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Choosing an EPI? Governance and the choice of a policy mix

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What is an EPI?

The key aspect on an EPI is that change is voluntary; it involves channelling private interest to the collective good. That is, the private incentives provided will result in some individuals choosing to change in a way which delivers a collective gain Because it is voluntary, this means that only some people will change. In turn, this implies that there are some differences between people that can be exploited for the collective good. For example, if some people can make a change at a lower cost than others then it makes sense to induce those people to change rather everyone changing – provided that the amount of change that results is sufficient to achieve the objective. Secondly, EPIs rely upon the use of private financial incentives to induce some people to make the change.

EPIs are then different means of exploiting those differences for the collective good. The three main forms of EPIs are then:

- The use of prices or subsidies; generally, these are targeted at reducing some use of water,

- The creation of market in which some thing can be exchanged; commonly, this mechanism is adopted to redistribute usage between users,

- A voluntary agreement between people to make some change; most usually, adopted to reduce usage of some kind.

But innovative instruments may either have a different basic purpose or combine purposes. In summary, the two starting points when considering the adoption of an EPI are:

1.There have to be differences within the population being considered;

2. It has to be possible some of the population to change in a way that achieves the intended objective (e.g. 'good' ecological quality). That they haven't already made this change implies that their present behaviour maximises their private interest but not the collective interest, or that there are other barriers or disincentives for them to make a change. Incentives therefore have to be introduced which are sufficient to overcome these barriers.

The value of each possible EPI is then the extent to which it either overcomes the barriers that exist within the population to making a change (e.g. trading) or provides an incentive to make the change (e.g. a charge/subsidy) sufficient to overcome the barriers and disincentives to making the change.

What is the problem space?

Both as a substance and as a management problem, water has characteristics which make it unique. It is the only commodity which is entirely recycled, through the natural hydrological cycle. Its chemical and physical properties (Ball 2000) mean that only in a few uses are there any substitutes and it cannot be manufactured but the varying naturally occurring supply must instead be allocated between competing uses. It is heavy and incompressible so that transfer between areas except through gravity is exceptionally expensive and generally uneconomic. Plants require water for cooling and other uses in enormous quantities; the figure of 1000 tonnes of water being required to grow one tonne of wheat is the usual rule of thumb. Agriculture is consequently the dominant use of water. Thus, water has to be a cheap, bulk commodity and this in turn means that transaction costs rapidly become a major determinant in the cost of water services and relative transaction costs influence what is the most efficient way of intervening.

Water management involves both natural systems (catchments, coastal zones, aquifers) and artificial systems (storage, treatment and transfer; collection, treatment and discharge). Each system, whilst presenting its own problems, is more or less closely coupled to the others (the obvious exception being unconnected aquifers). The primary

characteristic of a system is that there are interdependencies and interactions between the components of the system. In systems, externalities are the inevitable consequence of action at any point; intervention at one place will have effects downstream or upstream and at other times. Externalities are not simply unfortunate but necessary consequences of action in the case of catchments.

That we are dealing with highly dynamic and closely coupled systems is the basis for the adoption of the Integrated Water Resource Management approach (GWP 2000). The nature of water management may be argued to make the management problem more difficult than, for example, air pollution management because of the richness of the interdependencies in and between the systems. The consequences of any intervention have to be considered across the systems as a whole. So, it is necessary to look both for potential synergies between interventions and also antagonisms. The highly connected nature of water management means that both are likely to be experienced.

There are wider characteristics which are critical to water management. Firstly, water availability is a function of meteorology, precipitation and evapotranspiration, times land form, which influences runoff. The runoff resulting from a particular land form is, to a degree, influenced by land use (Calder 2000). Given the temporal and spatial variability of meteorology, water management is consequently about coping with variability, notably the extremes of floods and droughts. Coping with this variability involves providing storage and this is one of the major reasons why water management is so capital intensive. The replacement cost of the water supply and wastewater systems in England and Wales, countries in which rainfall variability is low and where irrigation is not required, is equivalent to about 1/3 of national income. The centrality in water management of coping with variability in meteorology is the reason why climate change has such alarming implications for water management.

Consequently, water management has been central problem throughout human history and consequently produced innovations both in technology and in forms of governance (Fagan 2011; Mithen 2012). The challenge of the future is perhaps even greater.

What is the choice?

EU policy is for the increasing involvement of stakeholders in water management. Who are the stakeholders, the nature of this involvement and the form of the appropriate decision process are then difficult questions (Green and Penning-Rowsell 2010). But the question for this project is:

- Why and when should the stakeholders in a decision consider one form of EPI either instead of other forms of intervention or as a complement to some other forms of intervention such as regulations?

In turn, what are the reasons why the stakeholders might choose to adopt an EPI? The following discussion does not consider the ideological issues sometimes associated with the adoption of EPIs (i.e. that governments should be reduced in scope) but considers only the practical aspects to be considered when choosing whether or not an EPI, and which type of EPI, is a useful policy tool.

Historically, the focus has been on modifying the environment to satisfy immediate human requirements. The shift to sustainable development requires that instead we modify our behaviours to the limits created by the sustainable use of resources. Thus, the problem is one of change, how to induce change.

Two reasons for considering the use of an EPI are:

- The existing mix of policy instruments do not readily address an emerging problem area

or the objectives that it is now deemed necessary to achieve.

- The desire to have a 'better' policy in practice; one, for example, that enables resources to be used more efficiently within sustainable limits.

There are seven possible starting conditions. The problem is currently:

1 .Uncontrolled in any way (e.g. in many areas, groundwater is treated as an Open Access resource).

2. Other instruments have been tried and failed.

3. Some form of EPIs have been tried and failed in some way. This includes the condition where the existing mix of individual incentives do not induce behaviour which is in the collective interest.

4. Some combination of instruments have been tried and failed in some way.

5. An EPI has been tried and is more or less successful.

6. Other instruments have been tried and have succeeded, or succeeded in some regard.

7. Some combination of instruments have been tried and have succeeded or succeeded in some regard.

In terms of policy urgency, the first two conditions may be expected to be given the highest priority. It is not unreasonable to give these conditions priority over improvements over conditions where there is partly success. What constitutes 'failure' or 'success' is a difficult question but one for the stakeholders to decide. But an earlier EPIWATER report outlined some parameters which the stakeholders might wish to consider (Zetland and Weikard 2011). The current focus in Europe is on 'well-being' as the overall objective (CEC 2009; Stiglitz et al 2009), which defines multiple sets of outputs and inputs, where efficiency is the relationship between some set of outputs to some set of inputs. A problem here is that whilst economic analyses focus upon the efficiency, a restricted concept of what are the relevant outputs is used. Hence, an improvement in the use of resources may be offset by reduction in the creation of some desired outputs which are outside the limits of an economic analysis.

Choices are always comparative: the selection is between the options that have been identified. So one reason for choosing an EPI may be that is simply that the alternatives are impractical for one or another reason. This often a simpler question than that of whether an EPI is superior to the alternative. For example, the western USA and Australia may be said to have had dysfunctional water allocation systems, ones which were not adaptive to changing conditions, which in the case of the USA was accompanied by very high levels of public subsidy of irrigation water (Wichelns 2010). In neither case was the adoption of pricing of irrigation water at full cost recovery a feasible option, nor was a command and control approach. So, here, water trading has been a feasible and successful means of promoting the reallocation of water to more productive uses, notably in Australia (Young 2011). However, in the case of Australia, the Federal government has had to buy back water to increase flows in rivers to environmental flows (Connell 2011), even though the water being purchased in this way are the releases from taxpayer funded reservoirs. In these conditions, the adopted EPI may not be ideal but may be the best that can be achieved at present.

