UNIVERSITÀ CATTOLICA del Sacro Cuore

CRANEC

Centro di ricerche in Analisi economica
e sviluppo economico internazionale

Working Paper 05/20

Stakeholder-driven design and appraisal in hydroelectric projects: a participatory gaming approach

John M. Kelsey and Dr Steve Kadivar

VP VITA E PENSIERO

UNIVERSITÀ CATTOLICA del Sacro Cuore

CRANEC

Centro di ricerche in Analisi economica
e sviluppo economico internazionale

Working Paper 05/20

Stakeholder-driven design and appraisal in hydroelectric projects: a participatory gaming approach

John M. Kelsey and Dr Steve Kadivar

VP VITA E PENSIERO

John M. Kelsey, Bartlett School of Construction and Project Management, Faculty of the Built Environment, University College London, 1-19 Torrington Place LONDON WC1E 7HB, United Kingdom.

Steve Kadivar, Senior Water Environment Consultant, P.O. Box 357, Los Altos, CA 94023.

✉ j.kelsey@ucl.ac.uk

Tutti i saggi sono soggetti al referaggio di due Membri del Comitato Scientifico prima di essere pubblicati nella Collana dei Working Paper Cranec edita da Vita e Pensiero.

✉ segreteria.cranec@unicatt.it

www.vitaepensiero.it

ISBN 978-88-343-4414-9

Abstract

Hydropower is an important source of renewable energy, but large hydropower multipurpose river basin projects can displace communities and have serious adverse effects on the local environment and livelihoods. The Sardar Sarovar Dam in India and other similar projects have provoked local and international protest culminating in the temporary withdrawal of the World Bank from large hydropower project finance. It would appear to be a better option for powerful stakeholders to engage seriously with weaker ones. As well as ethical concerns, economic theory would suggest that there is a flawed basis for cost-benefit analysis which omits input from local stakeholders, particularly that of indigenous peoples who also have a role to play in project design. It is argued that the Kaldor-Hicks criterion should be abandoned and that decisions should be made based on a multi-criteria analysis of which cost-benefit analysis is but one component. It is suggested that full stakeholder engagement could best be conducted through participatory role-playing games which are being increasingly found in use as a means of exploring and resolving stakeholder conflicts. Such use is still relatively recent and safeguards such as a neutral moderator, advocates and ethical gaming rules are required to protect weaker and non-expert stakeholders.

Keywords Hydropower, Environmental damage, Indigenous Peoples, Cost-benefit analysis, Participatory Stakeholder Gaming.

INDEX

1.0 Introduction

Hydropower has a critically important part to play in securing necessary lower impact carbon energy supplies within the next generation. Additionally, river reservoir-based schemes will be important in some parts of the world in securing water supplies. Unfortunately, past neglect of smaller stakeholders has compromised the performance not only of dam/reservoir schemes but also a range of development projects in different parts of the world. The power of a few, determined small stakeholders has demonstrated the desirability of engaging seriously with them in decision making. The need to evaluate a project in economic terms using social cost-benefit analysis raises questions which are tricky using conventional methods, particularly when addressing losses sustained by stakeholders displaced by the project. Additionally, given the complexity involved, the particular local knowledge of local stakeholders may be wasted if they are not brought into the decision-making process at an early stage of the project. Indigenous people are of particular concern.

This paper examines some forms of participatory gaming and simulation as decision support tools available to assist in solving these problems. These tools are still largely experimental but sufficient work has been carried out using them in the field to suggest that they have a valuable role to play in decision making in complex issues not only for those most affected by projects requiring stakeholder displacement but also the policy makers and project actors themselves should they wish to use them. It is argued that there are nonetheless still pitfalls and limitations in the use of such tools and care needs to be taken not only in designing and using such games but in the interpretation of their outcomes. Clearly there are also contextual limitations in their use if there are powerful antagonistic stakeholders with coercive power – particularly when the underlying model contains an implied

critique of the existing stakeholder power structure. Nonetheless large stakeholders (both hostile and more favourably disposed) also have a necessary and positive contribution to offer in the development of such tools.

2.0 The contribution of Hydropower development to electricity power generation and water supply

2.1 The importance of multi-purpose hydropower schemes

As the economy of a country grows, its infrastructure requirements become heavily weighted in favour of energy generation projects (World Bank 1994). Climate change has put added pressure on countries to develop alternatives to carbon-based generation. China's energy supply had been dominated by coal-fired stations but with a significant contribution coming from hydroelectric power and to a lesser extent nuclear power (Kahrl *et al*. 2011). In Brazil, hydroelectric power is the dominant source (Schaeffer et al 2001) but continuation of this dominance is threatened by environmental concerns over large schemes particularly those in the Amazon rain forest such as the Belo Monte dam (Lampreia *et al*. 2011). One of the largest and most controversial proposed dams in South East Asia is the Bakun dam in East Malaysia. (Sovacool 2011).

IPCC (2007) predicts an increase in large dams/reservoirs to 2030 – notably in lower income countries for particularly energy but also reasons of water supply vulnerability – although the impounding of water can itself be a source of such vulnerability elsewhere. They note, however, the increasing political problems with project approvals. They predict that renewable sources of energy could provide 35% of world electricity supply mix by 2030 with nearly half (17%) potentially coming from hydropower. Additionally, hydropower generation involves

a relatively mature technology compared with some other forms of renewable energy. Clearly, then it is likely to be a major player in the next generation of energy supply sources in the decarbonisation of world electricity (although the performance of large hydropower in terms of the environment and greenhouse gas emissions is still a contested territory).

2.2 Hydropower development problems and wider issues of displacement and resettlement

Helvarg (2003) has claimed that dams threaten local livelihoods dependent upon fishing. This is supported in a recent study by Fitzgerald *et al.* (2018) which showed significant damage to fish stocks following construction in Brazil of the Belo Monte Dam which is the fourth largest in the world in terms of generation capacity. Begotti and Peres (2020) have shown more generally that land with low-density indigenous populations in Brazil is increasingly threatened by population pressures to allow economic development that would pose severe problems both to indigenous people and biodiversity.

Bui and Schreinemachers (2020) examine a hydropower project in Vietnam and show that a compensation scheme alone is insufficient for displaced people to resettle without a decline in their welfare and that more direct intervention is required.

Fernando (2018) considers people who were displaced by a flood-risk scheme in Colombo. Surveys showed that this worked best where local authorities worked closely with displaced people and local NGO's to establish new settlements. However, there were examples where this did not happen and where no care was taken to create access to or opportunities for new jobs.

Dash and Punia (2019) argue that poor governance in both hydropower and water management as well as disaster risk reduction was a significant factor in the 2013 floods in Uttarakhand, North India which killed an estimated 5,000 people. Choudhury (2016) argues that mountain communities in India have borne environmental and socioeconomic costs in excess of the benefits they have received, and significant other benefits have been transferred elsewhere.

In Africa Syagga and Olima (1996) investigated the impact of compulsory land acquisition on displaced households. This was actually an urban water supply project which took place in a rural area thus illustrating the impact of increasing urbanisation on rural communities. Significant room for improvement was found in terms of both compensation and resettlement processes together with understanding of the negative socioeconomic impacts of forced relocation.

3.0 Underestimating the big power of small stakeholders in water and elsewhere

3.1 Sardar Sarovar Dam

The Sardar Sarovar Project (SSP) in the Narmada River Valley in Western India was, according to different points of view, either ill-conceived (Turaga 2000) or properly conceived (on economic grounds) but poorly managed (Ranganathan 1993). After an abortive start in 1979, an opposition movement was successfully started in 1985 and initially led by one very determined woman. This movement so challenged the SSP that eventually the World Bank withdrew its support. Key to this was the demonstration that the state governments did not have the will or the means to adequately resettle all project displaced stakeholders (Baviskar and Singh 1994). It is not an exaggeration to say that this was the catalytic project for the creation of the World Commission on Dams. Unfortunately, subsequent lessons do

not seem to have been learned and the project continued displacing a total of 250,000 people right up to its opening in 2017 (Bretton Wood Observer 2017).

3.2 Botnia Fray Bentos Cellulose Pulp Mill

The Finnish firm Botnia SA have constructed a cellulose pulp mill at Fray Bentos, Uruguay which started operation in 2007. On the Argentine side of the Uruguay river, a citizens group protested against the mill fearing pollution of the river and damage to local tourism. There is a continuing roadblock by this group stopping traffic flowing between Argentina and Uruguay (by this route anyway). One Dutch bank advising Botnia has withdrawn from the project. More critically the group is now concentrating on opposing additional pulp mills in the area (Aaltonen and Kujala 2010).

3.3 Wu Ping - The "Nail House" rock in Chongqing

In 2004 a very determined homeowner, Wu Ping, refused to move from her home in the path of the bulldozers of a developer wishing to build an estate of luxury apartments. She and her husband held out for three years with their home perched on an island of land surrounded by the deep ground works excavations of the development. Photos of this in China have become iconic and Wu Ping something of an unofficial folk heroine (Mertha 2009).

3.4 Susette Kelo and the City of New London

In 2005 a determined, female homeowner, Susette Kelo, having refused to accept the exercise of the power of eminent domain to remove her from her house, took her case to the United States Supreme Court. She lost but the judgement so outraged many people in the USA that many states revised and limited the use of their powers of eminent domain. Susette Kelo's house was physically removed to a new location. The economic rationale for the original development disappeared and

the contested site stands empty. It is significant, given the influence of the USA, that the exercise of the power of eminent domain is now a highly politicised issue (Ryskamp 2007).

3.5 The winner's curse and the loser's reward

In purely technical terms, each of the four small stakeholders lost their fight with the authorities. The SSP went ahead, the pulp mill was built, the "nail house" was demolished and Ms Kelo was removed from her property. However, in all cases there was a payoff reduction not only to the individual large stakeholder(s) involved but also to a wider class of larger stakeholders. It is now more difficult to get approval for large dams anywhere and for pulp mills in Uruguay. Developers in China will think twice before taking on a "nail house" owner and those in the USA can rely much less on the ability of a local state to exercise powers of eminent domain. The winner's curse is that they have reduced their future ability to develop projects both for themselves and other similar organizations. The loser's reward is that they have significantly altered the playing field for future contests.

3.6 Environmental protests worldwide

Jiménez *et al.* (2015) map water resource conflicts during the period 1960-2014 citing 384 examples in which only 3% appear to have reached a formal agreement. A number of these conflicts resulted in project cancellation. The authors argue for the importance of finding ways to bring both powerful and vulnerable stakeholders into negotiation and co-operation.

Liu *et al.* (2018) investigated reasons for public protest against major construction projects in China and they found the most significant factors were a) population displacement, b) inadequate compensation, c) government decision-making style, d) disregard of public opinion and e) failure to fulfil project-related commitments. In a study of European

electricity transmission projects Schmidt and Lilliestam (2015) found that protests were caused by a general mistrust of the basis on which the projects were appraised and of the claimed 'neutrality' of cost-benefit analysis.

Unfortunately, evidence exists that some large stakeholders have covertly instigated threats of, or actual violence against environmental activists with some particularly unpleasant actions directed at female activists and this seems to be an increasing trend (Helvarg 2004, Bretton Woods Observer 2019a, Larsson 2020, Global Witness 2020).

3.7 Ethics, the UN and International Financial Institutions

Wellington (2018) argues for the creation of ethical standards specifically for water in terms of its value, the design and execution of policy including addressing gaps in governance. These it is argued should go beyond the economic principle of utility maximisation to embrace consideration of human rights and even further to include non-anthropocentric approaches valuing all life forms. Creation and agreement of standards would help guide legislative and regulatory action as a basis for project appraisal.

The United Nations (UN) has issued a Declaration of the Rights of Indigenous Peoples (2008) which contains the following:

1. "Indigenous peoples shall not be forcibly removed from their lands or territories. No relocation shall take place without the free, prior and informed consent of the indigenous peoples concerned and after agreement on just and fair compensation and, where possible, with the option of return. (Article 10)"
2. "Indigenous peoples have the right to participate in decision-making in matters which would affect their rights, through representatives chosen by themselves in accordance with their own procedures, as well as to maintain and develop their own indigenous decision- making institutions. (Article 18)"

It can be argued that consideration of the rights of indigenous peoples should inform corporate social responsibility. One would hope, however, that International Financial Institutions would definitely incorporate such consideration given that they are mostly UN bodies.

Given the number of professional engineers involved in such projects it may also be instructive to look at professional codes of ethics such as that issued by the UK-based Institution of Civil Engineers (2017) – particular:

1. All members shall have full regard for the public interest, particularly in relation to matters of health and safety, and in relation to the well-being of future generations.

   Members must take account of the broader public interest - the interests of all stakeholders in any project must be taken properly into account, including the impact on future generations. This must include regard for the impact upon the society and quality of life of affected individuals, groups or communities, and upon their cultural, archaeological and ethnic heritage, and the broader interests of humanity as a whole. (*guidance notes*)

2. All members shall show due regard for the environment and for the sustainable management of natural resources.

   In all the work that members do, they must be able to demonstrate, by an appropriate audit trail, that they have taken all reasonable steps to take account of all the relevant factors in relation to the impact upon the environment and the sustainable management of natural resources. It is increasingly the case that engineers are called to account for their decisions, especially where projects are controversial or are opposed by particular interest groups. (*guidance notes*)

Chen and Landry (2018) compared hydropower projects funded by the World Bank and China in Cameroon. They found that the World Bank had performed better in terms of regulating local adverse impacts but more recently the Chinese Eximbank had improved its environmental regulation for projects and required greater corporate social responsibility from supply chain firms. The World Bank withdrew from financing large hydropower in the mid-1990's but resumed such finance from around 2013. They have an environmental and social framework (World Bank 2017) although there are fears that with the creation of a Global Infrastructure Facility together with an increased commitment by the World Bank to hydropower they will come under pressure to relax safeguards. It should also be noted that the European Bank for Reconstruction and Development has created an Independent Project Accountability Mechanism (EBRD 2019) requiring adherence to specific standards of stakeholder inclusion and environmental protection.

Against this it should be said that the World Bank's private sector finance arm the International Finance Corporation (IFC) invested substantial sums in Indian banks which in turn loaned over $3bn during the period 2005-2014 to the National Hydroelectric Power Corporation which is the largest dam-building enterprise in India and has been involved in the last decade in two controversial hydroelectric projects. The IFC is also believed to have invested in private equity funds which invested in the Teesta III dam which was one of the targets of criticism in Choudhury (2016) mentioned earlier (Bretton Woods Observer 2019b).

Given such conflicting evidence, whether International Financial Institutions are genuinely committed to the welfare of indigenous people or whether this is purely cosmetic remains an open question. This is not helped by the lack of transparency regarding sources of infrastructure finance which precludes advocacy organizations from bringing

cases to the attention of those attempting to enforce bank codes of project compliance. (Bretton Woods Observer 2019b).

Nonetheless with ever-increasing interest in sustainability and climate change combined with the communicative power of the internet, public pressure for fair treatment of minorities is more likely to grow than recede.

4.0 The stag hunt and the stakeholder's game

4.1 The stag hunt and the stakeholder's choice – to co-operate (or not)

Rousseau produced an example of two people who set out to hunt. Each of them could go hunting for hare (a small payoff) without the co-operation of the other. Only if they both co-operate however can they catch a stag (a large payoff). If there is little trust between the hunters, then there optimum strategy is to abandon co-operation and hunt hare. Conversely if there is trust between them then their optimum strategy is to hunt stag. Their actions are governed by their beliefs about what the other hunter will do (Skyrms 2004).

The very existence of the World Commission on Dams (1997-2001) and its final report (WCD 2000) changed the rules of the game whether or not large stakeholders choose to follow its recommendations. This report and stories of determined actions by so-called "powerless" stakeholders can be communicated to any part of the globe very quickly. Aaltonen and Kujala (2010) argue that where small stakeholders are ignored, they will be relatively slow to mobilise and act during the pre-construction phase of a project. They are far more likely to cause later disruption during the construction phase which is potentially far more damaging to the larger stakeholders.

The situation in water projects is not yet one of a 'stag hunt'. However, it is moving in that direction. Larger stakeholders can choose to ignore smaller stakeholders and hope to push through their scheme (with the large reward of the stag) without the co-operation of the smaller stakeholders. However, the increasing likelihood is that smaller stakeholders will choose to fight and either the 'stag' will escape or the costs and risks of catching it will increase. A preferable alternative strategy would appear to be serious, early engagement with smaller stakeholders – for instance, at the time the Project Initiation Documents (PID) are being produced.

4.2 Declaration of interest

At this point one of the authors (JMK) should declare an observational interest from having lived and worked in an indigenous village for six months in 1974. It was an area of tropical hill forest located in the Eastern Ghat mountains in Tamil Nadu, South India.

The people, who adhered to an animist culture, belonged to a wider group designated as Scheduled Tribes by the Indian government. The area was marked as an 'un-surveyed area' in the 1971 Indian Census. It was also an unpoliced area. The people were fiercely independent and somewhat contemptuous of mainstream society and suspicious of outsiders. They largely grew or reared what they ate and only visited the outside world to sell surplus produce for those few extras they desired that were unobtainable in their village. These were few in number and the only outside resource that they really respected and desired was modern medicine. They were capable of cruelty to those of their own who violated social norms and to animals who were slaughtered for meat in a rather inefficient manner. They were also capable of great generosity and hospitality. Should a project have been proposed which would have caused them to be displaced they would have probably put

up fierce resistance – possibly with violence – and would have been very difficult to negotiate with. This paper does not start from some idealised vision of pure and innocent people living in a virgin environment but rather a realistic view of a minority group of people with their own culture but with the same virtues and faults as other human beings.

4.3 The stakeholder game

Weak stakeholders are aware of their own potential losses and local environmental damage. They are sometimes understandably less aware of the wider benefits or the methods of appraisal. Critically they may be unaware of alternatives. For them therefore the alternative outcomes appear as either the project goes ahead, or it does not.

Powerful stakeholders have tended to regard projects as ones which they design on the basis of technical and aggregate economic benefit with weak stakeholders as a minor irritant. They do not see the need for weak stakeholder involvement or engagement in the planning or design of the project and assume that such stakeholders can be satisfied with some monetary compensation or compensatory project such as the provision of a local school. What they are unlikely to consider are alternatives based on wider appraisal criteria.

What is ignored therefore is that there may be other ways of proceeding through stakeholder engagement which may produce an acceptable outcome which, while not necessarily making everybody better off, may still allow for a project with an acceptable stream of benefits to powerful stakeholders and the wider community without the risks of serious damage to either local communities or the environment. No-one can say in advance that such a solution exists but without engagement no-one is ever going to find out.

Table 1
Stakeholder negotiation options and outcomes

		Protesting Weak Stakeholders	
		Willing to Negotiate	Unwilling to Negotiate
Powerful Stakeholders	Willing to Negotiate	Possible reduction of project value to large stakeholders but with possible increase in total project value	Increased likelihood of project proceeding and use of state force and displacement with inadequate compensation
	Unwilling to Negotiate	Possible retention of full economic value but with loss of reputation or increased possibility of disruption or cancellation of project	Uncertain outcomes ranging from project proceeding with disruption and violence to project cancellation. Potential loss of value to all stakeholders

5.0 Moving from expert-driven to stakeholder-driven projects

5.1 Social Cost-Benefit Analysis and the problems of project definition and economic evaluation

Projects involving dams and reservoirs may result in displacement of residents either through:

i) Technical necessity because of the need to submerge an area of land
ii) Environmental consequences if local sources of livelihood (e.g. fisheries) are damaged

It is argued here that local, less powerful stakeholders and particularly project displaced stakeholders (PDS) have a role to play in (among other things):

i) The possibility of shaping project objectives, planning and design
ii) Evaluating costs of displacement and resettlement

5.2 Issues in valuation of the environment

Knoke *et al.* (2020) argue that there is a problem with the use of Net Present Value (NPV) in that the volatility of individual benefits is not adequately reflected in the NPV figure. Where individual or group stakeholders are dependent on a steady stream of specific benefits arising from changed environmental conditions, this could be critical. The authors suggest that NPV should be incorporated into a larger multi-criteria decision analysis model as one important but not exclusive criterion. They also propose the use of discounted utility which values a steady stream of benefits over an equivalent stream with high volatility.

Choy (2018) highlights the neglect of wellbeing in environmental valuation or rather the equating of wellbeing with the more traditional concept of welfare. The paper was based on an investigation of values among remote tribal groups in Malaysia. What was revealed was a complex and holistic valuation of not only both the environment and the local community but also the history of interactions between and within community and environment in the form of memories and oral culture of which the environment itself is a repository of reminders. They also had a very strong view of intergenerational justice in needing to pass on a good environment to their descendants. Choy refers to this collection of beliefs as 'transcendental communal value' – a concept not normally found in economics textbooks.

Stoeckl *et al.* (2018) consider the valuation of ecosystem services. The Millenium Ecosystem Assessment (2005) gave rise to the term 'ecosystem services' which represent the benefits delivered by a well-functioning ecosystem. These arise from natural processes which provide an integrated system for the:

1) provision of food, water, medicines and materials

2) regulation through climate, pollination, carbon storage and flood control
3) cultural enrichment through inspiration, aesthetic pleasure, education and recreational space
4) support systems and natural infrastructure such as soil formation, biodiversity, habitat and primary production (such as production of oxygen through photosynthesis)

The concept of individual and social goods is well understood. What is less recognised is the division into simple and complex goods. Recreational fishing, for example, has complex benefits – recreational, cultural and psychological but it is normally an individual set of benefits. Traditional indigenous fisheries are exploited socially and so, in addition to providing food, they provide social co-operation and interaction which over many years provide a socio-cultural repository of shared norms, memories and oral tradition. This type of asset is designated as a complex social good. Stoeckl and her colleagues argue that while the difficulty in valuing such goods has been recognised for some time little has been done to develop new techniques of valuation. Cost-benefit analysis has tended to focus on individual benefits with sometimes dubiously valued externalities added on. The problem is that complex goods confer multiple benefits which are separately valuable, but which are also non-separable. Therefore, a question put to an individual such as "what would you need to be paid to forgo this asset?" is not just wrong – it does not even make sense. An attempt to treat such assets as if they were marketable commodities does not work. The institutionalising of an appraisal system primarily based on an aggregation of individual values therefore 'crowds out' valuation of complex social goods. In such a faulty valuation system one can arrive at a net positive aggregation of individual valuations for a project which will actually produce socially unacceptable outcomes.

The tendency to undervalue the complex social goods provided by ecosystem services also comes with pressures on ecosystem governance systems to be transformed into systems for the provision of largely private goods. Falk *et al*. (2018) argue that Ecosystem Services governance needs institutions with a set of rules and values which facilitate social processes to support production of acceptable outcomes. The valuation of the social goods in the appraisal also therefore needs to be matched by the governance systems on the ground. This is especially the case where there are many stakeholder groups, excludability of services is difficult and there is rivalry in consumption (subtractability).

Norton (2017) considers the study of environmental value to be chaotic with a number of conflicting approaches. Some embrace stated preference techniques in terms of contingent valuation (Jones *et al.* 2018). Others have demonstrated inconsistent outcomes of stated preference techniques while yet others, more behaviourally inclined (Venkatachalam 2008) have emphasised issues of bounded rationality and sub-optimal decision-making in terms both of alternative choices and in subjective risk assessment. Yet others set constraints such as intrinsic environmental value or minimum standards of environmental protection which sit more easily in some form of multi-criteria decision analysis than cost-benefit analysis. He distinguishes between static and dynamic evaluation. The former has an approach within which to make sense of stated individual preferences or values and potential environmental changes in a *ceteris paribus* framework. The dynamic approach to evaluation emphasises the variability of preferences and values. It invites a conversation between stakeholders in which values, preferences and constraints can be debated and changed. Many such debates may still end in disagreement. What then is needed is some process of decision-making which aims to arrive at an action which is acceptable (or equally unacceptable) to all stakeholders. The process

is messy, chaotic and dynamic but it is collaborative in the wider sense of all participating even if no agreement is reached. The valuation of the environment therefore becomes an emergent process from collective encounter rather than one in which individual preferences are fed into one end of the Cost-Benefit black box and an aggregate valuation is churned out at the other.

5.3 Valuation of the losses of PDS

Before tackling this, one question needs to be asked – "is a valuation of PDS loss necessary?" – Raganathan (1993) pointed out that the resettlement costs conceded by authorities in the case of the SSP could have been paid ten times over and this would have not affected the project's economic viability. However, if one PDS says "there is nothing that could be paid to me to compensate for my displacement" then, in theory, the sum of minus infinity needs to be added to the Net Present Value which kills project viability. Therefore, the PDS loss does need to be measured.

The assets of rural PDS in remote locations may consist of:

i) *Economic capital* – access to land which is marginally productive or only optimally productive with special skills possessed by the PDS
ii) *Social capital* – membership of a co-located social (and possibly ethno-linguistic) group
iii) *Symbolic capital* – a living environment valuable to the PDS both as heritage in terms of symbolic significance or as a series of memory triggers from which identity is construed (Kelsey and Roberts 2010)

There are problems in the economic valuation of all three items. Firstly, unless there is some special feature of the land which might, for instance, provide a tourist attraction, there may well be no available market transactions in such land. Also, if the land is only economically productive with special skills peculiar to the PDS then clearly, they would in theory outbid anyone else for the right to purchase the land

(Miceli 2011). There may be no market evidence and what exists may not provide a correct valuation of the land.

Secondly the existence and valuation of social capital is very much predicated on the geographical co-location of the group and the continuation of possibilities for ongoing interaction within the group of a kind similar to that which currently exists (Lin 2001). Therefore, if the PDS have spent most or all of their lives in such a group it would be very difficult to ask them to value the loss of the group in economic terms. (To most people, other than economists, it is not a meaningful question.)

Thirdly the societal value of the environment as "symbolic capital" may not be evidenced by actual market transactions or observed use as much by its potential use value (Krutilla 1967). This idea is referred to as "passive" use value and recognised as such in US case law (Flores 2003).

In carrying out valuation economists prefer "revealed preferences" for which market transactions can be produced as evidence. Clearly this is going to be problematic for the reasons stated except in one respect namely the costs incurred by PDS groups in actions designed to stop the project going ahead. These are observable costs of defensive behaviour (Rosenberger and Loomis 2003) expended in order to avoid some undesirable outcome.

In a novel practical example Xia et al. (2018) showed how in a Chinese hydropower project PDS were re-classified as active core stakeholders rather than passive receivers of compensation. The project managers worked out a method of benefit-sharing based on full analysis of PDS before and after status including physical relocation costs, temporary income losses and other longer-term resettlement costs. This longer-

term process tends to result in significantly higher compensation to PDS than under previous methods.

5.4 Project Definition and Equivalent Reinstatement – stated preferences

A number of dam projects have sought to overcome the problem by direct resettlement or equivalent reinstatement of PDS elsewhere rather than through the payment of monetary compensation. The acquiring authority pays for reinstatement or resettlement and substitutes that cost as the cost of the loss of PDS assets. The question still arises as to what is acceptable to the PDS as equivalent reinstatement and whether there is still some additional loss in the event of a "second best" resettlement on inferior land.

In the absence of revealed preferences, one has to turn to "stated preference" techniques in order to value the PDS assets (Louvière *et al*. 2000). It can be seen from the foregoing arguments that we are dealing here not with a land asset so much as a bundle of attributes that attach to the land not least since different PDS may have different existing rights over the land from which they are displaced. However, the PDS may still have strong views about the fate of the land from which they are displaced and about which they may have unique and intimate knowledge. They can therefore express a set of attribute preferences about:

1) Whatever project takes place on the land from which they are displaced
2) Equivalent reinstatement or other forms of compensation

One form of stated preference is contingent valuation which requires the consumer to value the consequences of a future event in the form "How much would you pay to stop X happening or for a Y facility to be provided?" This could also be expressed for PDS as "How much (or what alternative) would you accept to leave the place where you now live?" Boyle (2003) does not play down the problems inherent

this approach and a number of assumptions for using the method, a key one of which is familiarity with the commodity to be valued which in the case of PDS means familiarity with an alternative location and means of earning a living. In a situation where PDS have a lifelong history in one area, they may not have the ability to value their earning potential (or lack of it) in an alternative location. Furthermore, in situations involving an overall set of stakeholders with a wide distribution of income and/or wealth, those at the lower end may provide values which are low in absolute terms but represent high values in relation to their own current earning potential.

Conjoint analysis was designed for market research and involves the presentation to "consumers" of different characteristics of a product or service and asking them to comparatively rank or value the alternatives. (Gustafsson *et al.* 2001). Analytical Hierarchy Process on the other hand was designed for modelling complex choice problems and presents decision makers with a set of paired attribute comparisons with a numerical range of degree of preference of one over another. From the resulting matrix of preferences, the relative importance of each choice may be obtained (Saaty 1980). Although well-attested, these methods have the drawback that the consumers react to a predefined set of choices. Success in using these methods depends on discovering an appropriate set of choices. The greater socio-cultural distance between researcher and consumer, the harder this may be. In wider decision theory, choice inconsistency can be demonstrated for different background contexts (Tversky and Simonson 1993) and different risk weightings (Kahneman and Tversky 1979). Therefore, it is essential to elicit from stakeholders their understanding of context, risk and appropriate choice set.

5.5 Private sector failure in fully financing resettlement of PDS

Owen *et al.* (2020) consider the financing of the resettlement of PDS albeit in a mining context. Project supply chain actors regard resettlement as an additional cost outside their core business activity with the result that they tend to incur the minimum up-front cost to meet their immediate obligations and then engage in minimisation, deferral or default in meeting post-resettlement and post-project costs which arise as resettlement is a dynamic process requiring a number of years. Essentially the process is not managed efficiently as a separate project nor adequately costed or adequate budget provision made.

5.6 The Kaldor-Hicks criterion and the issues of property rights, market prices and estimation error

Social Cost-Benefit Analysis recognises that different stakeholders may gain and/or lose as a result of a project. Analysts rely on the Kaldor-Hicks principle that the project is viable (*ceteris paribus*) if the winners could in theory compensate the losers regardless of whether such compensation occurs (Boardman *et al* 2006). In many parts of the world, property rights are not as well defined as in higher income countries. Therefore, the discussion above refers to PDS regardless of their established legal title on the grounds that they are *de facto* "losers" compared with their current situation.

It should be noted that in his original paper Kaldor (1939) looked at whether compensation should have been paid to landlords following the repeal of the Corn Laws in 1846. Hicks (1939) similarly looked at some theoretical economic reform which would affect market prices and where, therefore there would be winners and losers. Both agree that the question of whether compensation should be paid is a political question and not one for economists.

The situation discussed here is somewhat different. Indigenous people often operate outside the price system of the country they are in since most of their needs are met by themselves. Much is made of the ability of the price system to convey information as a means of co-ordinating decision-making in a situation of widely distributed and fragmented knowledge (Hayek 1945). However, the level of compensation offered is only meaningful information in the context of a general understanding of prevailing market prices which may be absent in this situation.

Additionally, even if an amount of compensation is offered estimated as the cost of equivalent reinstatement, it is only an estimate. Reinstatement is, as it were, a sub-project within the larger hydropower mega-project which is vulnerable to estimating errors (Flyvbjerg *et al*. 2003). Reinstatement itself is likely to be subject to a significant number of unknowns and areas of uncertainty. Estimating errors can normally be absorbed by large stakeholders but not so by smaller ones. The only way to obtain a reasonably accurate figure for the cost of reinstatement is to actually carry it out. Therefore, the political question of whether to compensate is subsumed by the economic analyst's need to obtain a reasonably accurate compensation figure.

The Kaldor-Hicks papers were partly a response to a comment by Robbins (1938) who stated that he found that any political calculation that did not treat people as equal was morally revolting. He therefore found the principle of the diminishing marginal utility of income unacceptable. However, it was always understood that such a principle did apply equally to all people. Robbins made the logical mistake of comparing individuals who happened at any particular point in time to have different incomes. More significantly he found interpersonal comparisons of utility to be unscientific compared with other forms of economic enquiry. However, the cases of indigenous people are such that the loss of their lands or livelihood might threaten their very survival.

While one might not be able to calculate the negative marginal utility of the loss of £x for a middle or upper income individual it would be reasonable to assume without detailed investigation that either would be less than the negative marginal utility of death.

5.7 Issues of complexity and uncertainty

Water management programs present a highly complex picture for those engaged in program management (Gregorson et al 2007). Water resources themselves are spatially complex. Surface runoff alone can operate over different regions, states and countries giving rise to water usage disputes between different political authorities. Hydrological and technological issues may not be well understood at local administrative level creating political difficulties for political leaders. Environmental and social effects may not be well understood even (or sometimes especially) by those with technical or engineering expertise. Local stakeholders have additional local environmental knowledge which may be of use. Additionally, the existence of complexity challenges whether conventional forms of decision making are appropriate (Pahl-Wostl *et al.* 2011).

Junk and Nunes de Cunhha (2005) outline the complexity of issues surrounding the Pantanal – a large and still relatively untouched wetland in the centre of South America covering parts of Brazil, Bolivia and Paraguay. However, this area is threatened with large development programs which may disrupt both the environment and the biodiversity of an area rich with unique species. In 1993 the UN declared it a World Heritage Site. Nonetheless the actual population in and close to the area is low. It should be clear from this description that no-one is going to evaluate alternative courses of action through a simple cost-benefit analysis with three states plus the UN involved. The unique hydrodynamics alone are extremely complex with large seasonal variations in water levels. It is clear in such a case that something

like a permanent multinational governance organization with multiple periodic episodes of stakeholder engagement is required to manage this resource and make collective evaluation of project proposals.

Bertoncin *et al.* (2019) consider irrigation megaprojects in Sudan. A complexity issue here lies in the ambiguous role of the state which in some cases directly exploits resources as an entrepreneur and more recently in others it licenses private sector companies to exploit resources within a regulatory framework and it becomes purely a collector of income. Cost-benefit analysis would be regarded as neutral with regard to the mode of exploitation. However, observed differences in behaviour between state-owned and private enterprises means that such neutrality is not justified. It matters who the economic actors are.

Bekessy and Selinske (2017) examine decision-making in water resource management. They highlight both the complexity and uncertainties involved in multiple interpersonal, spatial and intertemporal interactions. They describe a whole toolbox of different methods of evaluating social-ecological systems with a particular emphasis on networks physical, social, belief-based and decision interdependency. Discussions around alternative scenarios are also included. Deployment of these tools lie outside traditional project appraisal.

Chaffin et al. (2016) also concentrate on networks in looking at the Klamath River Basin water governance in the USA. They examine 'adaptive' governance which is able to adapt to changing social and ecological circumstances through non-hierarchical networks of polycentric inter-organizational networks taking in both local and wider interests. They stress the need for networks with different sources of power and legitimacy which can facilitate trust-building and learning. They too concentrate on complexity and uncertainty with a network

model as the best vehicle for governance. The Klamath network includes six Native American tribes as well as local government, state and federal agencies and even specific litigation groups. Hydroelectric dams and fish are included in the disputed issues. Social Network Analysis (SNA) is used but with organizational rather than individual connections. Changing network characteristics reflect changes in the state of negotiations and episodes of partial agreement (as in the settlement of litigation) but not necessarily in ways expected by the researchers. However, they could identify a shift from an hierarchical system to one where key brokers emerged indicating increased levels of inter-organizational trust and collaboration. Water governance is an ongoing rather than a project process. Projects, however, sit within and have to satisfy a larger governance process. While SNA in this context is still relatively young it is emerging as a useful tool in identifying stakeholders, their salience and connectivity.

Faust *et al.* (2013) indicate the complexities of identifying stakeholders for early engagement in water projects. They developed a model using the infrastructure and environmental systems as starting points with which to select random potential local stakeholders for surveys which used binary decision trees to elicit their areas of concern and interest in a proposed project. This also helped to shape understanding of the most pressing issues in local stakeholders' minds.

5.8 Stakeholder-driven design, appraisal and delivery

In this section it has been argued that:

1. There are shortcomings in standard techniques in cost-benefit analysis for valuation of the environment and losses incurred by project-displaced stakeholders (PDS) – particularly so in hydropower multipurpose projects.
2. The Kaldor-Hicks criterion needs to be set aside – whether losers are compensated is an issue that cannot be ignored.

3. PDS and other local stakeholders need to be treated as key stakeholders who have a role to play in project planning, design and evaluation, and not merely as people who need compensation.
4. The resettlement of PDS needs to be fully carried out as an integral part of the project with external governance and post-project follow-up in the operational phase. Enforced removal and payment of (usually) inadequate compensation is not enough.
5. The complexity and uncertainties of water resources river basin projects embrace technical, social, political, environmental, economic, cultural and international aspects. While expert-driven cost-benefit analysis is a useful part of project appraisal it is inadequate as a total appraisal method. It can only be part of a much wider process of multi-criteria decision-making involving processes of total stakeholder engagement and negotiation.

6.0 Participatory stakeholder gaming and simulation

Having established the need for stakeholder interaction it is necessary to consider a possible framework and to introduce role-playing games.

6.1 The nature and development of simulation and gaming tools for complex decision making

Gaming /Simulation involve techniques for developing a functional model from an abstraction of social phenomena in order to allow experimental manipulation of significant aspects of the phenomena in a semi-laboratory setting. The technique makes such experimentations possible for students, practitioners, public and educators with relatively little time and preparation.

Gaming involves a characterization of the role of significant individuals and social groups through design of rules and regulations which

abstract the relationships of the real-world characters. The game/simulations designer thus writes a role description for all the characters involved in the gaming simulation and by developing an accounting system, quantifies the players' interactions in the decision–making processes.

Simulation involves a careful selection and abstraction of significant variables and their inter-relationships within social phenomena worked into a functional model. Thereby, relevant information related to the phenomena can be examined, experimented and communicated to others (Kadivar 1979).

Taylor (1971) recounts the development of simulation and gaming exercises as a means to deal with complex decision-making problems. He describes the emergence (from war gaming) of such exercises in the field or urban planning in the 1960's and 1970's. There were considerable problems in development models of sufficient complexity for them to be useful but not so much complexity that they were too unwieldy to manage. Originally the games had to be played through analogue means using physical tokens and boards/maps to represent different positions, possibilities and choices. Feldt (1995) (a father of USA gaming) also deals with the frustrations associated with such means as well as the diminishing availability of funds to carry out research in this area. One more optimistic scholar called simulation gaming "the future's language" (Duke 1975).

6.2 Playable "meta-games"

Mayer (2009) points out that larger scale models in the 1960's and 1970's failed both because of the limitations of computing; but also the use of a comprehensive, rational and linear paradigm for decision making instead of the bounded, political and incremental model which was then emerging. However, increasing computer power made the

modelling of complexity rather easier. In particular the need for environmental impact analysis led to the development of a game preceding official decisions being:

> "A deliberate procedure in which goals and objectives are systematically clarified and strategic objectives are invented and evaluated in terms of the values at stake. The exercise is a preparatory activity for effective participation in official decision processes; its outcomes are not official decisions." (Brewer 1986 quoted by Mayer 2009)

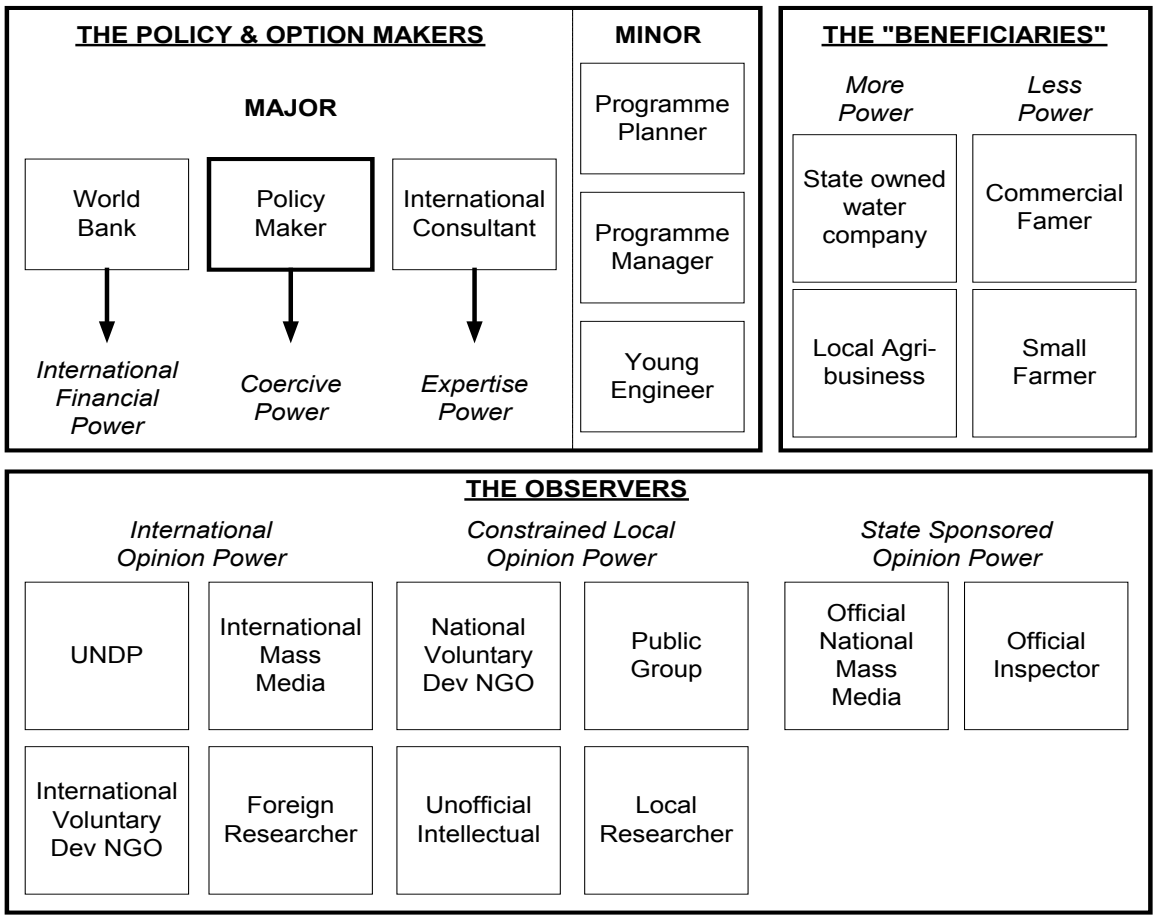
These role-playing "meta-games" (Bots and Hermans 2003) proceed with a structured problem, a set of role-playing stakeholders, a set of policy options and inter-optional dependencies. The outcomes are scenarios which may reveal the extent of points of conflict and compromise as well as the credibility of threats and promises. The point is that the post-game analysis is as interesting (if not more so) than the actual game. The actual game can be conducted by people sitting round a table, or in conference rooms with separated cubicles (large scale simulation exercises) – the computer will normally be required, however, to analyse what is actually going on in the game or to demonstrate the outcomes of specific policy options. The players can play with cards representing voting for options or through computer input if preferred.

6.3 SIR WALRUS a "meta-game" example in the water sector

SIR WALRUS was developed out of engineering and planning practice from the viewpoint of water facilities and project management. The model was developed to assess and demonstrate the decision-making power structure in large-scale regional water and land resource development programs. What emerged after testing different research methods was the use of serious simulation gaming as a language and tool to portray the rigid centralized public planning processes that prevailed in many lower income countries during the 1960's and 1970's

(Kadivar 1978, Kadivar *et al.* 1978). The model was initially tested at number of universities by engaging professors and graduate students to assume the role of gaming characters.

Figure 1
Water and Land Resource Use Simulation (WALRUS) Roles
(Adapted from Kadivar and Franzini 1977)



The model later was presented and played at International Simulation and Gaming Association meeting with the game designers. It was also used at an international UN conference. Forty-five people were intensively engaged in a simulated environment for eight hours. Participants took the roles of three categories of actors as adapted in Figure

1. Participants discussed and weighed many policy choices, which entail recognition of individual (and opposing) solution preferences, judgments of what is best for society, judgement of which solutions best reduce negative impacts, and discovery of how to break rigid management style. In summary it is a model of stakeholder engagement in a safe simulated environment where the purpose and method of the applications have been identified and defined.

The list of participants included:

- Managers and engineers of public works project within the international community such as the UN family or with a government organization
- Planning directors of multi-national engineering or construction companies sensitive to the problems of current issues in water resources development and the critical role to be played by the population.
- Voluntary organizations or professional organizations
- Researchers in many fields including political sciences, education, engineering, project planning, economic development, anthropology, communication,
- Grass roots organizations

With the subsequent revolution in computing and current capacity in information communication technologies, the model can be adapted and improved by using innovative techniques involving more complex communications and detailed accounting methods.

6.4 Benefits and pitfalls of gaming/simulation in actual use

Mayer (2009) argues for the use of gaming on the grounds that decision making is chaotic and messy – particularly in a complex multi-actor setting with different values and priorities. The interactions lead to unanticipated effects and emergent properties of decisions which may not have been otherwise predicted. They may also reveal possibilities for mutually welfare-augmenting Pareto optimal tradeoffs. The

existence of such complexities may, however, be doubted by policy makers who are "experts" in complex policy decisions.
A problem may be caused where there are missing institutional stakeholders who are locally based experts whose knowledge and role play is critical for accurate local values to be input into the game. For instance, Inguane *et al.* (2014) while not writing in a gaming context, warn of the consequences of the absence of locally based Regional Water Administrations in delivering effective water resource governance in Mozambique. This would be particularly important in the case of indigenous peoples where they would most likely need advocates and possibly translators to participate alongside them or on their behalf. Visualisation capabilities of modelling would greatly help in communication – especially where there is a language barrier.

Lankford and Watson (2006) describe the use of simulation in water-related projects in Nigeria and Tanzania. This uses a board analogue model to simulate the physical reality of a river basin. Becu *et al.* (2008) describe experiences of using discursive participatory simulation in Thailand. Boutet *et al.* (2003) describe a stakeholder simulation process in a French river valley.

The benefits are that:

i) There is evidence that many participants enjoy and actively engage with the process
ii) There is evidence of both social learning in interacting with other parties and technical learning in that participants can learn the reality of differing levels of access to water.
iii) There is evidence of unforeseen outcomes emerging from successive rounds of interaction
iv) Processes (when well developed) have a mixture of realism with simplicity that allows a grasp of the emergent properties of a complex system.

There can be problems however:

i) Large strategic stakeholders may decline for commercial, political or other reasons to participate in order precisely not to show their strategic hands.
ii) Other stakeholders may participate purely to gain strategic information about other participants and then withdraw from the process when sufficient knowledge has been gained
iii) Less sophisticated participants may confuse the relationship between the game and reality
iv) Interpreting outcomes in contexts of local social tensions and power differentials may be problematic.

6.5 Some recent developments in gaming, modelling and simulation applications

A favoured modelling approach is 'Companion Modelling' (Daré et al. 2014) which is attractive because it takes a particular ethical stance. Because the 'players' include both expert and lay stakeholders there is a principle that everyone's beliefs and points of view are to be taken seriously. Equally all assumptions and beliefs are open to challenge whether held by experts or not. (This is particularly important in a game involving indigenous people or their advocates.) It envisages a 'game master' (male or female) who moderates the processes in the role-playing type of game where there are pre-confrontational deliberations, confrontational episodes and inter-confrontational and post-confrontational reflections which attempt to construct a post-episodic common understanding of the point reached in the negotiation. The game master also referred to as the 'commodian' will also actively suggest methods for stakeholders to reflect on the framework of rules under which they and others are operating. This is especially important where conceptual clarification is required between different types of stakeholder with differing levels of expertise. The modellers also have a responsibility to be able to demonstrate the assumptions behind the modelled objects and the limitations to which they are subject. Finally,

the commodian has to guard against stakeholders attempting to manipulate model outputs through false inputs. (This would be obvious, for instance if the model starts producing physically impossible outputs.)

Worrapimphong *et al.* (2010) provide a practical example of the companion modelling approach applied to fishery management in Thailand. Souchère *et al.* (2010) provide another example applied to the problem of erosive runoff in France. A third case is provided by Sermet *et al.* (2020) for Bexar County, Texas concerning water-related hazards.

Becu *et al.* (2019) set out procedures for role-playing simulation games and argue that there need to be activities both where stakeholders can interact with a simulation but also where modellers can experiment simultaneously on a simulation to explore scenarios and develop collaborative learning. Since gaming of this type is still in its infancy the technical providers of such games are themselves on a learning curve and need space in which to improve their skills.

Li *et al.* (2017) demonstrate the usefulness of a game to show the advantages of ecological corridors in the Yangtze River Basin in China. Stakeholder players became aware of the socially negative results of pursuing individual gain as a priority. Players eventually showed increased understanding of and co-operation with other stakeholders. Development of the game also provided a means of educating a wider public.

Wang and Davies (2015) present an experimental gaming model designed as a decision support tool for drought management in Canada designed to promote better collaborative decision behaviour. The results showed an increase in player understanding of the complexity of

water resource management and the trade-offs that managers have to face.

Craven *et al.* (2017) developed a simulation game for sustainable basin management in the Magdalena-Cauca Basin in Colombia. The simulation period is 30 years to show long-term effects of decisions. The game encouraged dialogue between stakeholders and communicated the complexity of stakeholder relationships.

Xu *et al.* (2020) developed a public web-based decision support game for mitigation of water-related hazards from the Iowa Watershed in the USA. The idea is to educate local residents about watershed hazards during extreme conditions. It also aims to encourage greater stakeholder engagement with the problems, risks and updated status of local hazards and encourage dialogue about mitigation measures.

Fleming *et al.* (2020) developed a table-top role-playing game in training for Disaster Risk Reduction and Management. This consisted of an initial scenario presentation, the playing of the game in eight 'rounds' with between-round assessment, a final assessment and a debrief during which participants could share their insights gained during the exercise. Participants were positive about the exercise and considered it a useful way of addressing disaster-related issues and to stimulate critical thinking. However, participants also contributed views on how the exercise might be improved including the identification of missing stakeholder roles.

Onencan *et al.* (2016) conducted an existing participatory game in Nairobi, Kenya around the topic of disaster risk reduction in the Nile Basin. They found that participants took decisions on a short-term basis and lacked strategic foresight. The participants learned much from

the game about longer term development as well as the risks and resilience of the Basin area.

What can be seen from the foregoing is that serious simulation and role-playing games are being increasingly used in both educational and multi-stakeholder engagement contexts. There is also an increased appreciation of the benefits of such games as well as of the need for careful preparation, ground rules for operation, debriefing, learning from both experience and relevant research findings to facilitate ongoing improvement.

7.0 Conclusion

This paper has argued that large key stakeholders need to engage with small stakeholders at an early stage of a water development project – in particular those who may be displaced or otherwise dispossessed by the project. The processes of project planning and design – particularly that of evaluation – which follow conventional economic and technical rules may founder in the light of knowledge and socio-cultural (or even linguistic) gaps between stakeholders which may render false the theoretical assumptions on which such processes are based. It has been further argued that various forms of participatory gaming and simulation can provide valuable assistance in exploring the complexities of multi-objective, multi-criteria, multi-stakeholder environments. But it is recognised that there are weaknesses and limitations of such forms of interaction and that considerable further work needs to be done in the field; both to develop and test more effective gaming and simulation models.

8.0 Recommendation

The potential prize is an enlarged toolbox which assists in helping develop more equitable water development projects through dialogue

and co-operation on a basis of openness and trust in which the possibility of a project not proceeding remains on the table. Powerful political and/or expert stakeholders have a potentially valuable role to play in developing the use of such models alongside less powerful stakeholders. Some large stakeholder may indeed be using such methods and, if so, the authors would like to hear from them. The authors believe, however, that a decision not to engage in serious dialogue with less powerful stakeholders is not a long-term option if the full potential benefits of hydropower and water supply projects are to be realised.

Acknowledgement: This paper has been developed from one presented at the HYDRO 2011 Conference in Prague and parts of that paper have been reproduced here by kind permission of Aqua-Media International Ltd.

References

Aaltonen, K., and Kujala, J., (2010) A project lifecycle perspective on stakeholder influence strategies in global projects, *Scandinavian Journal of Management* **26** 381-397

Baviskar, A., and Singh, A.K., (1994) Malignant growth: the Sardar Sarovar Dam and its impact on public health, *Environment Impact Assessment Review* **14** 349-358

Becu, N., Amblard, F., Brax, N., Gaudou, B., and Marilleau, N., (2019) How to involve stakeholders in the modeling process, in Banos, A., Lang, C., and Marilleau, N., (eds) *Agent-based Spatial Simulation with NetLogo: Volume 1, Introduction and Bases* London, ISTE Press and Kidlington, Elsevier

Becu, N., Neef, A., Schreinemachers, P., and Sangkapitux, C., (2008) Participatory computer simulation to support collective decision-making: potential and limits of stakeholder involvement, *Land Use Policy* **25** 498-509

Begotti, R.A., and Peres, C.A., (2020) Rapidly escalating threats to the biodiversity and ethnocultural capital of Brazilian Indigenous Lands *Land Use Policy* **96** 104694

Bekessy, S.A., and Selinske, M.J., (2017) Social-Ecological Analyses for Better Water Resources Decision Making, in Hart, B.T., and Doolan, J., (eds), *Water Resources Policy and Management: An Australian Perspective* London, Academic Press

Bertoncin, M., Pase, A., Quatrida, D., Turrini, S., (2019) At the junction between state, nature and capital: Irrigation mega-projects in Sudan *Geoforum* **106** 24–37

Boardman, A.E., Greenberg, D.H., Vining, A.R., and Weimer, D.L., (2006) *Cost benefit analysis: concepts and practice* (3rd edition) Upper Saddle River NJ, Pearson Education

Bots, P.W.G., and Hermans, L.M., (2003) Developing 'playable metagames' for participatory stakeholder analysis, in Arai, K., (ed) *Proceedings of the 34th Conference of the International Simulation and Gaming Association* (ISAGA) Chiba, Japan 25-29th August

Boutet A., Barreteau O., Cernesson F., and Garin P., (2003) An agent-based model for cooperative water management in the Orb Valley. A participatory modelling case *GDN 2003: A Conference within EURO/INFORMS*, Istanbul

Boyle, K.J., (2003) Contingent valuation in practice, in Champ *et al.* (2003)

Bretton Wood Observer (2017) Controversial Sardar Sarovar Project dam set to displace thousands, October

Bretton Woods Observer, (2019a**)** Landmark report finds attacks on human rights defenders in name of 'development' on the rise, July

Bretton Woods Observer (2019b) Local communities oppose planned dam construction supported by World Bank in Manipur, December

Brewer, G., (1986) Methods of synthesis: policy exercise, in Clark, W., and Munn, R., (eds) *Sustainable development of the biosphere* Cambridge, Cambridge University Press

Bui, T.M.H., and Schreinemachers, P., (2020) Livelihood changes of affected households under resource scarcity: The Son La hydro-power project in Vietnam *Kasetsart Journal of Social Sciences* **41** 321-328

Chaffin,B.C., Garmestani, A.S., Gosnell, H., and Craig, R.K., (2016) Institutional networks and adaptive water governance in the Klamath River Basin, USA *Environmental Science & Policy* **57** 112–121

Champ., P.A., Boyle, K.J., and Brown, T.C., (eds) (2003) *A primer on non-market valuation*, Dordrecht, Kluwer

Chen, Y., and Landry, D., (2018) Capturing the rains: Comparing Chinese and World Bank hydropower projects in Cameroon and pathways for South-South and North South technology transfer *Energy Policy* **115** 561-571

Choudhury, G., (2016) Impact of Hydropower on Mountain Communities in Teesta Basin of Eastern Himalaya, India *Developments in Earth Surface Processes* **21** 239-277

Choy, Y.K., (2018) Cost-benefit Analysis, Values, Wellbeing and Ethics: An Indigenous Worldview Analysis *Ecological Economics* **145** 1-9

Craven, J., Angarita, H., Corzo Perez, G.A., and Vasquez, D., (2017) Development and testing of a river basin management simulation game for integrated management of the Magdalena-Cauca river basin *Environmental Modelling & Software* **90** 78-88

Daré, W., Barnaud, C., d'Aquino, P., Etienne, M., Fourage, C., and Souchère, V., (2014) The Commodian Stance: Interpersonal Skills and Expertise, in Etienne, M., (ed) *Companion Modelling* Versailles, Editions Quæ

Dash, P., and Punia, M., (2019) Governance and disaster: Analysis of land use policy with reference to Uttarakhand flood 2013, India *International Journal of Disaster Risk Reduction* **36** 101090

Duke, R.D., (1975) *Gaming: the future's language*, New York, John Wiley

European Bank for Reconstruction and Development, (2019) *Project Accountability Policy* London, EBRD

Falk, T., Spangenberg, J.H., Siegmund-Schultze, M., Kobbe, S., Feike, T., Kuebler, D.H, Settele, J., and Vorlaufer, T., (2018) Identifying governance challenges in ecosystem services management – Conceptual considerations and comparison of global forest cases *Ecosystem Services* **32** 193–203

Faust, K., Abraham, D.M., and DeLaurentis, D., (2013) Assessment of stakeholder perceptions in water infrastructure projects using system-of-systems and binary probit analyses: A case study *Journal of Environmental Management* **128** 866-876

Feldt, A.G., (1995) Thirty-five years in gaming, *Simulation and Gaming* **26** 448-452

Fernando, N., (2018) Voluntary or involuntary relocation of underserved settlers in the city of Colombo as a Flood Risk Reduction Strategy: A Case Study of Three Relocation Projects *Procedia Engineering* **212** 1026–1033

Fleming, K., Abad, J., Booth, L., Schueller, L., Baills, A., Scolobig, A., Petrovic, B., Zuccaro, G., and Leone, M.F., (2020) The use of serious games in engaging stakeholders for disaster risk reduction, management and climate change adaption information elicitation *International Journal of Disaster Risk Reduction* **49** 101669

Flores, N.E., (2003) Conceptual framework for nonmarket valuation, in Champ *et al*. (2003)

Flyvbjerg, B., Bruzelius, N., and Rothengatter, W., 2003, *Megaprojects and Risk: An Anatomy of Ambition* Cambridge University Press, CUP

Global Witness (2020) Defending Tomorrow: *The climate crisis and threats against land and environmental defenders* London, Global Witness

Gregorson, H.M., Ffolliott, P.F., and Brooks, K.N., (2007) *Integrated watershed management: connecting people to their land and water*, Wallingford, CABI

Gustafsson, A., Herrmann, A., and Huber F., (2001) Conjoint analysis as an instrument of market research practice, in Gustafsson, A., Herrmann, A., and Huber F., *Conjoint measurement: methods and applications* Berlin, Springer

Hayek, F. (1945) The use of knowledge in society *American Economic Review* **35/4** 519-530

Helvarg, D., (2003) The Last Fish *Earth Island Journal* Spring

Helvarg, D., (2004) *The War Against the Greens: The "wise-Use" Movement, the New Right and the Browning of America* (2nd edition) Boulder CO, Johnson Books

Hicks (1939) The Foundation of Welfare Economics *Economic Journal* **49/196** 696-712

Inguane, R., Gallego-Ayala, J., and Juízo, D., (2014) Decentralized water resources management in Mozambique: Challenges of implementation at the river basin level *Physics and Chemistry of the Earth* **67–69** 214–225

Institution of Civil Engineers (2017) *ICE Code of Professional Conduct* London, ICE

I.P.C.C., (2007) *Fourth Assessment Report of the Intergovernmental Panel on Climate Change*, Cambridge University Press, Cambridge

Jiménez, A., Molina, M.F., and Le Deunff, H., (2015) Indigenous peoples and industry water users: Mapping the conflicts worldwide *Aquatic Procedia* **5** 69 – 80

Jones, B.A., Berrens, R.P., Jenkins-Smith, H., Silva, C., Ripberger, J., Carlson, D., Gupta, K., and Wehde, W., (2018) In search of an inclusive approach: Measuring non-market values for the effects of complex dam, hydroelectric and river system operations *Energy Economics* **69** 225–236

Junk, W.J., and Nunes de Cunha, C., (2005) Pantanal: a large South American wetland at a crossroads *Ecological Engineering* **24** 391–401

Kadivar, S., 'Options for Rural Development' based on SIR WALRUS simulation model ,1978 UN *Conference on Technical Co-operation Among Developing Countries* (TCDC) Buenos Aires, Argentina, September 1978

Kadivar, S., A Simulation Gaming Model for Critical Analysis of the Public Planning Process, Stanford University, Civil Engineering Department, PhD Dissertation, California, USA, January 1979, unpublished)

Kadivar, S., and Franzini, J.B., (1977) SIR WALRUS – a policy decision game, 16th Northern American Simulation and Gaming Association, Annual Conference, Boston MA, 15-18th October

Kadivar, S., Franzini, J.B., Paisley,W., and Dajani, J., Potential of the Simulation Gaming Model to study Third World development Planning Phenomena *IX International Simulation and Gaming Association Annual Conference.* Lund University, Sweden, 22-26 July 1978.

Kahneman, D., and Tversky, A., (1979) Prospect theory: an analysis of decision under risk, *Econometrica* **47** 263-291

Kahrl, F., Williams, J., Jianhua, D., and Junfeng, H., (2011) Challenges to China's transition to a low carbon electricity system *Energy Policy* **39** 4032-4041

Kaldor, N., (1939) Welfare Propositions in Economics and Interpersonal Comparisons of Utility *Economic Journal* **49/195** 549-552

Kelsey, J.M., and Roberts, A.H., (2010) Sustainability in world heritage and urban regeneration: the case of Bath *Proceedings of the 2nd International Conference on Heritage and Sustainable Development*, Evora, Portugal 22nd-26th June Vol. II

Knoke, T., Gosling, E., and Paul, C., (2020) Use and misuse of the net present value in environmental studies *Ecological Economics* **174** 106664

Krutilla, J.V., (1967) Conservation reconsidered *American Economic Review* **57** 777-786

Lampreia, J., Muylaert, M.S., de Campos, C.P., Freitas, M.A.V., Rosa, L.P., Solari, R., Gesteira, C., Ribas, R., and Silva, N.F., (2011) Analyses and perspectives for Brazilian low carbon technological development in the energy sector *Renewable and Sustainable Energy Reviews* **35** 3432-3444

Lankford, B.A., and Watson, D., (2006). "Exploring metaphor in natural resource gaming; insights from the River Basin Game.", in Barreteau, O., Etienne, M., