' them.

Temptations to abuse water systems and to uphold or introduce inefficiencies for personal gain stem partly from so-called "principal-agent problems". Generally speaking, principal-agent problems are deficiencies related to contracts and agreements between exchange partners, e.g. between the provider (the agent) and the customer/client (the principal) of goods or services (Furubotn and Richter, 1997). Since such deficiencies are pertinent in many fields of water management and in development cooperation in general, it appears to be worth the effort, to have a closer look at exchange relationships in general and at the situations that seem to be so overly attractive to opportunistic behaviour. Let us consider a so-called "complete" contract relationship between the provider of a good or service and the customer or client of this provision as illustrated in Fig. 1.

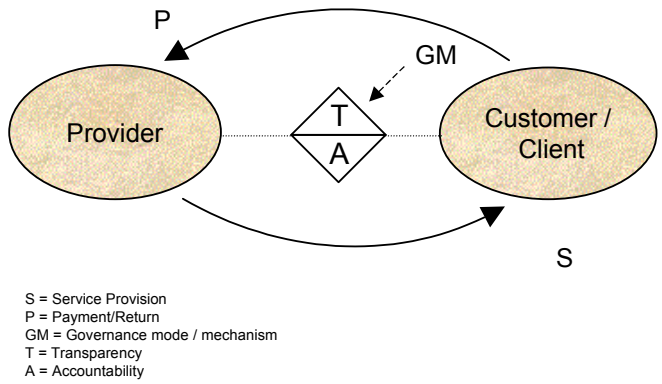

Fig. 1 Illustration of a "complete" contract relationship

In such an exchange relationship, the concerned transaction can be easily described: the goods or services that are exchanged are truly determinable and it is possible ex ante to specify clearly which services and returns (e.g. payment) will be provided. Hence, there is complete transparency for both parties about the contents of the exchange (indicated by the "T" in Figure 1). Furthermore, these goods or services are objectively verifiable ex post by third parties and there are clear and enforcable rules and laws that govern the relationship (indicated by the governance modes and mechanisms "GM" in Figure 1). This, in turn, implies that it will be easy to check and ensure mutual accountability (indicated by the "A" in Figure 1). Such a context of a contract situation is termed a "complete" contract by institutional economics (Furubotn and Richter, 1997).

The purchase of a new piece of pipe by an irrigation farmer is an example for this kind of contractual relationship: the amount and the quality of the good as well as the price are unambiguously defined. Service and return are delivered (almost) simultaneously, on a kind of 'spot-market'. There are laws and courts to enforce each party's rights and duties in case one party cheats. The contractual exchange will work, no matter who the buyer is. All of the contractual provisions can be specified in advance, monitored, verified, and enforced.

Unfortunately, this is not the kind of contractual relationship that we usually find in irrigation management in developing countries. Given the high level of complexity and uncertainty surrounding typical tasks in irrigation management, a different kind of service relationship will have to be established in many cases (Wolff and Huppert, 2002). A lot of the services involved cannot be described in an exhaustive manner in advance. Many of them cover longer periods of time and are susceptible to a great number of external influencing factors. Take for example the service of "organizational development support to the establishment and strengthening of Water User Associations" as commissioned by the Irrigation Department (the principal) of a particular country to a consulting company (the agent). There is no spot-market for this kind of service anymore. Instead, the production and delivery of the service requires a contract which is conditional on a variety of parameters. It is no longer possible to describe every detail of the service to be provided, since this provision is highly contingent on factors such as the interaction with and the inputs of the Water Users during the service provision. And such factors are highly unpredictable in most cases. In institutional economics, one speaks of "incomplete" contracting situations in cases like these (see e.g. Furubotn and Richter, 1997).

