National Conference for the Management and Development of Water Resources in Yemen

Paper 2-B Managing water for social equity, economic efficiency and environmental stability: governing spate-flood Irrigation for social equity, environmental sustainability and economic output.

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Abstract

Based on research at the International Conflict Research Group at ETH Zurich, this paper first traces Yemen's performance in applying the principles, policies and actions of good water management. The paper then takes a detailed case study of water resources management in action, tracing the underlying mechanisms of water allocation problems in spate irrigation systems on the basis of qualitative data (2007) from the Tehama region in Yemen. It asks through which policies Yemen has tried to establish local water management rules that ensure social equity among water users, and to which extent it has managed to set up governance of sustainable and conflict-free self-government within spate-flood basins. Finally, the paper traces out six mechanisms by which the efficiency, equity and sustainability of Yemen's water management may be enhanced for the future.

Managing water for social equity, economic efficiency and environmental stability: governing spate-flood irrigation for social equity, environmental sustainability and economic output

Preamble: Measuring Yemeni progress towards the goals of good water management

Social equity requires that water services are available for all, existing water uses are respected, and the benefits of development are shared equitably, with a care for the poorest. Economic efficiency requires that income per drop is maximized, and water is available for its highest value economic use. Environmental sustainability requires that the water resource and the broader environment are not harmed, and the needs of future generations are taken into account. How is Yemen doing, and what are the major problems and lessons?

Regarding social equity and 'water services available for all', reform of urban water supply began in 1997 to increase coverage and achieve financial sustainability. By (2007), 56% of the urban population (3.6 million people) had access to network water, supplying an average of 56 litres per person per day. In rural water supply, public agencies are being decentralized and have adopted a demand-responsive approach,

and coverage with safe water went up from 25% of the rural population in 2002 to 44% in 2007. Overall, user satisfaction within decentralized, demand-responsive schemes is high, and this has proved a successful approach. However, tariffs are typically higher in rural areas and consumption can be as low as 20 litres per person per day.

Regarding social equity, and sharing the benefits of development equally, with respect for the poorest, spate schemes (examined in this study) have gained considerable increase in benefits due to development in modern times, but these benefits have gone increasingly to upstream riparians and powerful irrigators, and the cutting off of sub-surface flows has further worsened the position of downstreamers. Groundwater: development has brought an enormous boost to the agricultural economy, but has changed historic water rights and concentrated water in the hands of those with the capital and power to access subsidies. The 2005 doubling of the price of diesel disproportionately disadvantaged the poor due to rising transportation costs of food supplies. In rainfed agriculture, the import of cheap cereals, subsidies to irrigation and rising wage rates have led to decline of rainfed agriculture and the pauperization of farm families.

Overall, there has been a development-induced structural scarcity for peripheral water users, and lack of coercive governance power or political will to enforce equity. However, the resurgence of community-based organization may provide some counter-balance to these trends.

Regarding economic efficiency and the imperative to maximize income per drop and direct water to its highest economic use, water is being used for high-profit agricultural produce (qat, fruits) and this is driving resource depletion. The Land and Water Conservation Project (LWCP) and its successors (e.g. GSCP) have had some successes in 'more income per drop' through technical improvements in irrigation efficiency – but it is not clear if there are real water savings. No formal mechanism exists for transferring water to higher value uses (e.g. from agriculture to potable use). Meanwhile, commercial agricultural incentives and absence of groundwater governance institutions drive groundwater depletion in a 'tragedy of the commons'.

Regarding environmental sustainability and water resource security and provision for future generations, there is now awareness of resource depletion at government and local level – but no knowledge at either level that would allow the development of sustainable resource management. Perverse incentives drive resource depletion.

With dependency of the majority of population on agriculture as income and no active policies for transition from agriculture-dependent economy to diversification of economic (and thus labor-market) portfolio, much of the population is vulnerable, and there is ongoing resource depletion at expense of future generations ongoing, with little or no institutional mechanisms for more sustainable management. There is,

however, scope for more 'managed aquifer recharge' including through subsurface and groundwater replenishing/storage in spate systems.

Regarding the extent to which Yemen has implemented policies and actions of good water management, good water management requires participation of all stakeholders. decentralization, and management of water at the lowest possible level, efficient management of supply and demand through an incentive structure reflecting the true value of scarce water to society, and integrated, inter-sectoral management, with the basin as the unit of management. How is Yemen doing, and what are the major problems and lessons?

Concerning participation of all stakeholders and decentralized approaches, water management in Yemen is decentralized by its nature. Decentralized approaches at basin-level and local-level foster project-credibility and identification among stakeholders. Pilot projects like the Community Water Management Project (CWMP) demonstrate the potential for local level stakeholder self-management in partnership with government.

Concerning efficient management of supply and demand through an incentive structure reflecting the true value of scarce water to society, from the 1970s to the 1990s, the incentive structure actively promoted groundwater development and overexploitation. From the 1990s: subsidies were scaled back, but diesel is still 'cheap'. Cheap wheat imports and subsidies to irrigated agriculture bias relative prices in favour of more water-intensive cash crops. There is no regulation or resource charge for groundwater and the 'tragedy of the commons' creates powerful incentives for a 'race to the bottom'. As a result, and due to very weak legal governance, measures exert virtually no influence on water extraction. Overall, the true value of scarce water is not reflected in water-use nor in incentive structure. Resource depletion has not been stopped and still increasing. Sustainability has not been achieved.

Concerning integrated, inter-sectoral management, with the basin as the unit of management, integrated water resource management is the focus of the Water Law, and NWRA was set up to implement it. Several basin committees and basin plans have been established. Programmes in Amran and Sana'a basin have promoted bottom up approaches to water resources management. Government programs are in principle integrated in NWSSIP, and now supported by donors on a programme basis (WSSP). However, results to date are limited. Evidently, IWRM is a very long business indeed which requires persistence and consistent support.

Governing spate-flood irrigation for social equity, environmental sustainability and economic output

According to Thomasson (2006), it is important to know how to augment positive outcomes of investments in the water sector, which are an integral part of the Millennium Development Goals. However, he argues that there is much evidence of

conflicts that arise from such water interventions. The outcome of development help efforts implemented during the second half of the 20th century has been analyzed to a great extent. Cure-all solutions have not become apparent yet, how to re-code laws and re-design governance in order to ensure social equity within spate-flood river basin systems in an environmentally sustainable manner while at the same time pursuing a relative economic efficiency. This paper will treat local-level allocation-governance with regards to spate-basin irrigation only, but will evaluate practice and advice for governance-design for the purpose of sustainable resource-utilization on the macro-political level as well (e.g. taxation, import/export-regulation etc.).