The issue in a choice is also usually what to do first. Moreover, this approach is reinforced by the increasing stress on using an adaptive management strategy (Mysiak 2010). This requires adjusting the strategy in the light both of learning and changing conditions. Hence, what is done next is a decision to be left to later and then to be made in light of both the conditions then prevailing, what has been learnt. What is done now should not

therefore unnecessarily restrict the possibilities of what can be done later.

Failure

Existing interventions may be judged to have failed; in comparing possible future interventions it is as least as, and possibly more, important to look at potential failure modes as to consider success. There are at least three possible modes of failure:

- Ineffective; the desired change is not induced

- Inefficient; the resource cost of the induced change is excessive

- Perverse consequences; an unintended and undesirable change is induced.

A fourth possibility that the induced change has undesirable consequences is not a failure of the intervention option but of the analysis.

EPIs, because they rely upon voluntary action and leave open the individuals' responses to the incentive provided, are perhaps particularly open to the possibility of perverse consequences. An example is the consequences of subsidy programmes intended to improve the efficiency of water use in irrigation; for example, in the USA (Environmental Working Group 2013). Subsidy programmes, therefore, perhaps need particularly careful design, monitoring and review in terms of potentially perverse consequences. Subsidies also can create path dependency; once started, they can be difficult to remove. Notably, in the World Trade Organisation negotiations, it has been argued that existing agricultural subsidies can cease to have a distorting effect on trade because the expectation of continuing subsidy has been capitalised into the value of the land. Perverse consequences are possible for all interventions; the issues are how pervasive and how great will be those perverse consequences?

Conditionalities

The shift to sustainable development requires that we modify our behaviours to within the limits of the sustainable use of resources. Thus, the question is:

- How to change the behaviour of the relevant target populations in the desired direction?

The preconditions for success in doing this are:

- Understand the nature of water and water management.

- Understanding the barriers facing the target population in making the desired change, and to tailor the appropriate incentives to overcome those barriers.

- Understand the purposes of governance and how governance works since as to how to intervene are made through governance.

The failure either in adoption or in practice of some EPIs in the past may be argued to be the product of a failure of understanding in one or more of these three areas. For the reasons summarised in the annex, theoretical economic analyses of EPIs have often failed in adoption or practice as a result. But failure in any form of intervention will occur if there is a failure in understanding in any of these three areas; the problem is not limited to the use of EPIs but is common to all forms of interventions.

Looking for differences

If everyone is the same, then there is no practical gain from adopting an EPI rather than intervening in a different way unless the transaction costs are lower for the EPI than from the alternative approach. Conversely, the greater the differences within users of a particular catchment or sub-catchment, the greater the potential to exploit those differences for the collective interest. So the initial questions to ask concern the population who might change and the area in which a change is desired. The area is likely to be a catchment or sub-catchment or the land above an aquifer. Given the predominant use of

land and of water, the relevant population is often farmers. But it may be either the total population making some type of use of water (e.g. abstracting, discharging runoff, discharging wastewater) or some sub-population. The requirement is to identify the target population. Then within that target population there must a difference that can be exploited. That difference is in the costs of making a change either directly in making the change (e.g. investing in more efficient irrigation techniques) or in consequence of making the change (e.g. changing to a lower value crop but one which requires less water). What this implies is that the greater the number in the population, the more likely it is that there are differences that could be exploited because of an increasing heterogeneity of usage. A sub-catchment in which there are only ten farmers, all growing potatoes, is not a promising candidate for the use of either a charge or a trading system. In that instance, promoting the establishment of a Water User Association (Salman 1997) is probably a more promising means of dealing with the problem in that sub-catchment.

Assuming that there are differences within the population, it has to be appropriate to seek to take advantage of those differences. Firstly, it has to be physically appropriate. Because an EPI promotes voluntary change, the implication is that it is irrelevant as to:

- who changes,

- how they change,

- where the change occurs and

- when it occurs.