Nevertheless, even in such incomplete contracting situations, the parties concerned might consider it desirable to enter into an exchange relationship, because the expected benefits

outweigh the expected cost. Before they can do this, they must come to a consensus on the contractual goal with a verifiable definition. However, when it comes to decisions on the means to be used to achieve this goal, there must be sufficient freedom for the consultant to use new information, to adjust to unforeseen circumstances and to use her professional insight and methodologies that are unknown to the principal, the Irrigation Department. This, however, implies that the agent will have more information on the provision process than does the principal. Such a so-called "information asymmetry" and the related lack of transparency (see the shaded "T" in Figure 2 below) are, on the one hand, both necessary and desirable since they reflect the division of labour and the specialisation of the agent. On the other hand, though, the actor who is not as well informed, the principal (in our case the Irrigation Department), runs the risk of being exploited by the better informed agent. Whether or not the agent will behave in such a manner depends on her moral attitude and on the nature of the "contract"[3] between the two parties.

3. "Moral Hazard" situations

An uneven distribution of information after the conclusion of the contract, i.e. during contract implementation, entails a so-called "Moral Hazard" risk (Milgrom and Roberts, 1992; Wolff, 1995).

Such an information asymmetry may relate to two types of information :

First, it can refer to information on the quality of the service provided and the efforts made in reality by the agent to ensure optimal service provision. When this type of information is not accessible by the principal, the resultant scenario is referred to as *hidden action* of the agent. The principal cannot observe or monitor the actions of the agent he has commissioned, only the results of these actions. However, since the results can also be influenced by other factors related to the service provision, the result of the agent's activities says little about the effort the agent has put into achieving it. For example, the consultant on organizational development referred to above may be assessed via certain efficiency improvements in the management processes of the water user organization he supports. However, the water users' achievements may be fully or partially due to other factors, such as the efforts they have made themselves, the impact of internal conflict solutions or the motivation provided by a charismatic internal leader. Thus, the performance improvements of the user organization as such may not indicate properly the skills and performance of the consultant.

[3] The term "contract" needs to be understood in a wide sense here and may relate to formal or informal contracts, to mutual agreements, common practices, laws, rules, regulations or to a mixture of such governance mechanisms.

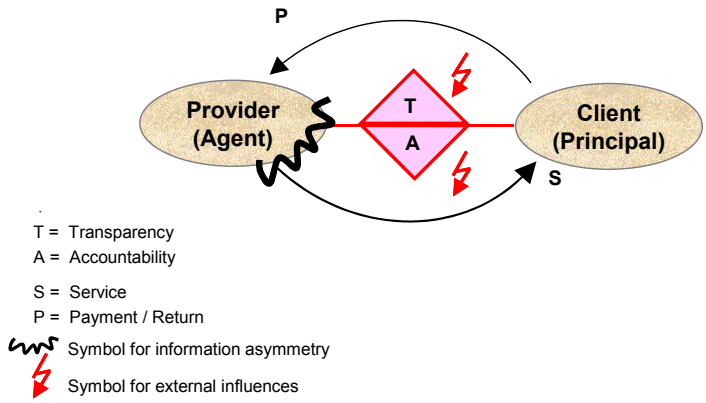

Fig. 2 Moral Hazard situation in an incomplete contract relationship

Second, the respective contractual partners may also be unequally informed about the *exogenous* factors influencing their contractual relationship - a situation referred to as *hidden information*. In this case, the agent acts on the basis of new information on changinmg framework conditions, which is, at that stage, unavailable to the principal. The agent might be able to observe certain indicators and draw conclusions about changes in the immediate environment. In contrast, the principal remains unaware of the portent of these indicators because he is too far removed from the place of action. He is thus unable to determine whether the agent is really using this information to promote his interests as good he can (Arrow, 1985). Furthermore, the principal's ability to hold the agent accountable is strongly impaired: in case of suboptimal performance the agent may refer to external factors outside of her own control and therefore reject responsibility.