The array of traditions, original settings and local arrangements may be interfered with or even disrupted by super-imposed development projects: the disposal of wastewater as an outcome of development-induced industrial growth; populations displacement as a consequence of large infrastructure development such as dams; economic sectors competing for the same resource, especially in water intensive industries etc. Given a water intensive industry such as the textiles, this can account for severe competition among industrial sectors. The Yemen, however, is by far not an industrial society, since only 1.1 percent of water is withdrawn for industrial use while as much as 92 percent account for agricultural use (Naji & Ahmed 2009). Within this sector, we find privatization, the exclusion of marginalized groups as well as the reallocation of water from rural to urban areas (as shown for example by Padrutt 1997), as water management flaw. Furthermore, we may differentiate between *inter*- and *intra*-catchment conflicts of water allocation. Allocation conflicts within a single catchment are assumed to be far more numerous, since such offenses can be performed by means of water-diversion at the micro level.

Yemen ranks among the most arid regions in the World (Unicef 2003, p. 36). Even if called *Arabia Felix* (Happy Arabia) by the Romans because of its rather fertile mountain range as opposed to the mostly deserted rest of the Arabian Peninsula, coastal and inland plains repeatedly face serious water shortages. In addition to unsteady rainfall occurrence, groundwater depletion proceeds at a dramatic pace (Naji & Ahmed 2009). At the same time, the Yemeni population depends on agriculture for the most part. This economic branch not only serves as a generator for labor. Much more important, for a large part of the population agriculture serves as an essential source for self-supply (Wehner & Arvidsson 2001). Agriculture requires a constant supply of freshwater in addition to drilled well-water in order to yield a harvest on a regular basis. Furthermore, there are no sufficient financial resources to cover this supply by means of food-imports (Wehner & Arvidsson 2001), even though cheap subsidized wheat has e.g. at some points even diminished the market potential of similar local produce (Lichtenthäler, 2003). Nevertheless: up until today, 90 percent and more of total water withdrawal in Yemen were used for agricultural, i.e. irrigation purposes (Naji & Ahmed 2009).

A host of large-scale infrastructural development projects were implemented in the Yemen during the second half of the 20th century, aiming at rendering agriculture more efficient and increasing income per drop. However, these developments have

largely been ignoring existing traditional resource governing regimes, as well as overall potential in renewable water-resources. As a consequence, many functioning regimes within the wadi courses drifted into a loose set of disorder and arbitrariness when it comes to the allocation of freshwater among its riparians (Al Askari 2005, p. 13). Hence, many of these projects – in addition to other external factors such as changes in market-settings or economic and political incentive-structures – have obviously disrupted old governing systems, and nearly depleted existing water resources nationwide.

Research in the field

Underlying mechanisms will remain obscure without knowledge about agency as well as conditions and opportunities for certain actors to cause conflict with regards to water. Hence, the point is to disentangle political, institutional, economic and social determinants from often irrevocable physical sources of constraint. Gleditsch (2004) thus urges to answer the question how resource conflicts - whether driven by scarcity or abundance - are mediated by political and economic factors. The first differentiation concerns the actors involved. One important point is the water use by category and sector. Household water withdrawals are estimated at only 5-10 percent of total societal withdrawal. A benchmark figure for industrial withdrawals is 20-25 percent. By far the largest water user is agriculture with about 90 percent (Naji & Ahmed 2009). Depending on the degree of industrialization of a country, agriculture can have even more relevance (see above). Therefore, and due to the TOR for this paper, it will focus on water used for agriculture.

In case of the Yemen, the state in terms of the central government seems to play a rather small role when it comes to enforcement of governance and codified law at the local level, especially in peripheral regions. Not even officials in the respective governorates seem to play an important role in the development of conflicting situations over irrigation water. However, it does play an important role with regards to its control over key incentives such as energy pricing (diesel for well-drilling), taxation (or rather non-taxation/subsidization) of wheat and general food imports, and so on (Lichtenthäler 2003; see also Lawrence & van Steenbergen 2010).

Besides degradation, depletion and increased consumption of renewable resources, scarcity can as well evolve through human-induced inequitable distribution which could lead to violent conflict (Homer-Dixon & Percival 1996) and dramatically negative influence on a sustainable environment through resource capture processes (Lichtenthäler 2003). Or put differently, there is absolute physical scarcity from supply through rainfall, demand-induced scarcity as with population pressure and, there is also structural scarcity which arises from changes in distribution and cropping patterns. That is the dimension interesting for this paper: since it is induced by human agency and hence subject to the possibilities of internal water resource management.

This Paper - Theory and Methods

A discussion of "Governing the Commons" explains the principles of self-governance in light of common resources. Then, the peculiar characteristics of the Yemeni coastal spate irrigation systems with its water allocation and multi-layer legal system are drawn out. The analysis uncovers the underlying mechanisms in intra-catchment conflicts about irrigation-water between farmers upstream ('upstream actors', UA) and downstream ('downstream actors', DA) – incorporating contextual factors in order to shed light on all levers that may be pulled to improve water resource management in Yemen. The actor-centered analysis points at the gap in the governance design established so far by the irrigation improvement project in Yemen, and gives ideas for the advancement of social equity. Last but not least, macro-political and micro-level governance-instruments to tackle resource-depletion are being discussed and put up as relevant suggestions for policy-action.

Governing the Commons in *Sayl* and *Ghayl*

Finding or gradually developing mutual agreements - whether official or tacit - about how to govern or better yet allocate scarce common resources among players having equal rights is key to sustainable resource utilization. When "everybody's property is nobody's property" (Ostrom 1990, p. 1) individual welfare has to be sacrificed for joint welfare in order to prevent the destruction of the common good as well as the stability within the relationship among its users. How do communities reach such a state, where the amount of joint welfare can compensate a deliberate renunciation of individual welfare?

Elinor Ostrom (1990) laid out the principles of how the commons ought to be governed in avoidance of exploitation and conflict. After evincing the two traditional tenets about how institution building has to come about - by Leviathanish centralized control mechanisms or direct privatization - Ostrom argues that "the capacity of individuals to extricate themselves from various types of dilemma situations varies from situation to situation" (Ostrom 1990, p. 14). By analyzing different successful self-governing systems (from high-mountain meadows to fishing grounds), Ostrom lists several characteristics that repeatedly appear in these common pool resource settings. Central to these characteristics is the ability of people to commit *themselves* to a cooperative strategy: 1) use a private arbitrator from within the community rather than a civil court as enforcement-mechanism, since his motivation-structure is pro-solution (p. 16); 2) use a participatory-approach in contract-design ensuring deliberation and mutual agreement, since self-interest of negotiators will lead them to monitor each other and report observed infractions (p. 17).