If any of these conditions make a significant difference to the achievement of the collective good then an EPI is less likely to be appropriate. For example, the adoption of Sustainable Drainage Systems (SuDS) which reduce and/or delay surface water runoff is increasingly being promoted to reduce the risks of flooding. But a catchment is a dynamic system where part of flood risk management is to reduce the risk that the flood peaks from different tributaries coincide at some downstream point. Hence, if the adoption of SuDS is focused in some particular parts of a catchment as a result of urban redevelopment, it might make the flood problem worse. When any of four conditions matter, any intervention strategy must be appropriately tailored to the specific circumstances.

A secondary issue is whether it is more efficient for the target population to act individually or collectively. There are frequently strong physical economies of scale in water management. So, in the above example, if a community bands together to build a retention or detention basin, this may be a more efficient use of resource than if each land owner installs, say, permeable paving and green roofs.

A specific problem with applying EPIs in water management is that catchment are systems and the innate feature of systems that making a change in one location will result in changes elsewhere in the system. For example, a failure in traditional approaches to flood risk management is that they have often simply moved the flood around. Thus, interventions on the Rhine for flood risk management and other purposes have both increased the peak flow that reaches the Netherlands and reduced the time taken for the flood peak to reach the Netherlands (Bosenius and Rechenberg 1996). What therefore results in a local improvement may then simply degrade the overall performance of the system. Any intervention, including an EPI, must therefore be tailored so as to ensure that the performance of the system is improved. Lipsey and Lancaster (1956-57) referred to this as the problem of the 'second best': when there are a large number of imperfections in a system, addressing one local problem may have the effective of degrading the performance of the whole. This is perhaps a particular problem in urban areas where land values are influenced by the positive and negative externalities created by other land uses.

Hence the performance of the system as a whole needs to be considered and it is probable that a policy mix will be appropriate and one which recognises market segmentation.

Secondly, it has to be socially appropriate to exploit those differences. For instance, a number of socio-economic and demographic factors influence household water consumption (e.g. the number of people in a household, the age structure of the household, the health status of its members, income and so forth). It may be inappropriate to tailor the EPI to exploit all of these differences and appropriate to tailor it so that households with some differences are not adversely affected by the EPI. Thus, in Australia, special free allowances of water are made to households where a member is receiving home kidney dialysis and hence has a very high demand for water (Kidney Health in Australia/ The Home Network nd). Again, in metered households in England, low income households where a member has one of a specified list of health conditions is entitled to a rebate on their water services bill (Consumer Council for Water nd). Most obviously, to use prices requires that it is appropriate to exploit differences in ability to pay coupled to desire for water.

Change

Power is the capacity to induce change (or conversely to resist change) (Lukes 1974). Hence, anything that has one of these two effects is a form of power, and the questions are:

- How does power work?

- What forms of power are most appropriate in which contexts?

For power to work, it may hypothesised that there are three necessary elements (Green 2010):

- A signal as to what is the desired change

- An incentive which is sufficient to overcome the barriers to changing

- A means of testing compliance if the incentive is not sufficiently greater for all so as to overcome the barriers and also constrain the changes to those that are desired. For example, metering provides an incentive to making illegal connections, to falsify readings, or bribe meter readers, all of which occur, as well as to reduce consumption. If the barriers to making illegal connections or falsifying readings are less than to reducing consumption, then it might be expected that the result of metering will be the former rather than the latter.

The signal has to be such as to attract attention where human beings have limits to their capacity to recognise and process signals (Klingberg 2000). It does not seem to be as simple as that the size of the incentive is sufficient for a signal to be selected and recognised.

In seeking to make change, it is necessary to consider why change has not yet taken place. For a change to occur, first there have to be some within the target population who have the capacity to change in the desired way. Secondly, in order to achieve that change, the incentives for them to make the change have to be sufficient to overcome the barriers to making that change. Currently, there may be no incentives to change or they may be insufficient to overcome those barriers. Whilst part of the attraction of EPIs is that they leave open the scope for innovation, the invention and adoption of more efficient or effective means of making the change, it is sensible to start by identifying a practical means whereby some of the population could make a change which has the desired effect. If such a practical means cannot be identified then the EPI would be being introduced in hope rather than expectation. Experimentation would seem to be

appropriate in such circumstances.

There are a number of barriers to be considered. The simplest case is when the change could be made through a change in behaviour (e.g. turning off the tap when brushing teeth). But often changes require both an available technology and investment. For example, drip irrigation is arguably the most water efficient means of delivering irrigation water to plants but small scale farmers were prevented from adopting this technology until low cost drip-irrigation technologies were developed (International Development Enterprises nd). There are institutional barriers as well; for example, those renting properties do not have the incentives to make permanent changes to the fabric of the property and may be inhibited by the rental agreement from doing so. In the case of furnished properties, those restrictions apply to water appliances (e.g. washing machines) as well.

There may be physical issues as well. For example, it is generally found that the crops providing the highest economic return to water are vegetables and fruits (Molder 2007). But equally often, low value crops such as grass are also found to be being irrigated and the obvious question is: why is the farmer growing grass rather than fruit or vegetables? There are many reasons but one is simply that crops, like all plants, fit into ecological niches (Grigg 1991) and areas in grass may simply be unsuitable for growing fruit or vegetables. Hence, charging for water may not result in a switch from grazing to horticulture but only increases input costs to farmers.

A clear understanding of what are these barriers and what is necessary to overcome them, and consequently what is required of the EPI or other instrument is required. One of the ways of gaining that understanding is to listen to and discuss with the target group what is desired and what could be done to achieve those ends. Those it is desired to change are likely to have a better understanding of the problems they would face in making a change than an analyst. Analysis is then required to determine what would be the consequence of making the change. In general, for this and in order to build up trust and agreement as to proposed measures, a central message is that a lengthy period of discussion with the stakeholders is required prior to finalising the design of the EPI and implementing it. This is a common message from the ex-ante case studies in France, Hungary and Spain.

Making a change has two cost aspects: the consequences of the change (e.g. changing cropping patterns, adopting demand management techniques, constructing local wastewater reuse); and the costs of change itself. The net consequential gains from the change have to be sufficient both for individual making the change and to the collective if the change is to occur.

Making the change itself involves costs to the individual sometimes but not always these include money and resource costs. For example, since Simon (1957), it has been recognised that neither organisations nor individuals seek to or do make optimal decisions; they try to do the best they can within the constraints. Hence, Rees (1969) concluded that the reason why firms use more water than would maximise profitability is because water costs are too low a fraction of input costs. Firms therefore focus their attention on the issues which critically affect firm survival but to do so means neglecting other issues. Individuals work the same way: prioritising the apparently important but consequently neglecting what is deemed to less important. Confronted with a crying baby and a note upon how to reduce water usage, a parent can be expected to worry about the baby. Thus the one true scarcity is attention.

In turn, as Stiglitz (2008) pointed out, acquiring information has costs including attention costs. Human beings also have cognitive limits: again, we deal with these limits by

excluding some things from consideration. Hence, even if were possible to have perfect information about everything, we could only use some of it, that which we selected as being the most important. The two ways of attracting attention to an issue are therefore to make the issue more important (e.g. by increasing the relative price) or to cut the costs of attention. For example, whilst tradable licences were initially introduced in Australia, the volume of trading was low; the volume of trading only accelerated when there was a drought (Kaczan et al 2011). Suddenly water became more important; in addition, a lot of effort went into reducing the costs of attention. Conversely, it might be suggested that if real energy prices are rising rapidly, and energy costs are a higher proportion of input costs or household budgets, then this is not likely to be an effective moment to introduce water demand management. However, conversely, if water demand can be linked to energy demand and energy costs (Energy Saving Trust 2013), this may be an effective strategy. Conversely, water management actions that involved increased energy requirements are less attractive.

At the same time, to provide a collective gain, the gains from the change must exceed all the costs of making the change and inducing the change. For example, in England, the costs of introducing water metering to domestic properties is estimated to add £30 to the average domestic water supply bill (Walker 2009); a 16% increase as compared to the costs of what is in effect a property tax. This transaction cost has to be justified by reductions in the cost of supplying those water services. In consequence, in many countries, individual apartments are not metered (e.g. Paris, Copenhagen, Germany) because the additional cost of individual metering cannot be justified against the savings of water services that may result from metering. In general, these 'transaction costs' are often a significant issue in water management and must be considered in choosing between options. For example, separately charging in urban areas for surface water drainage only really became feasible when GIS systems were available. Previously, the cost of calculating the charge for each individual property would have been a significant fraction of the resource costs of dealing with the load.

Power

If it changes behaviour, it is power. There are thus many potential forms of power (Green 2010), the question is: what is most appropriate in the circumstances? But broadly, power may be argued to work either by influencing what the individual wants to do or what they think that they ought to do. This implies that influencing both may be more effective than addressing only one side of the equation. Equally, that it is undesirable to induce a conflict between the two. The force of social norms in particular should not be underestimated; in Social Dilemmas Theory studies of games, it is commonly found that those breach the group norm are punished by other players even when there is a penalty of so acting to those other individuals (Nowak and Highfield 2011). What Nowak also found experimentally is that rewards for acting in the collective interest is more effective than punishments in promoting acting in the collective interest (Nowak and Highfield 2011). This may suggest that subsidies are more likely to be effective than charges or prices in inducing desired behaviours.

What is governance?

There are many suggested definitions of governance but one that captures what governance has to do is that given by the UNDP (1997) :“Governance comprises the complex mechanisms, processes, and institutions through which citizens and groups articulate their interests, mediate their differences, and exercise their legal rights and obligations.” Governance is then done by different agencies, groups and organizations; critically, governance is done by people interacting and it is who interacts and how they

interact that determine the success of governance. Governance is not only social relationships in action but the resulting actions either reflect or create social relationships. A central question is therefore: what are or what ought to be social relationships as expressed in the courses of action adopted?.

Governance arrangements can analysed in several different ways (e.g. Ostrom 1995) but central to those analyses are the interplay of actors, rules and power. One purpose of rules, which govern who interact and how they interact, is to set boundaries to power, those boundaries being functional as well as geographical (Green 2010). The nature of these boundaries and the fit of these boundaries the problem (Young et al 1999) is then critical in feasibility of a particular intervention. An example of a functional boundary is where a water management agency has the power to set charges but only sufficiently to cover its administrative costs. Following from the WFD, it might then be given the legislative power to set charges sufficient to achieve full cost recovery as defined in some way.

The practical questions to consider in relation the possible adoption of any policy instrument are:

- Who has the power to implement the proposed instrument?

- Does the instrument fit the problem?

- Is this the best means of achieving the desired result?

To illustrate the first two questions, consider a tradable instrument for water abstraction. Could this be adopted by the competent authority for a catchment using its existing legislative powers or would it require new legislation at the provincial level, at the national level at provincial level, or even European legislation? Secondly, the administrative boundaries of the body with powers may not fit the problem domain; the catchment, aquifer or coastal region (Young et al 1999). Notably, on international catchments, international agreement and national legislation in each of the relevant countries would be necessary to enable water trading across national borders. The greatest proportion of catchments in terms of area in Europe are transnational in nature.

The final question is the core of this report. Is, and where is, the use of an EPI the most effective and efficient form of power to use?

General conditions

In considering using an EPI, there are both general conditions to be considered and those specific to the particular EPI being considered.

