Codifying water rights in Contested Basins of Afghanistan
NWO

Water rights, water distribution rules and codification in spate irrigation systems
Experience from Pakistan and other countries

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1 Managing unpredictability

Water distribution rules and rights help to mitigate the unpredictability that is inherent in spate irrigation. Rules and rights impose a pattern, and reduce the risk of conflict, by regulating relations between land users that have access to floodwaters. The way rights are defined in spate systems is diametrically different from perennial systems. In essence water rights in spate systems are reactive. They deal with agreed claims in a changing and variable environment. They describe acceptable practices in a given situation, rather than quantifiable entitlements to a resource, as in perennial systems.

Water rights and water distribution rules in spate irrigation regulate access to water and hence minimise conflict. Water distribution rules make it easier to predict which land will be irrigated. As such they encourage pre-flooding land preparation, which is important for adequate water storage and moisture conservation.Water rights and water distribution rules also define the likelihood of irrigation for different areas and hence serve as the key to the collective maintenance and rebuilding of diversion infrastructure. Particularly where floodwater users depend on one another for maintaining flood canals and reconstructing diversion structures, and this work is substantial, agreement on how water is distributed is a precondition for co-operation. Water distribution rules are not necessarily clear in fine detail. Serjeant, 1980, makes this point for instance for Wadi Rima, Yemen – noting that 'many of the disputes seem to lie dormant, though not forgotten, but they can spring to vigorous life with some new turn of circumstances'. Al-Maktari, 1983, makes a similar observation for the unwritten customary rules in Wadi Surdud.

Water distribution rules also have to be placed in the context of medium and long term change in flood irrigation systems. Increases in land levels and changes in wadi courses and flood canals are almost unavoidable. Spate irrigation systems are morphologically far more dynamic than perennial irrigation systems. Water distribution rules deal both with reducing and mitigating the risk of such dramatic long-term changes, as well as coping with them when they come along. In the end water distribution rules tend to be packages describing the distribution of flood water, the way maintenance is organised, the practices in avoiding breaches and changes to the command areas, and the arrangements and penalties, associated with operating the rules. Table 1 summarizes one such set of rules for the Kanwanh spate river (Rod-e-Kanwanh) in Dera Ghazi Khan District in Pakistan. The rules were recorded during a land settlement of 1918/1919, and are still used.

Based on experience in Pakistan, the report describes the most common types of water distribution rules, including the rules on protecting command area boundaries, section 2. Section 3 describes how the water distribution rules are enforced. There is strong relation with the overall governance in an

area and the local organization in spate irrigation and the codification of the water distribution rules in particular. The final section 4 describes how changes in the water distribution are caused and how they take effect. Experience of several engineered interventions in large spate schemes is that they have unwittingly altered water distribution rules, by creating new opportunity sets for different players. The reactive nature of water distribution rules in spate system has often led to a gradual accommodation of these new opportunities. The purpose of this chapter is to increase awareness and understanding of water rights and the changes therein, so as to:

- Support the development of water distribution rules in new systems
- Understand the process of codifying and enforcing water rules and rights and identify opportunities for improvement in enforcement and modification of water rights
- Understand the impact of interventions on existing water distribution rules and practices and avoid the worst of pitfalls.

Table 1 – Water management rules in Rod e Kanwah (Kot Qaisrani, DG Khan, Pakistan)

Water distribution	**Command area protection**
Water distribution starts from the head and goes to the tail	Even if field(s) remain barren for long periods the right to irrigation remains valid.
When after a first irrigation the upstream fields are watered, but the downstream fields are not irrigated sufficiently, then the upstream field can still take precedence in using the second flow.	The location of a diversion structure, channel intake or division structure can be changed with mutual consent of land owners
There is no limit on depth of irrigation of an upstream field.	If after filling his own field a land owner delays breaching his diversion structure and a nearby field is destroyed, then the losses will be met from the person who did not breach the diversion structure in time
No body can sell or donate his share of water. In land transactions water is transferred as well	No person has a right to construct new branch/flood canal that deviates from the prevailing situation. However, when the channel has changed naturally, then a new flood canal can be constructed, provided the earlier flood canal is completely damaged.
A field cannot be supplied by more than one diversion structure	When a person intentionally destroys the water then according to common loss is recovered both for the loss of water and the destruction of the field
If a bund in a flood channel irrigates two fields, water will first be applied to the higher land.	On reappearance of eroded land, (through siltation) the rights are vested with the original owner.
When a diversion structure has been washed away during irrigation, it is allowed to construct a new diversion even if water is already reaching other fields.	
Maintenance	**Others**
Common maintenance work is performed on the basis of area of land	Ownership of the flood channel – including trees inside, is based on ownership of the adjacent fields
To maintain the flood embankments close to a main bund is the responsibility of all users of the ghanda (diversion bund)	A diversion structure can be constructed on one's own land as well as others land, wherever it is most suitable
Strengthening the banks of flood canals is the responsibility of the owner of the land facing the bank.	No body can expand his land by encroaching the river bed.
Landowners whose fields are irrigated through overflow (chal) and not through bunds and embankments do not take part in the common maintenance work.	When one shareholder does not contribute in the common labour during the specific period, he will not get right of water in the current year. In case he wants to contribute in future then first he will have the compensate the previous year costs of common labour and also by a fine of eight days labour.