In order to explain their success, Ostrom urges to look for factors external as well as factors *internal* to a certain group. Ostrom's focus lays on small-scale common pool resource settings, where the common pool resource is located within one country

and the numbers of individuals affected varies from 50 to 15'000 persons that are heavily dependent on the resource, i.e. gain a major part of their economic return from the resource (Ostrom 1990, p. 26). Ostrom's case, the Huerta region in Andalusia, Spain, has a limited quantity of rainfall throughout the region as well as an extreme variation in rainfall. All its river-basins face uncertain and complex environments, due to erratic rainfalls. These preconditions result in a very high potential for conflict. However,

> *"(...)the institutions devised many centuries ago for governing the use of water from these rivers have proved adequate for resolving conflicts, allocating water predictability, and ensuring stability in a region not normally associated with high levels of stability." (Ostrom 1990, p. 70)*

The regulations within these institutional regimes specified who had the rights to water and how the water would be shared in years of drought. Hence, they explicitly regulate the handling of allocation in light of freshwater availability anomalies. Yemen also provides ample evidence for successful self-governance, as e.g. Martha Mundy has shown for the case of Wadi Dahr:

> *"The community possesses a global allotment of water, a collective right jealously defended against other communities and the state. And the practical management of irrigation, overseen by local irrigation supervisors, not the shaikh, itself creates an important sense of community." (Mundy 1995, p. 62)*

However, the river-systems addressed are more or less of spring-flow character, rather than more uncertain spate-flood systems. A 1983 article by Daniel Martin Varisco (Varisco 1983) serves as a key eye-opener explaining why the two major types of water allocation systems in the Yemen entail different levels of allocation difficulties. Varisco compares these two major systems in the Yemen: the seasonal flood (*sayl*) and the highland spring flow (*ghayl*). Varisco mainly argues that tribal political organization offered an adequate adaptive response to spring flow allocation with fixed rotation-cycles. Strong kinship and economic ties guarantee a certain quality within the social fabric in which the rights to water are clearly defined and protected - without any external influence, as shown by Ostrom and Mundy as well.

> *"The distinctive character of spring flow distribution in al-Ahjur [spring flow system] is that everything is in the hands of the irrigator himself who is responsible for appropriating the water at the cistern. He is not dependent on simultaneous activities by any other individual, nor is he directed by an irrigation official." (Varisco 1983, p. 373)*

Several of the constants just mentioned are not given in spate torrent flood systems. Flood irrigation accounts for the most part of agriculture in Yemen after all (Varisco 1983). Flood flow is traditionally diverted by means of earthen barrages that lead parts of the flow into offtake channels. These barrages are constructed as temporary structures and must often be breached in order to let the water flow through toward downstream irrigators with rights. Many of these earthen banks are also

repeatedly destroyed by violent floods during the rainy seasons. This ensured the provision of downstream actors without fail (Mehari et al. 2005, p. 6f). These environments make it especially difficult to establish regulations that consolidate themselves within the local societies on a long term basis. There is a cogent need for supervisory actors in the allocation process in order to coordinate the distribution of water - especially, when the flood is low and not strong enough to naturally destroy the earthen barrels and flow downstream.

Legal setup

Two social and legal systems mainly influence the buildup of a *corpus iuris* within irrigation systems in the Yemen: tribal *'urf* (customary) and Islamic law. Islamic law i.a. rules that surface water which is not contained is *res nullius,* i.e. belonging to nobody. In reference to this, Kohler emphasizes that actors downstream irrigation systems have been fairly protected by law, because "water abstraction from the wadi is restricted whenever it can cause damage to users in the lower part of the wadi." (Kohler 2000, p. 173). Yet, if we look at customary law, this argument does not always hold. One reason is the often cited traditional water rule *Al a'la fa al a'la*, which points to an irrigation sequence giving upstream users priority (Lawrence & van Steenbergen 2010). This is an extremely important rule concerning water conflicts in spate irrigation schemes. In itself, this rule appears to downright discriminate actors downstream. Yet, the rule has to be examined within the actual system where it was and is applied.

In light of traditional diversion techniques, where dams and bounds are built of gravel, sand and mud, this rule does not affect the availability of water for downstream water users. As already mentioned, dams and bounds were usually washed away repeatedly by the torrent in times of heavy rainfall. This allowed the floods to reach the canals and fields further down the stream. Where this was not the case (in the event of weak floods), accompanying measures mostly ensured the lower riparians a degree of protection. This is, riparians downstream were usually ensured fixed (even if very short) periods of appropriation time. During these periods, the upper riparians were urged to open their sluices (Kohler 2000, p. 171). Two developments altered existing equilibria. New technological means and the absence of state-capacity to enforce regulations altered the opportunity structure of actors upstream.

This is exactly the turning point where development is followed by a new demand in legal adaption/adjustment and enforcement respectively. Depending on adaptive capacity and homogeneity of a water-sharing community, the *corpus iuris* of *'urf* and Islamic law suffices or not. Because of a governance-gap in a mixed environment of tribal-affiliated and independent social entities in spate-flood systems, supra-communal political mechanisms to arbitrate between independent communities and to

enforce decisions would be required, since neither homogeneity nor adaptive capacity is given.

One basis therefore shall have been the National Water Law, passed by the Yemeni Government in 2003. Still being contested and discussed, this law body has not had much impact so far. That the Yemeni state is not regarded by its citizens as ensuring a common good but rather as an actor with vested interests, and that multiple actor-groups with vested interests below the central state easily outweigh any enforcement-agency adds up to this (Kohler 2000, p. 170). Hence, the state constitutes no relevant source of legal norms so far. Hence, analysts and political advisors have resorted to rather promoting a state focusing on macro-political demand management instruments e.g. setting diesel price, elimination of credit-subsidies for agriculture, modification of vegetable and fruit import ban, taxation of water-use etc. (Ward 2009).

Defective irrigation practices

In the traditional water-diversion system in the wadi (and before the possibility of obtaining water from deep-wells), upstream communities were restricted to grow water-saving crops only, because the high floods naturally destroyed the earthen diversion structures. Therefore, and this is most important, continuous watering with high quantities of water was not assured. Thus, upstream users did not cultivate water-intensive cash crops such as water melons, bananas, and of course qat. In game-theoretical terms, a payoff matrix of the situation free of conflict can be drawn where no structural scarcity is produced (Table 1). UA here has no means to render structural scarcity for the DA.

Table 1: Payoff Matrix – Traditional system

	UA cooperative	**UA conflictual**
DA cooperative	(++) Remain with traditional water-saving crop in order to yield guaranteed harvest.	(--) No means to securely achieve profit-yielding outcome by defecting from traditional rules.
DA conflictual	(---) No reason.	(---) No reason.