- The good or resource being considered has to be clearly definable. For example, a problem experienced in California when trading was introduced was that of 'paper water' (California Department of Water Resources 1993). 'Paper water' exists when return flows are not considered when trading withdrawals; for example, lining an irrigation canal will not yield a net gain in water availability if the leakage water at present simply accumulates in an aquifer from which is then abstracted.

- The larger the target population and the greater the differences within that population, the more likely is an EPI to have an effect. It is also necessary look for and take account of market segmentation.

- A highly desirable potential consequence of an EPI or any form of intervention is that it induces innovation or economies of scale in the production of an existing technical option. However, unless a viable form of change can be identified before the introduction of the EPI, this is to substitute hope for expectation.

- If one policy area is highly coupled to other areas, then the consequences of change in the first area may be difficult to predict. It may not be desirable if, for example, a reduction in water pollution simply means that those pollutants are discharged to the atmosphere or accumulate in the soil. Conversely, if a single intervention has clear benefits across different problems, then this is a major advantage. For example, the adoption of green roofs is considered not only to reduce surface runoff and water pollution but also to ameliorate the heat island effect in urban areas and reduce air pollution (Banting et al 2010). This is to say that how people respond to a particular EPI may determine the desirability of introducing that EPI.

- Any higher transaction costs as compared to the alternative have to be smaller than the reductions in comparative resource costs.

- Economists commonly assert that clear 'property rights' have to be established before any form of trading can be established. The danger here is to wish away a difficult question. However, contemporary discussions in the law (Davies 2007; Worthington 2003) define property rights as relationships between people articulated through access to some 'thing'. The nature of those personal relationships are articulated through property in different ways (Schlager and Ostrom 1992) and in different cultures (Meinzen-Dick and Nkonya 2005). The obvious question is, therefore, what should be those inter-personal relationships? This is not consequently solely a question of what set of relationships will result in the most efficient, in some sense, use of resources.

- Economic analyses typically assume that the resulting changes will be small in effect. But it is sensible to examine the likely nature and extent of changes first e.g. the shift to maize for biofuel production is seen as one of the factors that resulted in a sudden non-marginal upward shift in global grain prices (Hélaine et al 2013); an example of perverse consequences.

There are some specific conditions for particular EPIs:

Specific conditions for

- Voluntary agreements require the existence, or the capacity to create, a community of some kind: a group with a shared interest and an identity. These communities can be of many kinds and the nature of the shared interest can vary. Practical examples of such communities include trade associations such as the Federation House Commitment of members of the UK Food and Drink Federation of manufacturers to reduce water use in manufacture by 20% by 2020 (Food and Drink Federation (nd), local farmers, and groups such as Business Improvement Districts (Land Use Consultants and Green Roof Consultancy 2010).

- The most successful examples of water trading (e.g. Australia, USA) depend upon a taxpayer financed system of storage and infrastructure.

- The most successful examples of using prices commonly involve hypothecating the revenue in order to provide soft loans or grants to further the objective for which the charge is intended (Andersen 1994). A critical purpose of prices is to raise revenue, notably sufficient revenue to cover costs. The revenue raising, behavioural change inducing effects, and the allocation functions of prices may need to be considered separately and no single pricing schedule may be ideal for all three purposes.

- Charging for potable water in particular has undesirable consequences if it is too effective in reducing demand, or demand falls for other reasons, as it can, as in some cities in the eastern part of Germany, result in revenue falling below costs (Hummel and Lux 2007).

- Generally, the effects of pricing in water management as a means of changing behaviour have been disappointing, having only a weak effect at best. This is possibly for the reasons

identified by Rees (1969).

Making change in practice

The complexity of water management makes it dangerous to be too specific in setting out a path of adaptation. The essential requirement is to seek understanding of the individual case rather than to follow a fixed set of rules. Part of this understanding is to identify where there may be synergies (and conversely antagonisms) between both intervention options and also problem spaces.