2 Rules and rights

There are several types of rules that regulate the distribution of the varying quantities of flood water. Not all rules apply in every system, but it is usual to find that several rules are used simultaneously. The repertoire of water distribution rules includes:

- Demarcation of land entitled to irrigation;
- Rules on breaking diversion bunds;
- Proportion of the flow going to different flood channels and fields;
- Sequence in which the different fields along a flood channel are watered;
- The depth of irrigation that each field is to receive;
- Practices regarding second and third water turns.
- Rules on small and big floods

In addition there are rules that regulate changes in the command area and system morphology:

- Rules on maintenance of bunds and boundaries
- Rules on adjusting the location of intakes and other structures
- Rules on manipulating wadi bed and flood canal scour and siltation processes
- Compensation for lost land.

2.1 Water distribution rules

Rules on land demarcation

Demarcation rules define the area entitled to irrigation. As such, these rules precede all other water distribution rules. They define the command area, and with this the land users with access to the spate flows. Demarcation rules often protect the prior rights of downstream landowners, by prohibiting new land development upstream which could result in the diversion of floodwater to new lands, formation of a new group of stakeholders, and the loss of farming systems and other established water uses downstream. This can result in violent conflicts, particularly in areas where irrigation development is relatively new. For example in southern Ethiopia land alongside the Woito River was given to private investors. They diverted water upstream to the detriment of nomadic groups downstream, whose only option had been to use excess flood water in the summer season. In the conflict that ensued workers of private investors were killed, and then the government retaliated. A history of long running water rights disputes in Wadi Rima Yemen related to the construction of “illegal” upstream canals is described later in this chapter.

The demarcation of the outer boundaries also ensures that overspill from breaches in flood channels does not develop into an established practice, van Steenbergen, 1997. The corollary of such demarcation rules are the penalties for negligence in the maintenance of bunds and channels. In the spate systems of the Suleiman range in Pakistan explicit agreements exist, obliging landowners to plug gullies that developed after severe floods. This is to prevent new drainage patterns from developing in these soft alluvial plains. Similarly, in Eritrea and South Yemen farmers are penalized for not maintaining field bunds, which could cause water to escape to new areas. Such rules are, however, not in force everywhere.

In some systems there are ‘sanctioned’ overspill areas. Though they do not have a recognised claim to the spate flows, custom has it that these areas receive water during unusual high floods. Water is then allowed to escape at certain pre-arranged points to avoid damaging the canal network downstream. Like most of the other distribution rules demarcation rules are in place when water is scarce. They are more common in lowland systems, where land is abundant, than in highland systems. Ahmad et al., 1998, documents the ongoing land formation in four small upland systems in Balochistan (Pakistan). Using the silt deposited by the spate water in the fields as well as from borrow pits in the flood channels, in the last 50 years command areas increased as population pressure increased. The area

under spate irrigation increased from 148 ha to 205 ha. The rise in population and the increase in the number of tractors enabled a better control of the water. In such systems, where the floodwater is usually in excess of the land that can be irrigated, rules on land demarcation are unusual.

Rules on the breaking of bunds and timing of water rights

A category of rules closely related to the rules on the boundary of the spate area concerns the breaking of diversion structures, or the timing of a water right. The rules on breaking bunds are usually in place in areas where the entire river bed is blocked by earthen bunds, as in the lowland systems in Pakistan. The earthen bunds are generally made in such a way that they scour out in high floods. This works as a safety valve (see also chapter 10). It avoids substantial damage to the canal network, as very large floods flow down the river rather than playing havoc with the flood canals and fields. In several systems there are also rules on when farmers can break bunds, e.g. once the designated area served by an upstream bund is irrigated (see above) or when a certain time-slot of the flood season has lapsed. An example of such time-slots are the rules for breaking gandas (earthen bunds) in the Nari River in Kacchi, Pakistan (box 7.1). The rules were formalised in 1917 and are still observed, although there is considerable tension on the actual breaking of bunds.