However, if the opportunity structure for the UA changes, the basis of decision will alter as well. In course of the second half of the 20th century, government and donors financed concrete dams and diversion structures as well as equipment for deep-well exploitation, in order to improve local agriculture. In view of the new possibilities the concrete structures offered to them, combined with a temporary import-ban on fruits and vegetables, the cultivation of cash crops suddenly became feasible.

As a consequence, the decision basis of the UA actually changed. The UA renders structural scarcity by abstracting more water in favor for a shift to the cultivation of water-intensive crops – because of his perceiving his agricultural opportunities and ability to cope with DA's reaction. The situation for the DA worsens without any enforcement institution to resort to. Hence, the DA's beliefs about his detrimental consequences direct his preference order toward the option of restoring justice even by violent means. This again can be visualized within a game theoretical payoff matrix illustrated in Table 2.

Table 2: Payoff Matrix - Conflict

	UA cooperative	**UA conflictual**
DA Cooperative	UA: (++) Remain with traditional water-saving crop in order to yield guaranteed harvest.	UA: (++++) Means to divert water and secure water-intensive cash crops. DA: (- - - -) No water.
DA Conflictual		UA: (+++) Accepts risk of DA reaction. DA: (+) Because no functioning polity of conflict-mediating mechanisms.

The following questions need to be addressed in the following: Why did upstream actors actually start to refrain from such long-established rules of water appropriation? What has been undertaken to tackle allocation inequity (and as an outcome thereof, social inequity)? What problems remain in spite of establishment of local water user organizations through the Irrigation Improvement Project? Respective narratives have been traced along qualitative interviews in Wadi Zabid and Wadi Tuban.[1] And finally, which macro- and micro-political instruments are suggested by the literature in order to tackle overall water resource depletion (in particular groundwater aquifers)?

1 Read the detailed and extensive interviews in the original study available online at: *se2.isn.ch/serviceengine/Files/RESSpecNet/.../WorkingPaper_43.pdf*

Narratives from the field

a. Wadi Tuban - Outset

Wadi Tuban ranks among the most fertile wadis in Yemen. However, it is also one of the most wide-stretched wadis with regard to length *and* broadness. Therefore, in some years the villages in the lower part of the wadi like *Ar Riyadh* and *Al Waht* do not get any water at all during the whole season. In the 1950s, the Sultan of *Lahij* promoted the codification of the traditional Agricultural Customary Law of *Lahij* and *Wadi Tuban* respectively. Central pillar of the management of this system was the Agricultural Council (AC). Later, 14 smaller water user associations (WUA) and an irrigation council (IC) were created to supplement the AC. Among the functions of the AC are the protection of customary water proportion and allotment rights. Unique to the Sultan's enforcement institution of the *qanun* (codified law) was the introduction of a kind of food supply assurance. A special system was set up, whereby certain lands were appointed for the cogent planting with sorghum of the highly stable *ghirbah* variety. Only the sorghum fields enjoyed the full water rights and the system was only self-regulatory as far as a certain threshold of food supply was met first. In addition, the *qanun* further defined, that any plot of land irrigated in order to grow *ghirbah*, although it has not been assigned for the cultivation of *ghirbah*, must not be given a second watering. Furthermore, the AC met as much as twice a week during the season of irrigation. Within these meetings, not only maintenance, disputes and respective penalties were handled. Also, the necessary *ad hoc* changes in the irrigation plan were deliberated. This measure enabled the institution to flexibly adjust the allotment sketch (drawn at the beginning of the season) to actual wadi discharge.

Seventy-two year old Saleh Mohammed Huaidir is chairman of WUA *Faleg Iyadh*, which lies in the middle of the wadi. Huaidir served the different governments in doing agricultural planning for the Agricultural Council. Within the wadi, the area of *Faleg Iyadh* can be considered upstream, since all the areas further up the wadi only cultivate a rather narrow band along the water course. According to Huaidir, the dam in the middle of the wadi (which is just upstream of *Faleg Iyadh*) was already built in 1951 under the Sultan's rule. Further dams and channels were added in the 1970s and the mid-1980s. Surprisingly, the upstream actors (UA) in *Tuban* already began to cultivate water-intensive crop such as cotton, water-melons and tomatoes shortly before the Sultan codified the *'urf*. As Huaidir purports, the building of the dams led to professionalized cultivation and increased quality and quantity of the crops. And since the cultivation and irrigation plan was centrally planned, there was no such thing as illegal deviations from allocation policy - it was simply not necessary. Interviews with three more UAs were conducted during a meeting of the Irrigation Council of *Wadi Tuban* in *Lahij*. When asked, whether any DAs ever came to complain to the people of his WUA because of allocation irregularities, the chairman of WUA *Ras Al Wadi*, Jamal 'Ali, answered in the negative and stressed

that if anyone ever had such a problem, he could go to the Agricultural Council or the Irrigation Council - and that these institutions were always able to solve disputes by and large. Hussain Al Ban, head of WUA *Beizag*, agreed with this and added that with the introduction of cotton during the 1950s, the income of all the WUAs in the wadi rose considerably. When the group was then asked whether the situation of the downstream areas is now as positive as it is for them, they approved unanimously. IIP-representative Anuar Abdul Karim agreed with this, too. Yet, Abdul Karim added one restriction to this: Since the price for crop is not set by the state anymore, the farmers were exposed to the free market and its price volatility.

Statements by downstream actors (DA), were rather ambivalent. Two representatives of communities downstream were met during the stay in *Tuban*. Abu Bakr As Salaam is head of WUA *Muttawassid Al Wadi Saghir* and was the first DA met. Throughout the meeting, As Salaam emphasized his being satisfied with the system as it is now and expressed a strong notion of the people in the wadi being equals and act as such. The second DA interviewed, 87 years old Abdullah Aydrus Mohammed Saqaaf, was a water official in *Lahij* for over 40 years. He stressed the fact, that before the unification of Yemen, water allocation was always easily controlled by the elders upstream. Both DAs agreed upon the fact, that the Sultanate system was a system of cooperation and worked out for UAs as well as DAs without any flaws. Furthermore, after the introduction of cotton in the early 20th century, factories were built in the late 1940s. According to As Salaam, the tomato-canning factories as well as cotton-processing plants led to the launch of the Agricultural Council and agricultural planning, whereby there was special planning for every piece of land and every crop and water-allotment in order to increase the communities' profit. And since the AC was made up of the farmers themselves, they decided what kinds of crop they need and want to grow by themselves.