Fig. 2 indicates the worst case scenario of Moral Hazard situations, when the principal faces intransparency with respect to the agent's activities (illustrated by the snake-shaped line and the shaded "T") and the agent claims that influencing external factors beyond her control (illustrated by the flashes) have impacted on the performance of the service provision. In this case the agent cannot easily be held accountable for suboptimal performance (illustrated by the shaded "A") and the principal's evaluation of the service provided can neither be based on the efforts of the agent nor on the result of the process (Huppert and Wolff, 2002).

4. Identifying Moral Hazard situations in irrigation practice

Coming back to the example of water fee collection in the Sriramsagar irrigation scheme in Andhra Pradesh, described in the introductory chapter of this paper, we are now in a position to identify the mentioned constraints as typical Moral Hazard problems (see Fig.3):

The Revenue Department as the principal has commissioned the service of fee collection to the revenue collector, the agent. However, for the principal, the details of this service and the efforts made by the agent are highly intransparent (indicated by the shaded "T" and the snake-shaped line in Fig.3): the fees to be collected are related to the type of crop and area irrigated by each water user and it is impossible for the principal to monitor and control the areas actually irrigated and hence the amounts of fees collected. Moreover, the level of fees collected is subject to changing external conditions: some of the farmers may leave their

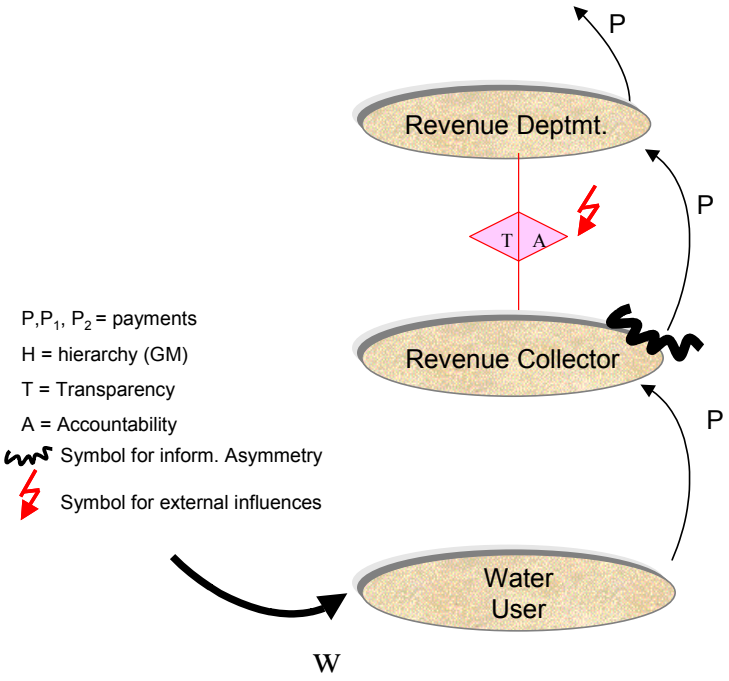

Fig. 3 Moral Hazard problems in irrigation fee collection

fields fallow for various reasons or they may cultivate only a part of the fields. Hence, complaints by the principal about suboptimal collection rates can be attributed by the agent to these external influences, that are outside of his control and responsibility. Therefore, it is difficult for the principal, to hold the agent accountable for insufficient fee collection (indicated by the shaded "A" in Fig.3). The consequences in the mentioned Sriramsagar irrigation scheme were remarkable in terms of loss of income for the principal, the Revenue Department, as outlined in the introduction.

Meanwhile, the problem of fee collection was not the only Moral Hazard problem touched upon by irrigation reform efforts in Andhra Pradesh. In fact, reform measures also impacted on one of the core problems faced by medium and large public irrigation schemes all over the world, if they are run by a multi-layer hierarchical irrigation bureaucracy. These are problems already indicated by Wade, 1982, in his seminal article on administrative and political corruption in irrigation. In its simplest form, it relates to an irrigation engineer or "ditch rider" who maintains unpredictable service delivery in order to be able to extract side-payments from farmers for timely delivery. This corresponds to a Moral Hazard situation if the following circumstances prevail: External conditions are such that actual water availability is fluctuating. It is only the irrigation engineers and subsequently the ditch riders who can claim to have information about frequency and occurrence of water discharges available for distribution. The farmer has no access to such information. Hence, he or she will not know in advance when and how much water (s)he will receive. The engineer or ditch rider, on the other hand, may use the "hidden information" about available discharges to his or her advantage, provide preferential water allocation to selected farmers and extract illegal sidepayments for a service (s)he is supposed to provide anyway. In such a situation it will be difficult for the farmer to hold the other party accountable, since discharges actually fluctuate and the engineer/ditch rider may refer to the unpredictability of this fluctuation as an excuse.

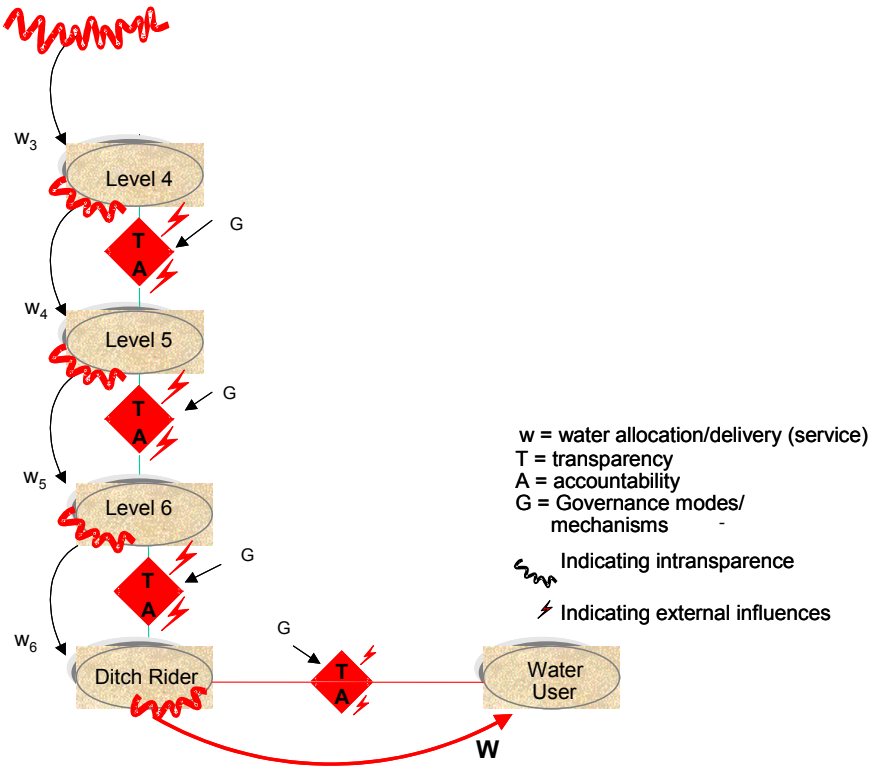

Fig. 4 Moral Hazard problems troughout the hierarchy of a large irrigation scheme

The interplay between farmer and ditch rider at the lowest level, allocating and distributing water to the individual farmers, repeats itself in a similar manner with respect to allocation decisions at higher levels of the hierarchy: Often only the highest engineering levels have information on the water actually available for distribution, since this requires high level management decisions in water short periods on how to balance demands with scarce supplies. The related intransparency and the fact that actual water availability is subject to various external influences like rainfall variations, reservoir management and allocation decisions on highest levels, brings about Moral Hazard situations in the lower and middle ranks of the hierarchy. If we consider e.g. engineering level 5 in Fig. 4 to be the provider and agent of water allocation services to the lower engineering level 6, the principal, then this principal faces a typical Moral Hazard problem. He may apply for a certain water allocation to cover the irrigation water requirements of the command area he is responsible for. However, he will hardly be able to hold the higher engineering level accountable, in case the actual allocation does not correspond to the demands. First, as mentioned before, he faces high intransparency with respect to recent information on actual water availability.
Second, the agent , the higher engineering level, can always refer to unforeseen external circumstances that prevent implementation of the planned allocation program. This situation now opens the doors to temptations for opportunistic behavior: the agent who has to allocate water to several subregions, may opt for preferential allocation decisions based on special monetary or non-monetary favors. Considering that this Moral Hazard situation is aggravated by the fact that the agent is the superior of the principal and in most hierarchies does not feel obliged to provide background information about his decision making, one can imagine how such behavior may become engraved in the organizational culture of hierarchical irrigation bureaucracies.