Box 1

Rules on Nari System, in Balochistan Pakistan prepared in 1917 on revision of older rules and still observed

- From 10 May to 15 August the landowners of the Upper Nari are allowed to make gandas (earthen bunds) in the Nari River.
- When the land served by one ganda in Upper Nari is fully irrigated, the landowners in that ganda must allow landowners of the next ganda to break it.
- After 15 August the landowners of Lower Nari are allowed to make gandas in the Nari River.
- Landowners in Upper Nari are not allowed to irrigate their land during this period or let the water go to waste.
- Water is not allowed to go to waste to the low lying areas east and west of the Nari River. Guide bunds will prevent water flowing to these areas – all landowners will contribute towards these bunds with farmers in Lower Nari paying twice the amount per hectare in case bunds on the Upper Nari are broken.
- If any dispute arises judges appointed by Kalat State will inspect the area and are authorised to decide whether a downstream party should be allowed to break the ganda at an appropriate time or whether a guide bund should be repaired within 5-10 days. If repairs to guide bunds are not made the main bund of the area concerned may be broken.
- In case a landowner refuses to contribute gham (the contribution for maintenance) his land may be confiscated.

The reluctance of upstream land users to have their bund broken is not only because it allows more water to be diverted to the upstream area, but also because it saves the effort of rebuilding the bund in a subsequent year, see box 2.

Box 2 Disputes over bund breaking

A fairly typical example of a dispute on the breaking of a soil bund concerns the Chacar Bund on the Chakar River in Balochistan. In the past this earthen bund – spanning some 50 metres across the river – was constructed using bullocks and tractors. It collapsed every year, as the water seeping through its base undermined the structure. However, in 1990 the landowners of Chacar were given a generous allocation of bulldozer time by the government. They utilised this by making a very strong bund. The bund did not fail that year. It irrigated all demarcated land of Chacar and then the Chacar landowners allowed the water to escape through a breach in their flood channel to an area that was not entitled to floodwater. The same pattern repeated itself in the subsequent year. The Chacar landowners were not keen on breaking their bund, as they wanted to spare themselves the effort of rebuilding it. This led to fierce protest from downstream landowners, who approached the head of the district administration. The downstream landowners argued that the head of the district administration should break the by now controversial soil bund. His verdict was, however, only partly a success for the complainants. He reasoned he could not break the bund since there was no earlier agreement on breaking bunds in the Chakar River. However, he did maintain the demarcation rules and ordered the Chakar farmers to repair the breach in the flood channel to prevent water from going to unauthorised channels.

Rules based on the time slots when water diversion is allowed in different parts of the system are also found in Yemen. An example from wadi Zabid is shown in box 7.3.

Rules on flow division

This category of rules arranges the distribution of water between the different flood channels. Where an area is served by several flood channels, there may be an agreement on the proportion of floodwater going into the different channels. In practice, this is usually achieved by using rather crude hydraulic structures, e.g. the head sections of flood canals may be different widths, and obstructions may be placed in front of some of the channels to achieve the required division. Flow division may also be practised along a flood channel, with the width of the field intakes determining the proportion of flow that each field receives.

Figure 7.1 Flow division in a flood canal, Yandafaro, Ethiopia

Box 3 Water distribution in Wadi Zabid

The traditional canals in the Wadi Zabid system were split into three groups that that had water rights at different times of the year. These rules were retained when the system was modernised in the 1980's.

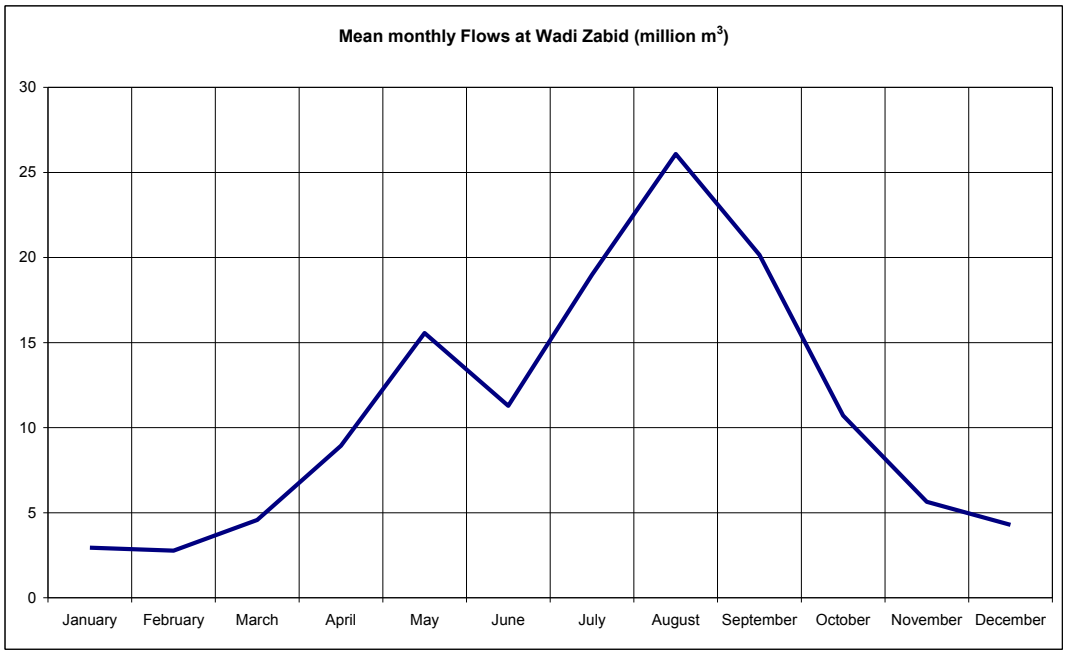
The canal groups, and the periods when they have water rights are:

Group	Nominal Command area (ha)	Dates
Group 1 (Upstream canals)	4325	29 March to 2 August
Group 2 (Middle canals)	9165	3 August to 13 September
Group 3 (downstream canals)	1305	14 September to 18 October

Canals within the groups also have water rights at different periods within the group turns.