However, according to the *'urf's* rule that the UA has the right to water first, the question remained whether there were any food shortages in times of drought. The answer, according to As Salaam is negative because of three facts. First, the already mentioned rule to secure a first and second watering of selected sorghum fields by all means arranged for a fair distribution in times of negative discharge availability anomalies. Second, during the last famine in the 1940s, the Sultan corrected for this with food imports from the Sudan and other countries. Third, after the early 1960s, almost every farmer in *Lahij* also worked for the government. Thereby, an additional income was guaranteed. One notes the characteristics of a centrally-planned economy (i.e. a semi-free market) and the additional income-rendering through government-employment.

It were only after the unification of Yemen in 1995, that the situation started to change slowly. This fact was stressed repeatedly by Mohammed Saqaaf. The government system imposed by powerful North-Yemen after the unification had stashed away the centrally planned economy. According to As Salaam, it is not anymore the government which markets the crops and thereby sets the prices. Saqaaf added to this that the water is not anymore divided in relative equality, but strictly

along *Al a'la fa al a'la* (watering priority to upstream actors) – without any institutional buffer. And the WUAs and the IC have not yet been able to control for this void in regulation. Adding to this, new dams in the upper catchment area – based in a different governorate – led water levels to decrease, said Lutf Saalem Saleh, head of WUA *Obar Yakup*. Which, of course, is out of the ICs sphere of influence.

Wadi Tuban – Learnings

In spite of concrete diversion structures, upstream riparians in Wadi Tuban did not commit a shift toward water-intensive crops in ignorance of the needs of DAs at any point in time. The community-led agricultural planning was designed by DAs as well. Second, the institutions imposed by the Sultan foreclosed any structural scarcity to emerge. This is a clear case for a) the participative approach with actual water users designing their own regulation systems; and for b) a controlled free-market, where agricultural planning allocates produce to fields and thereby decreases social inequity and water-capture mechanisms.

However, inter-governorate competition for irrigation-water as well as free-market pricing for commodities (or even more: cheap subsidized wheat to compete with) have brought about a structural scarcity, which adds to water-stress induced by absolute physical freshwater scarcity and demand-induced scarcity from population pressure. Therefore, market-incentives for water-saving crops such as the mentioned *ghirbah*-variety – by way of balancing down wheat-subsidies sufficiently – may alter the motivational structure among farmers, and thereby decrease demand – accustomed to lower stream levels from increased use in upper catchment areas.

b. Wadi Zabid - Outset

Wadi Zabid has one of the oldest and most developed traditional spate irrigation systems in Yemen. The functioning of its highly sophisticated *corpus iuris* in this respect was dramatically disabled by development of agricultural techniques in the 1970s. It was one of the first wadis being subject to major irrigation development projects. The World Bank sponsored project in *Wadi Zabid* has been completed in 1979 (Tahir & Noman 2002, p. 18). It is furthermore the only wadi, for which a jurisdiction of water rights in written form is available that is old to such an extent (Salameh 1995, p. 27). This code of law was established about 500 years ago (Tesco et al. 1971) by scholar *Ibrahim Al Jiberti*. This code is in effect and adhered to up until today. There was presumably one main reason for this codification of law in the 16th century. According to Salameh (1995), p. 28, the unconfined prerogative of the UAs allowed them to exploit their rights beyond a fair-minded extent. This must have resulted in repeated revolts from the DAs. The goal of this codification must have been then, to prevent such disputes by means of a fixed distribution key. Therefore, the experience of centuries about the course of rainfall and freshwater availability was

harnessed by *Al Jiberti* in order to develop this allocation formula along the limitations set by the local traditional customary law *'urf* and the Islamic law *Shari'a*. However, according to Salameh (1995), p. 32 this also implies the existence of clear dynamic elements within the *'urf*. *Al Jiberti* split the traditional canals in the wadi into three groups with distinctive water-rights at specific times during the year. The upstream canals are served the longest period from 19 October to 2 August, i.e. 288 days (note that only 97 days account for the rainy season, the rest is base-flow, to which the upstream canal group is entitled). The middle canals, which account for more than double the command area of the upstream canals are served from 3 August until 13 September (42 days). Finally, the downstream canals with about a quarter of the upstreamers command area are served from 14 September to 18 October (35 days) (Lawrence & van Steenberg 2005, p. 80). This distribution seems rather unbalanced, yet it curtails a strict priority to upstream users according to *Al a'la fa al a'la.* This *'urf*-rule would by itself grant upstream users priority rights to irrigate their fields until they "have exercised their rights to divert a quantity of water sufficient to satisfy their needs" - even if this means watering newly cultivated fields and ever more water-intensive crops (Lawrence & van Steenbergen 2010). However, the watering period for Group 1 is still assigned during the time where freshwater availability could be secured best (Abdulmalik 2003, p. 7). The traditional irrigation system consisted of 16 supply canals which diverted the spate to the fields by means of deflectors in the wadi bed. These structures were made from poorly compacted materials like soil, gravel or tree branches and were hence often damaged by medium or large floods (Tahir & Noman 2002, p. 20). Hence, the water got through toward the lower part of the wadi right from the very beginning of their watering turn. In addition to this codified body of law, *Al Jiberti* introduced the post of the *Shaykh Ash-Shareegh* (water officer). The *shaykh* had to control the times of appropriation as well as the state of the diversion structures and their maintenance respectively (Salameh 1995, p. 32).

The leading civil engineer of the Irrigation Improvement Project's (IIP) local project implementation unit, Ahmed Ahmed stressed the unfair situation between UAs and DAs since the concrete diversion structures were built and that the people in the lower part of the wadi suffer from these conditions. The amount of water they receive has decreased to such an extent, that there is now even a new problem of desertification in the lower wadi (Note: this has not been verified by the author through actual data).

Depending on the WUA-cluster under scrutiny, an actor (WUA) can be UA to some other actors and at the same time also suffer the disadvantages of a DA with regards to actors further upstream. The first meeting with a UA was held with Shaykh Mohammed Sulaymaan Aydrus, head of WUA *Al Girbah* in *Roda Girbah*. *Al Girbah* is the topmost WUA in the wadi and home to the wealthiest families in the whole of *Wadi Zabid*. According to Aydrus, water-intensive crops were mostly absent before the 1970s. It was not considered feasible to cultivate water-intensive cash crops. Water-intensive crop would have gone dry before the harvest. This would have

jeopardized the income needed from food surplus. These insights were confirmed by Shaykh Abdul Saalim Da'ab of WUA *Al Mawi*, which can be considered UA in Group 2. The interview was conducted in Da'ab's house in *Mahall Ash-Shaykh*. *Al Mawi* is by far the largest WUA in *Wadi Zabid* and within Group 2 they are the most well-off. Da'ab even purports that there was no sense of profit-oriented economic thinking in the minds of farmers in *Wadi Zabid* before the concrete diversion structures were built. The representatives from WUAs Ebri, Gerhazi and Yusufi all ascertained the findings above. They all cultivated cereals and sesame before the dams were built. Only after the concrete structures and the introduction of tube-well technology did they change their cropping patterns toward bananas, mango, water-melons and the like. Hence, the preference order of the UAs was in favor of a secure harvest of water-saving crops according to tradition.