It should go without saying that interventions need to be based upon a recognition of the fundamental nature of water and water management e.g. that nitrogen is an essential crop nutrient which has to be replaced, and to be available to the plant, it has to be inorganic and water soluble. Changing nitrogen loads in runoff and infiltration water on an individual farm consequently currently largely depends upon changing crops.

Making the transition to sustainable water management requires resilience in the face of shocks such as floods and droughts (Green et al 2011), being adaptive to the changes such as climate change and an ageing population (Giannakoursis 2008), and also innovating and learning how to do better (Argyris and Schon 1966). EPIs can be part of that process of innovation and learning but they need to be implemented in a way that allows that innovation and learning process to continue. Thus, part of the failure of the adoption of tradable abstraction licences in Chile was the failure to incorporate methods of learning from the experiment and adapting to conditions (Harris 2011).

EPIs are still an innovative approach and the full scope of the potential for innovation has not yet necessarily been explored. But it is the general nature of innovations that some will fail; hence, we need safe ways and places of making innovations. Ideally, they should be reversible. Alternatively, they should be tried locally first.

The choice is between EPIs as well as between EPIs and other instruments; for example, between adopting full cost recovery or some trading mechanism or voluntary agreement. So the choice is not whether or not to adopt an EPI but also which EPI. Combinations of instruments may yield synergies (or alternatively be antagonistic). In some of the case studies, a mixed policy approach has been adopted; here, it is impossible to separate out the relative significance of the different component instruments.

The two starting conditions where there is the greatest urgency to identify a feasible and effective form of intervention were argued earlier to be when either:

- Nothing is in place at present

- Command and Control, or another form of intervention, has been tried but is not deemed to be successful.

In the first, the logic is to start by a publicity campaign for the individual target groups. This may have some effect in inducing a change in behaviour (for example, voluntary calls for demand reduction during a drought in the short term at least result in a substantial reduction in demand) (USACE 1995) but primarily a publicity campaign is an agenda setting device which raises the problem that has to be addressed.

What comes next depends upon the specific conditions. But a common feature is the need for a significant period of analysis and discussion before adopting a particular strategy. Secondly, the most successful approaches to making a shift to sustainable water management seem to involve a policy mix rather than a reliance upon any single instrument. This approach can take advantage of the relative strengths and weaknesses of the alternative instruments. For example, in the dramatic shift to sustainable urban drainage systems in Germany there can be seen to have involved Federal law, local

regulations, charges for water usage, information campaigns and demonstration projects (Green and Anton 2012).

In the second condition, where a Command and Control approach has been tried but is regarded as having failed, the differences in the forms of command and control instruments need to be taken into account. The general feature is that they require all to make the change, either in the form of prohibiting some action or requiring some action. That requirement may either be specific (e.g. some cities in Germany prohibit car washing except in designated areas) or performance related (e.g. specifying that discharged loads may not exceed some limit). 'Failure' may come in several forms and it is the nature of the perceived failure that is important as the problem may be common to EPIs as well. For example, if there is a regulation limiting changes in land use but land development takes place in violation of the existing regulations then the only useful form of EPI would be one which resulted in compliance improving. It has to be recognised that EPIs are depend upon a compliance regime, another set of rules, which limit actions. Thus, whilst Adam Smith famously argued the virtues of market solutions as means of channelling private interest to the public good ("It is not from the benevolence of the butcher, the brewer, or the baker that we expect our dinner, but from their regard to their own interest"), bakers and brewers were amongst the strictest regulated trades in history, with ferocious penalties for selling underweight or adulterated bread. Moreover, Smith argued for even stronger command and control requirements: he asserted that those in the same trade or profession should never be allowed to meet, as this would inevitably result in a conspiracy against the public interest.

What Adam Smith's example illustrates is that there is less of a clear difference between regulations and EPIs than is sometimes assumed. Thus, that a policy mix approach will often be the best strategy; a combination of different forms of power.

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