This allocation gives the upstream canals access to base flows and the first part of the main flood season, whole the middle reach canals in group 2 supplying a larger area having about six weeks during the period when the main flood season occurs. The lower canals have a shorter period at the end of the main flood season.

Mean monthly flows measured upstream some distance from the first canal off take are shown below. (Some water is lost in minor abstractions and bed seepage between the measuring location and the first canal off take, and little flow reaches the first diversion structure outside the group periods.)



Flow divisions within the flood channels may be fixed, but it is more common that there is a large degree of flexibility to adjust to changing bed levels of river and flood canals and to variations in the flow. An example of a flexible flow division is the traditional main division in the flood canal of Wadi Laba, in Eritrea, which used to be adjusted by moving brushwood around. During a spate the water masters of the five main flood channels stood on top of the structure and adjusted it to ensure that the flows to each area were fair, taking into account earlier irrigation. In the same system a series of

gabion command area flow division structures were constructed to distribute water between major command area channels and to stabilize the canal beds. The first designs were conventional, but later a more flexible structure was developed at the instigation of farmer leaders. It consists of a curved wall that provides a strong point splitting high flows. Lower flows are adjusted using small earthen bunds to control the proportion of flows diverted to the two main channels. (This structure is shown in figure 10.27 in chapter 10).

Though flow divisions are effected by canal bed and water levels and slopes, it is unusual to find rules in this area. Conflicts due to changing canal bed levels, after fertile fine sediment deposits was taken from the channels, are reported in Ahmad et al (1998).

Many flow divisions occur automatically when the flows are not too large. When the quantity of water is small it is diverted to one part of the command area only, and the other flood canals are blocked, usually with a small earthen bund. When flood flows are large however water will break the small bunds and flow to several channels simultaneously.

Rules on sequence

A fourth category of rules is the pre-arranged sequence in which fields are irrigated. Where it applies, the route that water follows within the area entitled to irrigation is described in detail, in terms of the branch channel which will receive water first and the priorities of the different fields within the branch channels. Irrigation in many cases moves from the head of the channel to the tail (Serjeant, 1964; Maktari, 1971). In Yemen, the fundamental rule governing the use of spate water for irrigation purposes grants upstream users priority rights to irrigate their fields, but downstream users may not be denied the right to surplus water after the upstream users have exercised their rights to divert a quantity of water sufficient to satisfy their needs. Sequence rules are called 'numberwar' or 'saroba paina' (Pakistan), 'ala'ala fala'ala or rada'ah' (Yemen) or dinto (Eritrea).

The sequence is adjusted according to the level the flood reaches. If the flood is low, the water will only flow in one or two of the priority branch channels and the sequence rules will apply to those channels only. But, if the flood brings large quantities of water, it will find its way through a large number of channels simultaneously. Moreover, during high floods the force of water is larger and instead of being controlled and regulated, it will flow in a large number of fields at the same time.

In some cases the head reach first principles does not apply. One example is the Chandia system in Balochistan (Pakistan), where the upstream area is only supplied at high water levels or after the downstream area is irrigated. In other systems there are rules to send larger floods downstream on a priority basis.

Figure 2 Spate-irrigated Fields in Wadi Tuban, Yemen

Rules on depth of irrigation

All the four rules impose a certain predictability and equity. The definition of the command areas, rules on breaking diversion bunds and specific periods with water rights and the limitations on the width of field intakes prevent the water from being monopolised in the head reaches of the flood irrigation system. The sequence rules identify priority areas. Equity issues are also significant in the fifth type of water distribution rule, which concerns the depth of irrigation and is expressed in agreements on the height of the field bunds. These field bunds are usually built up from the sediments deposited within the fields. The height of the bunds determines the amount of floodwater that can be stored in the fields.

Rules on the height of the bund and hence irrigation depth are not common in spate areas in Pakistan, though they seem to be standard practice in Yemen, and seem to based on a ruling of the Prophet Muhammed that the amount of flood flow to be applied to a field with palm trees shall be the depth of two ankles or an amount sufficient to reach the tree trunk. According to the 11-century Islamic jurist Al-Mawardi, the underlying principle of this ruling is that the amount of water applied shall be sufficient to water the crop, and that it is easy to measure (Varisco 1983). The prevalence of irrigation depth rules in Yemen is probably related to the practice of field to field irrigation. In this system a farmer gets his turn as soon as his neighbour has completed irrigation his land. This is done by cutting the bund surrounding the field of the upstream farmer. Competition between neighbours can be fierce and rules on water depth may have evolved to mitigate this. Moreover, if the bund in the neighbouring field is very high and too much water is impounded, uncontrolled breaching could cause severe damage to the neighbouring fields. In some of the small mountain systems in Balochistan rules are in place that prescribe that the soil for repairing these field boundaries will be taken from the lower plot (Ahmad et al 1998).

In contrast, when each field is fed by its own separate intake, as is usual in the spate irrigation systems in Pakistan, such conflicts are rare, and rules on the depth of inundation are unusual. The amount of water applied depends on the height of the field bund and the levelling (or lack of it). Yet in most systems there is no limitation in this respect. Field bunds are seen as a way of disposing of the excess silt that accumulates with the floodwater and can reach any height.

In general it appears that the height of field bunds is influenced by two factors. The first is the size of field. When fields are only approximately levelled a large field needs high field bunds to ensure that all parts of the fields impound a reasonable depth of water. Fields of 1-2 ha in area with field bunds

higher than a metre, are found in Yemen, and up to 4-5 ha in area with very high field bunds in Pakistan.

The second factor is the number of irrigations that are expected. If only one irrigation is likely the field bunds need to be high to enable sufficient water to grow a crop to infiltrate the soil. When two or more irrigations are probable then less water needs to be impounded and lower bunds are used. (The water holding capacity of the soils will also be a factor.) Makin, 1997, describes the variations of the heights of field bunds in the Wadi Rima traditional system in Yemen, and relates these to the probabilities of receiving irrigation. Low bunds were found near the mountain front where two or more irrigations were almost assured, while the largest bunds, over 1 metre in height, were found at the downstream margins of the system where only one large irrigation was possible in years when very large floods reached the downstream sections of the wadi or the flood canals.

Figure 2 shows high field bunds in Wadi Tuban in Yemen.

Figure 3 shows small bunded plots in a spate systems at Yandefero in Konso, Ethiopia. The Yandefero system is characterised by a large number of relatively mild floods, allowing a distribution of water not very different from a perennial system, with secondary canals and fields with low bunds.

Figure 3 Yandefero Ethiopia – unusually low field bunds, related to the large number of mild floodings

Rules on second turns

Another important water distribution rule concerns the right to a second water turn. Several crops, give significantly higher yields when the fields are irrigated more than once and sufficient moisture is stored in the soil profile. Sorghum, wheat, castor and cotton are examples. Sorghum is in fact often grown as a ratoon crop to catch an off-season flood. For other crops, like pulses, one watering is sufficient.

The rules on second turns are particularly important in systems that receive a series of spates in a normal year. This poses a dilemma: can the second flood should be applied to land that has already had an irrigation or is priority given to those cultivators whose land is still dry. Both situations occur – in some cases upstream landowners being at liberty to take a second turn, as well as to restart irrigation where it stopped previously, and in others downstream lands are irrigated before upstream owners can use the water again. In Sheeb in Eritrea for instance preference is given to the 'driest land' first. In fact in Sheeb as far as practical irrigation in the next flood season starts, where it stopped the previous year. Another such case is the Jama Bund in Kharan, Balochistan (BMIADP 1994). The degree in which it is possible to honour these rules depends on the timing and size of the floods. If floods are very small,

they may not reach tail-end areas and it may only be possible to apply them on land that was already watered. A variation on the 'second turn' rules is that the right to a second irrigation is only allowed for special crops, such as the most important subsistence crops. This used to be the practice in the past in Rod Kanwah (Pakistan) for wheat and Wadi Tuban (Yemen) for red sorghum.

Clearly, there is a strong link between the rules on second irrigation and the size of the command area. This is also discussed in chapter 5. Where the demarcated area is relatively confined, second and third irrigations are possible, yet when the area is large and stretched single irrigation tend to be the practice.

Rules on large and small floods

Finally, the water distribution may differ according to the size of the floods. One example given is the automatic flow division when floods are large, and able to break the bunds in the various flood channels. In other systems there are explicit rules on how to accommodate small and larger floods. Small floods tend to be diverted to the upper sections of the command area, if only because small floods are not likely to travel that far. A rare example of explicit rules dealing with floods of different sizes concerns the Irrigation Plan for Wadi Tuban in Yemen, see box 7.4.

Box 4 Water Allocation Rules for Wadi Tuban (Yemen)

The principle of Rada'ah (upstream land first) is applied in Wadi Tuban and gives precedence to upstream users, who have the right to a single full irrigation of their fields before their downstream neighbours, both between and along the main canal systems. Furthermore, the rule has been established that spate water will not be diverted into fields that have already received either base flow or earlier spates. To ensure the efficient use of spate water , the allocation is based on the following Irrigation Plan:

- When the spate flow is small (5 to 15 m3/s), priority is given to the canals in the upper reach of the Wadi;
- When the spate flow has a medium size (15 to 25 m3/s), priority is given to canals in the middle reach of the Wadi;
- When the spate flow is large (25 to 40 m3/s), the flow is directed either to Wadi Kabir or Wadi Saghir in the lower reach of the delta, depending on which one has the right to receive the spate water; and
- When the spate flow exceeds 40 m3/s, the flow is divided equally between Wadi Kabir and Wadi Saghir.

3 Enforcement

The extent in which water distribution rules are enforced varies. There is a strong link with the overall governance and the social structure in an area. In the spate systems in the Eastern Lowland in Eritrea there is no large contrast between large and small landowners. Local government is active and there is well-established organization of farmer leaders. As a corollary disputes on water distribution are unusual. This may be contrasted to ubiquitous disputes in Tihama systems in Yemen, where powerful parties stand accused of using their power to their own advantage, and tail-end areas are increasingly marginalized.

It is not surprising given the nature of the unpredictable and sometimes uncontrollable flood water supplies, and changes in system morphology, that conflicts over water are common in spate irrigation systems. Spate systems need a far larger degree of discipline than other resource management systems, yet the returns are sometimes small. Enforcement of water distribution rules is related to three factors:

- Local water user organisation;
- Relation between water distribution and maintenance arrangements;
- Codification of water distribution rules.

3.1 Local water user organisation

The topic of farmer organization is discussed in more detail in chapter 8.

The enforcement of water distribution rules is often shared between local government and local farmer leaders. In Wadi Tuban for instance, for a long time, enforcement of water distribution rules used to be the responsibility of local leaders. Until 1950, the enforcement of existing rules regarding the allocation and distribution of base and spate flows at the level of Wadi Tuban, including the length of diversion structures, was the responsibility of the Sheikh al-Wadi, who was appointed by the local Sultan. If upstream users would take water without the permission of the Sheikh al-Wadi, the latter had the power to impose the following sanctions:

- The concerned farmers were not allowed to grow any crop on their fields but the immediate downstream farmers had the right to grow crops on the irrigated fields of their upstream neighbours; and
- If crops were already cultivated, the yields had to be given to the immediate downstream farmers following the harvest.

With investment in agriculture in Yemen and the collectivisation of agriculture in South Yemen, the operation and maintenance of the spate irrigation systems were taken over by government employees and staff in the agricultural co-operatives. When the role of these organisations declined, in particular after the reunification of South and North Yemen in 1990, they left a worrying vacuum, which has resulted in more conflicts between up- and downstream users as the traditional rules concerning the distribution of base and spate flows are no longer being observed, Al-Eryani and Haddas, 1998.

3.2 Link between water distribution rules and maintenance

There is a very strong link between the rules on distributing spate water and the organisation of maintenance. In principle the link works two-ways. In many systems the right to irrigation by spate flows is tantamount to one's contribution to repairs to the headworks or flood channels. If one abstains from public duty one is simply not allowed to open the intake to one's field (particularly if the network of fields is supplied by individual intakes). The link works the other way around, because, as mentioned in the introduction to this chapter, water distribution rules will often serve to create a more-or-less coherent group of land users who are dependent on the spate system and will jointly undertake the maintenance of the structures. In particular, the demarcation of the irrigated perimeter is important as this defines who has an entitlement to the floodwater. Without it, it is difficult to form a group of partners, making the organisation of the recurrent repair work problematic, including the formulation of rules on cost sharing. A second issue is the critical mass required in undertaking repairs. This is particularly relevant when repair is dependent on human labour and draft animals (as was the case in most systems in the past), and a large force is required to rebuild structures and make repairs. When tail-enders are systematically deprived of flood water supplies, they may no longer want to contribute to the maintenance. The critical mass factor hence works as a check on too large an inequity in water distribution. However, the importance of critical mass may be expected to diminish, when maintenance is mechanized or undertaken by government organizations instead.

3.3 Codification

In some spate systems the water rights and water distribution rules are codified. The oldest example is Wadi Zabid in Yemen, where the rules for distributing base and spate flows between the different diversion structures were first recorded 625 years ago by the renowned Islamic scholar Sheikh Bin Ibrahim Al-Gabarty.

Rules on spate rights in the larger systems in the Suleiman range in Pakistan (D.I. Khan and D.G. Khan) have been documented in a register, the Kulyat Rodwar, which was prepared by the Revenue Administration during the British colonial period. The register contains a list of all villages responsible for the labour on each bund. A special functionary was responsible for the enforcement of these rules, exhorting farmers to plug gullies and rebuild their bunds. The spate irrigated areas were an important grain basket at the time and also an important source of tax, hence the interest by the Revenue Administration. In recording the water distribution rules also provided the opportunity to resolve a number of long-standing disputes (Bolton 1908).

In the other main spate irrigated area of Balochistan, the long and extensive Nari system in the Kacchi Plains, detailed rules have been written down concerning the breaking of the different bunds in the spate river These rules were enforced by the 'teshildar ghandahat', an official put in place by the then native ruler of the area, the Khan of Kalat, whose land was located at the tail end of the system. After Kalat State joined Pakistan in 1948 this functionary became an employee of the new administration.

There is large value in codifying water distribution rules – because it clarifies and completes local water management arrangements and introduces a neutral factor in any dispute. Testimony of the importance of codifying water distribution rules is the continued use made of water registers, prepared as long ago as 1872, in the spare irrigated of D.G. Khan, (see figure 7.4). Yet recording water rights as such is not sufficient to mitigate conflict or ensure that water rights are observed. The vehement conflicts on Wadi Rima in Yemen – in spite of codified water rights stretching back over the centuries, Makin 1977, illustrates the point.

Figure 4 Pakistan: Revenue Official using the 1872 record of rights

It is striking that in all these examples the authority with which the rules were enforced has declined. It is particularly remarkable – as one could also expect the opposite – that enforcement has declined as water became scarcer. There are a variety of reasons for this:

- Decline in both traditional and modern government as the rule enforcing mechanisms;
- Decline in spate systems, with increased use of groundwater in the spate command areas;
- Confusion of responsibilities related to system management after public investment in the system;
- Change of opportunities with the introduction of mechanised power.

It is more common for water distribution rules not to be formally registered, even in relatively large systems. In some systems this is because there is little competition for the floods as the distance between the mountains (where the spate flows arise) to the sea or the main river (where they discharge) is short.

Even when there are no formal rules local district officials are often requested to intervene in conflicts in spate systems – particularly where it concerns water rights between different areas.

In smaller systems and within tertiary units enforcement is by local arrangement. Many systems have water masters who usually supervise water distribution and organise maintenance.

4 Changing water distribution rules

Water rights in spate system are not static. They change under the influence of factors such as population increase and the pressure for new land development, changing cropping patterns and new marketing opportunities; the introduction of more robust diversion structures; shifts in power relations; and changing levels of enforcement. The link between enforcement and overall governance is very strong. There are several examples were new water rights have been created by power play and intimidation, particularly in the spate systems in the Tihama Plains in Yemen. The development of water rights in Wadi Rima (Yemen) during the last few centuries illustrates very well the factors in play in the allocation and distribution of base and spate flows (see box 7.5). The skewed local power distribution, the weak nature of local government and the absence of effective countervailing power create the setting for the 'capture' of spate water rights by strong players – literally bulldozing their way through. In Wadi Zabid, Wadi Siham and Wadi Mowr all there have been examples of major upstream land development and water diversion by mighty parties in contravention of existing traditional rights or legal injunctions. This has been propelled by the possibilities of highly profitable banana cultivation on the basis of conjunctive use of groundwater and spate flows. In contrast far less of this reported from Eritrea or South Yemen, where the social structure has been far more egalitarian and the role of local government stronger.

Box 5 Changing Water Rights in Wadi Rima (Yemen)

At the end of the 17th century, four main canals were irrigating fields in the middle reach of Wadi Rima, which were constructed by the first settlers. During the last three centuries, the allocation and distribution of base and spate flows along Wadi Rima were affected by the following developments:

- In 1703, the right of abstraction was extended to downstream farmers by granting them the right to take water for 20 days in November, 10 days in June and 10 days in August. The resulting abstraction restrictions were confined to the upper four canals and not to additional canals further upstream, probably because they only took small amounts of water.
- In 1809, the customary water allocation rights were established for 6 different shaykhdoms and it continued to function without any major change for about 100 years. These water allocation rights only applied to low flows (i.e. base and flood recession flows) but not to flood flows.
- Due to the development of two upstream canals around 1900, farmers from the middle reach felt it necessary to take action through the courts to establish their prior rights to the low flows. They succeeded in obtaining an injunction to block the two new canals until such time as their four canals had taken all the low flows to which they were formally entitled without any restrictions on the cropping intensity nor the number of irrigations per crop.

- Following a civil war between the Imam and the Zaraniq people in 1928-29, a tract of land was expropriated by the Imam and the Al Hudayd canal was constructed from the point where the wadi emerged on to coastal plain to irrigate that tract of land. Although this new upstream canal initially took a small quantity of water, it took water throughout the entire year, thereby violating the principle that new lands should not be irrigated with low flows. The precedent created was used by landowners on the south bank to abstract the low flow as well. As their canals were much larger, they took the entire low flow at the expense of the downstream users.

- The people, who had lost their traditional access to the dry season flow, protested vehemently and they ultimately took the law in their own hands by breaking the main canal on the south

bank. However, the influential canal owner succeeded in jailing the culprits and eventually forced them to repair the canal.

- The irrigation expansion continued on the north bank despite the ruling in 1931 to the close the Al Hudayd canal commanding the land of the Imam.

- In 1952, major works were authorised by the Imam to enlarge the Al Hudayd in order to expand the irrigated area. Simultaneously, the Government sold water to people without original water rights at the expense of users with traditional rights to use water`of the Wadi Rima.

- Following the revolution in 1962, a committee comprising the Minister of Justice, local magistrates and the secretary of the former Imam ultimately decided that the claims of the people of the south bank should be respected and that the Al Hudayd canal, now supplying government land, should be closed. Until the mid-1970s, however, the Governor of Hudeidah did not implement this decision, possibly fearing the reaction of the people on the north bank (Makin 1977).

- The new modernised irrigation system commissioned in the late 1980's recognised at least some of the the South bank middle reach water users claims. A division structure was designed to provide a 1/3 north bank to 2/3 south bank division of the flows at the point where the South bank flows were passed under the wadi to the South bank supply canal. However the majority of the water is still being used on the North bank – the powerful North bank water users have vandalised the control gates at the flow division structure and the operating agency does not have the power impose the water distribution envisaged when the scheme was modernised. The impact this has had on de facto water rights is discussed later.

Water distribution rules have also changed – often unwittingly – as a result of external investments in spate irrigation, from the construction of civil head works or making bulldozer time available. The construction of new permanent more robust head works has often resulted in better upstream control, integration of previously independent systems; more controlled flow and changes in the maintenance requirements. The impact of these changes is summarized in table 7.2 and described next. They all results in larger control by upstream water users

Table 2 Effect of engineered headwork's on water distribution

Larger upstream control	Put upstream land users in position to control flows that would have destroyed there intakes in the past Decreases downstream access to flood flows and larger flood recession flows
Combining independent intakes	Creates dependency and creates new tail enders – water being distributed sequentially, where earlier each area diverted part of the floods
Controlled flows	Controlled flows reduce risk of scour and gullying, but the attenuated flows may no longer reach the extreme ends of the command area.
Changed maintenance burden	Generally reduces the dependence of upstream land users on the labour of downstream land users

Provision of better control of water at the upstream end of a system often disturbs a delicate balance that exists between upstream and downstream diversions. It is not uncommon for new structures to create a new water management situation – which over time changes the de facto water distribution rules, in spite of agreements that existed earlier, rules agreed at the time the new structures were

constructed, and provision of a water distribution infrastructure that would have made an equitable distribution of water possible.

An illustration of this is the change in water distribution in Wadi Rima in Yemen after the construction of the head works. In the past the tail-end area had been served by an independent intakes. The common head works allowed better upstream control of the spate flows, but over time the volumes of water passed on to the tail area were reduced (Al-Eryani and Al-Amrani, 1998). In the past water was diverted by earthen or brushwood diversion structures, that were usually destroyed during high floods, allowing water to go downstream. Now with a permanent structure in principle only the peak flow crosses the weir, but the lower flows remained upstream because of the way the system was operated

Another example of the inevitable impact of larger upstream control on water distribution is the Rehanzai Bund (box 6). The Rehanzai Bund case shows that it is hard to make enforceable agreements in the absence of a pervasive authority, and in a situation where people have considerable differences in power. Ultimately this technically successful soil bund increased in inequity. In other cases the change in water distribution create severe conflict. One of the most spectacular examples is the flood diversion weir, built on the Anambar Plains in Balochistan (Pakistan). The weir was meant to divert spate flows to the upstream land, but also cut off the base flow to the downstream area. Tensions ran high between both communities and were ultimately resolved when by mutual consent it was decided to blow up part of the weir (see figure 6).

Figure 6 Diversion weir where part of the crest was blown by farmers as it interfered with the base flows, Pakistan

Box 6 The Rehanzai Bund Balochistan

The massive earthen Rehanzai Bund – stretching over 2 kilometer - was constructed at the confluence of the Bolan Rover and an off-shoot of the Nari River on the Kacchi Plains of Balochistan. The construction of the bund allowed the control of spate flows in the Bagh area, where previously the spate flow had been too fast to capture. After the Rehanzai Bund was completed a number of well-placed landlords constructed a series of permanent diversion bunds immediately downstream of the new bund. This obstructed the water rights of the tail-end Choor-Nasirabad area. The district administration supported the case of the downstream farmers and instructed the upstream landlords to break the bund after their area had been served. The landlords, who had considerable power and influence, refused to do so. As time passed more and more people had to leave the Choor Nasirabad area for lack of farm income. The remaining group was too weak to exert any influence and the upstream landlords prevailed.

Another change sometimes brought about by engineering interventions is the integration of previously independent systems. A variation of this is when a system with a free intake is replaced with a common controlled diversion. Such changes bring people (sometimes entire communities) together in one system. In the past such communities may have had little affinity with one another and there may have been little interaction between them, but they are forced to work together to distribute scarce water. In some cases this has led to intractable social problems, elsewhere it has prevented integrated systems from materialising. Usually systems are integrated the reason to obtain the economies of scale that justify the large huge investment required in civil works to control the spate flow in a river at one point.

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