All the exponents of the UAs unanimously mentioned their switching to the cultivation of water-intensive crops as soon as the concrete diversion structures and new techniques were at hand during the 1970s (Al Askari 2005, p. 186). Even the UAs within downstream Group 2 were able to execute this switch as the case of WUAs *Al Mawi* and *Ebri* shows. Against these statements, some experts hold that the modernized system actually helped to improve control and enforcement through the state – and that only after 1985 and the fruit import ban, incentives changed and expansion of irrigated area upstream and change to cash crops happened (Ward 2009, p. 241).

Nevertheless, as Shaykh Mohammed Sulaymaan Aydrus puts it: "It is just that now, we have the possibility to actually fulfill our rights, whereas the DAs lost their [structural] advantage they had during the times of earthen bounds." This was not denied by any of the UAs *nor* later by any DA - this is a remarkable fact, since the residual flow for the DAs is considerably smaller than it used to be. Two interviews with pronounced DAs were held. First, Shaykh Saalim of WUA *Al Mahraqi*, one of the three lowermost WUAs in Group 3, and farmer Saiid Baraba of *Wadi Nasri*. *Wadi Nasri* is the lowermost WUA in Group 2 (furthermore, the insights from an extended meeting with Shaykh Abdul Saalim Da'ab and members of his family also reveal the WUA *Al Mawi's* position as a DA). Their perspective is very clear indeed. Since the late 1970s, they experience a dire state of structural scarcity. The water became dramatically less. This has been dearly bewailed by Saiid Baraba and his fellow farmers when they were interviewed South of *Zabid*. According to Baraba, the quantity of water reaching the fields of WUA *Al Nasery* dropped to less than half as before the concrete structures were built in the upstream areas (again, this has not been verified by the author with actual quantitative data).

Having been asked about any polity for them to voice their concerns, Baraba and the farmers did not directly deny the existence of such institutions. Of course, there is the Irrigation Council, the Governor in *Hodeidah* as well as their respective community eldest *shaykh*. However, these institutions were not of any help because of two reasons. First, the institutions themselves are bound by the fact that most UAs still act according to the rules of *Al Jiberti*. As Dr. Khaled Al Attas, head of the

Project Implementation Unit of the Irrigation Improvement Project told the author with regards to the people in Group 3: "These WUAs come to me to complain about their situation, they go to the Governor and even to the Minister because of this problem. But no one of us can do anything about this. *Al a'la fa al a'la* and *Al Jiberti* are the rules." Second, according to Saiid Baraba and Shaykh Saalim, most of the farmers upstream are very rich and thereby able to bribe policemen or government-officials. Hence, there are no convictions in case of actual breaches against the law by UAs. As they both stressed, there are absolutely no opportunities for any alternative income in the whole of the *Tihama* as well as the near abroad. The economic disadvantage was also repeatedly mentioned by Shaykh Abdul Saalim Da'ab in his role as a DA with regards to the WUAs in Group 1. Hence, there is a strong will to escape this state of structural scarcity and to improve the own wealth. However, DAs do not have the means to act-up. A great power imbalance stems from the 1980s, when, according to engineer Ahmed Ahmed, Yemeni expatriate workers returned relatively wealthy from the Sudan, Sa'udi Arabia and the Gulf States and bought up vast areas of land in the upstream region of *Wadi Zabid*. Due to the dimension of their land as well as their economic advantages since the 1980s, the UAs grew ever more powerful. Hence, the balance of power within the wadi is skewed to such an extent, that there are absolutely no attempts by DAs to enforce an at least partly fair new allotment of water anymore.

Wadi Zabid – Learnings

First, in a simply logical manner, the basic idea of *Al a'la fa al a'la* clearly makes sense by enabling the cultivation of (more water-intensive) vegetables where their survival and subsequent harvesting is best secured, i.e. the fields in the upper stream. Hence, this rule should continue to build the fundament of a law body/distribution rules. Before tube-well and dam techniques, water using did not affect aquifer levels and renewable water resources were kept in balance *per definitionem.* Second, the adoption of the *Al Jiberti* rules was a clear act towards an at least partial social equity without curbing *'urf* to an unacceptable extent. Their having been respected for so many decades not only indicates that self-governing abilities of local communities at *their* local level once already have existed. This should also give us confidence that, in the course of the current social inequity growing stronger, governance will inevitably *have* to fall forward into a new equilibrium under a new allocation system. In any event, lurking water-resource realities, i.e. depleted aquifers, will make the region regress to agriculture-patterns that rely on what the *sayl* may provide. And examples like the Rehanzai Bund on the Anambar Plains in Balochistan, Pakistan show, that even concrete (in both senses) development might as well be reversed (or in this case: blown-up), if their inequitable outcomes produce enough discontent (Lawrence and van Steenbergen 2010, p. 161f).

However, many might wish that change arrives much faster. Therefore, the undertakings of the IIP have tried to improve local governing mechanisms to tackle

social inequity, as well as raising awareness among farmers, about the resource depletion. It has become clear though, that without a cogent enforcement actor, deliberation and mediation remain without actual upturn for DAs. Even more so in the absence of any alternative means to generate an income. And therefore one may envision as inevitable an eventual "thinning out" of the population, since the mechanisms of the market don't allow for philanthropical acts. And that social inequity seizes to exist by sheer migration of disadvantaged citizens to urban centers in search for work and income. Or with the rather radical conclusion of Hellegers et. al. (2008, p. 90) on where to focus in future endeavors, positive gains from widely proposed water saving actions all over Yemen "are at best uncertain (…) and will rarely lead to genuinely sustainable outcomes" and therefore:

> *"(...) resources are probably best devoted to needs of ex-irrigators in the post-irrigation scenario."*

Fair enough. And probably the mandatory consequence of a vicious cycle of a tragedy-of-the-commons resource depletion. Yet, where markets are, incentives play a role influencing behavior. What instruments the Yemeni government *does* have, and how they may influence socially equitable use as well as sustainable resource utilization will be discussed in the following paragraph.

Instruments and ways towards sustainability and social equity

Obviously, governmental action with effective outcomes is hard to implement on the ground-level in Yemenis regions. Central government has never been strong enough to serve as a coercive power in the periphery. However, there are several macro-political levers the government may use, and that donors may support with accompanying measures (also to cushion potential negative externalities of progressive steps). In the following, I will treat the question of overuse/sustainability with higher priority, and the issue of social equity with secondary priority. This will be followed by a short emphasis on the *qat* issue.

New laws. At the basis of every government action is the law that gives the government authority to act. While runoff rights from *sayl* in many regions have been more or less in place, and some rules over well-access like the *harim* well-spacing rules exist, according to Ward (2009, p. 243): "no traditional rules exist for quantities extracted or water charges." Even though this is seen as extremely difficult to measure, rules on quantitative extraction and water charges shall be put in place based on latest estimates of aquifer-potentials. Furthermore, water-charge laws serve as a motivation for enforcement, since they will be a source of tax.

Achieve more sustainable and socially equitable water use. Knowledge is key – and to foster understanding of the situation and the urge to fit water use patterns to local resource potential (as to not fulfill the tragedy of the commons) stays an important soft-power instrument by the government and donor organizations. First, many authors advocate predictability of water flow as a factor to decrease allocation-

conflict potential, since rules may be tailored to expected realities, and socially inequitable use becomes more visible (Varisco 1983, see also paragraph on *sayl* & *ghayl*). To help enforcing rules and agreements, Lawrence and van Steenbergen (2010, p. 155ff) promote the establishment or further development of "self-motivated local organizations", i.e. what has been put in place already through WUGs, WUAs and ICs. As a prime example therefore, they mention the Sheeb Farmers Association in Eritrea, which has been established through local elections, and has gained further legitimacy through acknowledgement by government. Membership is moreover compulsory. They further promote interconnectedness as a prerequisite, and argue that "governance of spate systems has traditionally integrated the interconnectedness between water users in a wadi." Therefore, new governance for modern technological systems have to expand this interconnectedness from the command area to the catchment area, which may lie in a different governorate (which is the case for Wadi Tuban). Hence, the urge for a pooling of authorities.

With regards to the problem of resource depletion rather than allocation, predictability of volume and quantity are even more important. Ward (2009, p. 247) argues though, that it is much more difficult to measure and make visible "the depletion of an underground resource for which even experts do not understand the hydrogeology". Therefore, raising awareness often has to rely on trust, rather than hard facts, and as such has to follow a style of 'constructive criticism'. Thus, second, promoting water use efficiency still has to remain on the agenda (Ward 2009, p. 239). In terms of local-level development, this would mean promotion for switching to 'high-tech' irrigation methods such as drip or sprinkler, as well as water conveyance through closed channels to minimize evaporation loss (Hellegers et. al. 2008, p. 27). However, such investments could only be made with the help of government support, which might better be put to use in alternative levers.

Reduce & avert depletion. The dramatic state of groundwater levels and aquifer conditions is well established. The situation requires immediate and radical reduction of abstraction, if one still believes in their recovery, given the Malthusian population increase. First of all, and already under way in part through the IIP, Ward (2009, p. 263) urges for decentralizing the powers of NWRA to its local branches which "at least may back up the power of local communities to control abstraction and drilling" - a measure also long-supported by Lichtenthäler (1997, p. 11). Because local people are the direct stakeholders of their water as well as the main knowledge-carriers for their villages'/areas' hydrology and history. Therefore, cropping patterns may be adjusted to local resource realities. Kuster (2007) finds that cogent cultivation of water-saving crops for water saving and food security has been decreed by the Sultan in the case of Wadi Tuban, but that there is no coercive power in place now as to enforce such a rule. And as long as economic incentives are in favor of water-intensive agriculture patterns, farmers will most likely stick to current water use modes and 'race to the bottom'.

Thus second, the probably most powerful lever of central government is influencing profitability of different styles of agriculture and irrigation, and thereby

readjusting incentives. This may be raising the price of diesel, which raises the cost of pumping water from wells. This may also be the lowering of import-taxes and thereby allow import of cheap water-intensive crops, vegetables and fruits, which decreases incentives to cultivate these in Yemen. And on the other hand, import bans may be introduced for cheap foreign wheat and crops, as to increase demand and profitability of water-saving (and traditionally wider spread) sorghum varieties.[2] Hellegers et. al. (2008, p. 27) promote this measure, because influencing the price of product is much more within the power of central government, "while control of abstraction on the individual level is essentially impossible." On the basis of the Bosworth report (Bosworth et. al. 2002), they furthermore repeat the idea that prices for water must be raised "dramatically and generally well beyond the estimates of the cost of the service, if volumetric charges are to have a significant impact on demand" (p. 19). Recapitulating the history of government influence in the water sector, Ward (2009, p. 239) traces the antipodal ways in which this instrument has been used. Whereas in the 1990s, the early period of the modern Yemeni state, price-decreasing in diesel, credits etc. and selective import-bans were used to foster development of water supply and its technological systems, these demand management measures were reversed when awareness of water scarcity emerged in the early 2000s. However, the measures taken to day were inadequate and insufficient. Ward et. al. (2010, p. 12) emphasize the difficulties of increasing diesel price, as the 2005 doubling of the diesel price showed: because it also raised the cost of transport and food, and in the end particularly hit the poor, and eventually ended in violent riots. We might hold, that tax-, tariff-, and price-instruments that steer the production away from water-intensive crops towards a traditional portfolio-mix with a focus on water-saving produce, such as sorghum, much less affect the livelihoods of the poor (transportation, food), than e.g. the diesel price does. And where they *do* induce negative externalities such as income-loss, donor-aid might be used to bridge a transition-phase until alternative economic sectors/activities are in place (see also Hellegers et. al. 2008, p. 81). In addition, they could be cushioned in part by an overall system of inter-regional equalization transfers as in other federalist state-systems with heavy decentralization, e.g. Switzerland. Therefore, government should focus on these levers of influencing profitability.

Qat. Accounting for 30% of water use in Yemen alone (Ward 1999), the 'qat-issue' deserves special attention, when it comes to the saving of the water resource. Since the profit-margin of this cash-crop is exceptionally high, and its cultivation comparatively secure (high drought-resistance, fast growth etc.), even increasing costs for production means (water, diesel, and deep wells) will hardly be enough to sufficiently alter the incentive structure through profitability decrease. Therefore, mainly two levers are mentioned in the literature. First, according to Hellegers et. al. (2008 p. 41), import-price for qat from countries like Ethiopia would be cheaper compared to the local output prices, but imports – which are officially allowed – do

2 One may also consider a ban on imports of drilling rigs, or even such a radical measure as compulsory acquisition of present drilling systems.

not happen, since domestic producers hinder such imports. Nevertheless, one could assume that this would render pumping from a certain depth as not profitable any more (Hellegers et. al. (2008, p. 84). Hellegers et. al. (ibid.) argue though, that in the case of fossil aquifer that will not recharge, the use of the water saving may not serve any interest. However, their line of argument holds another element, that is highly interesting: the cooperative establishing of farmer-owned qat-plantations/-enterprises abroad, e.g. Ethiopia. Qat could not only be grown cheaper in Ethiopia and the production cost/market price difference serve as a compensation for income-loss for Yemeni farmers, but it would as well save considerable amounts of water. This mean is especially interesting, since ownership of qat-growing coops abroad could be tailored along traditional systems of solidarity and loyalty, i.e. tribes, families, villages. Plus, it would involve farmer-control (i.e. stakeholder-control), market-mechanisms and thereby competition. Most likely though, persuasion of farmers will prove difficult, since "ensuring the link between a share in revenues from the Ethiopian venture and actual reductions in water use is difficult" (ibid., p. 84).

Summary of findings from the research

It has become clear, that the problem of social inequity at the local level is made worse by an overall water resource depletion in the near future in Yemen. In view of national relevance, tackling the resource problem is more urgent. Nevertheless, we should harness possibilities available on the local level to support social equitable use and distribution of water.

As far as social equity in *Wadis Zabid* and *Tuban* is concerned, equity has been risked by developing agricultural efficiency. The desire to better control water flows has outweighed the care to protect existing water uses, as well as the introduction and promotion of well-drilling has been leading to resource depletion. Hence, the benefits of these developments can *not* be shared equally. In the case of *Wadi Zabid,* due to *Al Jiberti and Al a'la fa al a'la,* UAs never considered the appropriation of more water as defection. Rather, they perceived their changing as being truly legitimized by the old rules. Overall decrease in water use (as an expected outcome of the measures above) by itself may curb water-demand patterns of now advantaged actors (structurally and/or in terms of power), i.e. UAs in Wadis Zabid and Tuban. And thereby this may solve part of the problem of social inequity. In addition, increasing predictability of water flow, volume, and quantity will give leverage to self-motivated local organizations of governance.

This paper puts forward six strings of action that can be used to countermeasure the depletion of the water resource in Yemen and to promote its sustainable use. First, the establishment of rules for quantitative extraction and (tax-relevant) water charges shall be established case-sensitive, based on realities in the different areas/governorates – as a motivation and basis for enforcement. Second, the predictability of volume and quantity of the water-resource should be increased as far

as measuring allows – in order to raise awareness for lurking realities underground. Third, and long under way, 'constructive criticism' for local development in water use efficiency should still be continued as far as costs do not outweigh potential improvement. Fourth, to back local-level government-bodies, state-agencies like NWRA have to be decentralized – knowledge, leverage and foremost legitimacy are situated with local actors. Fifth, the government has to design tax-, tariff-, and pricing-instruments that steer the agricultural portfolio back towards a (traditional) focus on water-saving crops. Sixth, donor-aid and equalization transfers (urban to rural) have to be put in place to cushion and bridge the transition phase that most-likely follows such an alteration of the agricultural system in particular, and the economic system in general.

Policy Recommendations - Overview

Following the above analysis, six strings of action could help Yemen move faster towards achieving its goals. The six policy recommendations are structured along three dimensions: (i) rules and knowledge (clear and fair rules for water use/predictability of resource); (ii) design of implementation agencies and partnerships (user-centered implementation/decentralization); and (iii) levers for transition (macroeconomic incentive structure/ transition support).

1. Need for knowledge and predictability in water with the need for adequate institutions

NWRA should implement water resources assessments in major basins/water-user schemes, and agencies active at different basin-levels/local-levels should carry out pilots. Water-resource estimation can be conducted through a mix of remote sensing (RS) and ground measurements. Agencies active at local level may then integrate findings in knowledge-transfer and establish perception of data as source for adaptive rules at the local and basin level. The National Water Resources Information System (NWRIS) should be an open-access tool for planning from local level up to basin level. At the local level, participatory water resources assessments should be conducted, combining local and scientific knowledge to find ways for communities to manage their own water resources sustainably.

2. Need for new, clear and fair rules on water rights and use, underwritten by government

Following the pilot-phase of water-resource estimation, the data-base should be able to support clear and fair rules on local water rights and use. Local communities, WUGs, WUAs and ICs may modulate existing body of rules, following a community-centered bottom-up approach to negotiate clear and fair rules based on local realities from water-resource estimation. Partnership between local communities and public agencies should be formed to confirm and support simple, locally-accepted rules e.g. 500 m well spacing rule.

3. Need for partnership and dialogue on water management etc. to accompany promotion of water use efficiency

Agencies active at local level should ensure continuation of successful approaches: ownership of institutional tasks, decision-making, and financial contribution stays with locals (ongoing). GSCP and other programs supporting water use efficiency at the local level should broaden their approach to promote local level sustainable water resources management. Government and donors should ensure progressive development of institutional capability for working with communities on water resources management (e.g. sustaining institutional capability after 'closing' of IIP, SBWMP). Agencies should pursue groundwater-replenishment – e.g. managed aquifer recharge (MAR) for spate systems – in partnership with local owners (WUGs, WUAs, ICs).

4. Need for further decentralization of public agencies on the basis of partnership approaches between government and local (private) organizations

Public agencies have to decentralize financial resources and decision taking powers to the lowest possible level. These agencies should coordinate or integrate their actions at the basin level and below under the aegis of the basin committee and with technical planning by NWRA. Government has to recognize local community-based organizations such as WUGs and WUAs and to **empower** them – with knowledge and with support to bottom-up planning and to rule setting and enforcement, together with support to water-saving investment and practices.

5. Need for a macroeconomic/fiscal incentive structure that promotes the water using behavior desired, while balancing equity, efficiency and sustainability

Diesel prices should be raised at least to border parity levels, and the incentive structure needs to be rebalanced to favor the import of virtual water and discourage its export. The subsidy structure for irrigation improvement should be adjusted to encourage massive uptake of water saving technology and husbandry practices – including possible privatization of public implementation units (GSCP), roll out through the private sector, and results-based aid. Community organization for sustainable water resources management should become a condition for subsidy for irrigation improvement. Support to the livelihoods of the poor, in both irrigated and rainfed areas, should be scaled up.

6. Need for concerted government and donor support for transition away from water intensive agriculture

Within basin plans, agricultural agencies active on local level should prepare communities for inevitable changes in farming and livelihoods as groundwater runs out. Ministries concerned with agriculture and irrigation together with local agencies should assess and define vulnerable populations requiring cushions through donor support as a result of negative externalities of transition. There should be multi-

channel financing of transition-cushion through donor-agencies: new 'dedicated' funds for transition, coupled with 'green money' (on the model of subsidy systems in developed states such as Switzerland, such as mechanisms like payments for environmental services which may help sustain income for poor rural areas at least for a while).

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