While a single case of such ”petty corruption“ may be of little relevance as compared to large-scale corruption in the context of large infrastructure investments, it may seriously hamper efforts to improve the efficiency of irrigation water delivery if it becomes endemic throughout the hierarchical structure of an irrigation agency. Such a situation is indicated in Fig. 4. Since a set-up of this kind may provide additional income to many of the (generally underpaid) irrigation professionals, and since in most cases large and wealthy farmers will get preferential allocation, the system can degenerate into a very stable condition of inefficiency. In fact, none of the influential actors (the irrigation engineers and the large farmers) may have any motivation to change this situation – on the contrary. It is clear that any effort to improve irrigation system performance by means of technical improvements or

managerial prescriptions will stand little chance of success unless such incentive structures can be changed as well.

5. Coping with Moral Hazard problems in irrigation

Contractual mechanisms for resolving the Moral Hazard problem are, in principle, either geared to redressing the asymmetrical information status or to bringing the agent's interests more in line with those of the principal. Both mechanisms generate costs. Attempts to balance out the information status generate monitoring costs, whilst harmonising interests calls for a system of incentives, which again produces costs.

Concrete measures designed to limit the Moral Hazard risk by way of redressing the asymmetrical information status include : task profiles that facilitate monitoring, management information systems or co-ownership and team formation (for social control). Ways to improve incentives and bring the agent's interests in line with those of the principle may be bonus payments, prospects for future contracts or contract improvements and manipulating the agent's various alternatives for action (in order to prevent him from having more attractive options to the use of the resources available to him).

A remarkable way of redressing the asymmetrical information status in water user associations has been reported from traditional irrigation schemes in the Andes (Huppert and Urban, 1998). Some irrigation communities in the Bolivian Andes still apply the principle of "rotating tasks" ("cargos rotativos"). Members of different age groups are responsible for different tasks in the operation and maintenance of the irrigation system. This age-dependant rotation means that in the course of time everyone becomes familiar with all the essential tasks needed to keep the system functional. At the same time, it prevents one particular person from gaining specialised knowledge which is not available to the others. In other words, it prevents the emergence of an asymmetrical information status and hence the existence of Moral Hazard situations.

An example of an incentive based prevention of potential Moral Hazard risks in irrigation is provided by franchise systems like the one the French Government is using in the Gascogne (Huppert and Hagen 1999). There is a 10-year concession to the "Compagnie d'Aménagement des Coteaux de Gascogne" (CACG) to provide operation and maintenance services to water users in irrigation systems. If CACG as a provider does not perform in the desired way, another provider may be chosen for the next term. Creating a credible "threat of

competition" between alternative providers will act as an incentive for them to restrict themselves and not to deviate too far from the principal's interests when deciding upon the allocation of scarce resources. If opportunistic agents fail to comply with the principal's interests, they lose their source of income.

Solving Moral Hazard constraints in irrigation fee collection

Returning to our before mentioned fee-collection case in Andhra Pradesh, we find that the incentive systems were changed in the following way (see illustration in Fig. 5):

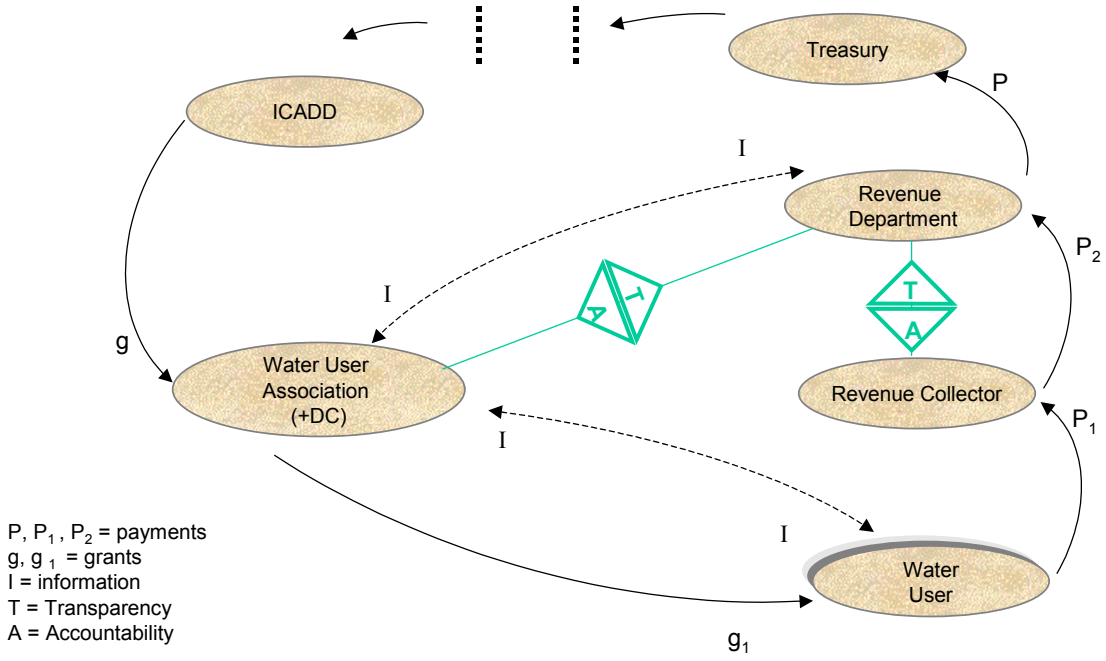

Fig. 5 Solving Moral Hazard problems in irrigation fee-collection

The mid '90s irrigation reform in Andhra Pradesh implemented several steps to modify the incentives relating to irrigation fee assessment and payment. The most important was channelling back parts of the collected fees as maintenance grants to the WUAs (arrows "g" and "g_1" in Fig. 5) and tying the level of these grants to the irrigated area registered with the Revenue Department. This conditionality provided strong incentives to WUAs to ensure that the full area of their actually irrigated land was registered. Moreover, the WUA representatives were allowed access to the registration records and thus could check the registered figures in cases of doubt. This created transparency of information not only for the water users but for the Revenue Department as well (indicated in Fig.5 by the non-shaded "T" areas between the Revenue Department and the WUA and between the Revenue

Department and the Revenue Collector). Thus, it was now possible for the Department officials to hold Revenue Collectors accountable for proper fee assessment, collection and remittance (indicated in Fig. 5 by the non-shaded “A” area beween Revenue Department and Revenue Collector).

This practice of solving the Moral Hazard problem related to fee collection is close to the above mentioned solution of ensuring “prospects for future contracts”. Even if the collectors’ jobs and salaries are not really tied to the amount of fees collected, their reputation and hence their job security depends on their performance, i.e. on the correct amounts of collected fees remitted to the Revenue Department. As mentioned in chapter 1, this way of creating transparence on the performance of the collectors has resulted in dramatic increases in the irrigated area carried on revenue records in many areas.

A limitation of the new setup as it currently exists is that it does not employ the potentially powerful leverage involved in paying for a service to control its quality. Because irrigation fee payments are not linked to the water delivery service function, the WUA and individual farmers are unable to indicate dissatisfaction with the service provided by withholding payment. They can, of course, refuse to pay fees, but the impact will not be felt by those officials who are responsible for implementing their water delivery directives. The payment function is thus effectively “out of the loop” with respect to providing incentives for effective and efficient water delivery service. Thus, the set-up illustrated above may contribute to the solution of Moral Hazard problems in fee collection under the special conditions of crop-area related fees but does not help solving similar problems in water service delivery.

Solving Moral Hazard problems in water service delivery

While the Moral Hazard problems in water service delivery of the Sriramsagar scheme, described in chapter 4 have not been solved so far, the approach taken by the 1997 reforms indicated promising ways how to achieve this (see Fig. 6):

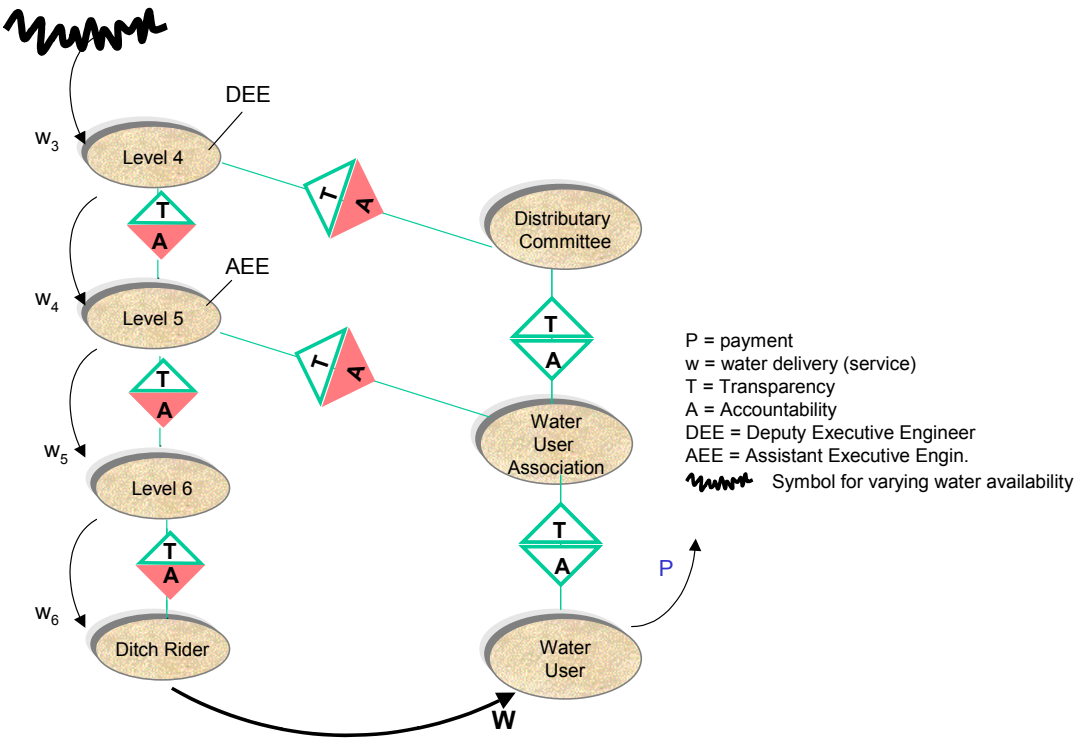

Fig. 6 Trying to solve Moral Hazard problems in irrigation water delivery by Andhra Pradesh irrigation reforms.

The irrigation reforms introduced three new actors into the set-up which was described in chapter 4 and illustrated by Fig.4. Water User Associations (WUA) were established at the level of the minor canals, and Distributary Committees (DC) at the higher level of the distributary canals. The third additional actor was the new role given to specified engineers in the field structure of the Department responsible for irrigation (ICADD) – that of a Competent Authority (CA). The importance of these two new organizations and the competent authorities lies in their particular powers and responsibilities and, especially, in the service relationships which exist among them, which change the prevailing incentive system substantially:

Although the service was delivered through existing hierarchical channels as before, it was now arranged differently. Under the new setup, the Distributary Comittee interacted with the corresponding Competent Authority, typically a Deputy Executive Engineer (DEE), to plan a water delivery schedule for the WUAs comprising it, within overall system operating parameters. This would create transparency for the Distributory committee on water allocations to be expected (indicated in Fig. 6 by the non-shaded “T” between District committee and the engineering level 4). Operational instructions can then be passed downward through the hierarchy by the Deputy Executive Engineer to field staff who make

the appropriate gate settings. The service is represented as being provided to the associated WUAs.

At the minor level, each WUA could interact with the corresponding Competent Authority, typically an Assistant Executive Engineer (AEE), to arrange delivery schedules for the WUA command. Again, this created transparency on water allocations to be expected between the WUA and the AEE. Here also, service is passed down through the hierarchy. Works Inspectors and Ditch Riders ("Laskars") made the gate settings channeling water to individual water users.

In this new set-up, farmers now had a hand in arranging service delivery, a process which had previously bypassed them almost entirely. Their only function under the old setup was to use whatever water they received to grow crops. This change is important, in terms of incentives, because the users of the service are the ones with the strongest conceivable incentive to arrange the highest possible quality of irrigation service. This critical service provision function was now decentralised to the farmers, replacing irrigation technicians and engineers who have little or no stake in the quality of service they provide, and thus little incentive to act in the interests of farmers.

The farmer's new role in service arrangement also had the potential to close off some avenues of opportunistic and corrupt behavior open to water delivery field staff. Previously, staff could play one farmer off against another, securing and bidding up side payment for preferential treatment in water delivery. Now, farmers had a venue (the WUA) in which to compare notes and take action to prevent this practice, which is not in their collective interest, as it raises the cost of water to them individually and collectively without increasing the overall quantity of water available to the group.

While the new set-up was an important step forward, it left some inconsistencies which may have contributed to the problems the system faced in recent years. First, the Competent Authorities after all were not officially and fully accountable to the water users but in fact remained to be part of the departmental hierarchy. These insufficient or unclear lines of authority were prone to create accountability problems both within the hierarchy and in relation to the water users (indicated by the still shaded areas of "A" in Fig. 6). Second, while farmer committees had been established on the lower levels of the system hierarchy (Distributory Committees and WUAs), no such bodies had been installed on the higher project levels (although there were originally forseen , e.g. Project Committees and statewide

Apex Committees), thus restricting the water user's influence on allocation decisions and on the elimination of information asymmetries.

7. Conclusion

Given increasing water scarcity problems worldwide, improving the efficiency of water management, particularly in irrigation, is of the utmost importance. However, many irrigation systems are locked in an inefficiency trap. This trap is due to the fact that inefficient water delivery and maintenance may provide sources for additional income or at least offer non-material advantages to the providing managers or technicians. In terms of the personal goals of income maximization and extension of socio-economic power that are pursued (not only) by most of government irrigation officials, such system inefficiencies may be highly efficient in terms of personal gain. More often than not they pave the way to rent-seeking activities and corruption. Therefore, the common practice of searching for technical and/or economic / financial solutions to the efficiency problem in irrigation is bound to fail in many cases. This holds true not only for public irrigation systems. Farmer-managed irrigation systems are by no means immune to such incentive distortions.

The example of irrigation reforms in Andhra Pradesh in the late 1990's and the positive lessons to be learnt from that experience need to be handled with care. Changes in the political framework conditions, fragile Water User Associations and the local context of power and interests have brought to a halt some of the initial reform achievements. Even though, the direction of various reform efforts can certainly set an example and provide a model when trying to find ways out of the Moral Hazard trap in irrigation management.

In general, it seems imperative to give more space to principal-agent analysis in water research and management and to search for solutions to problems of transparency and accountability. The degree of commitment attached by local governments to such approaches may be a good indicator of the chances for real performance improvements in the irrigation sector of the country in question.

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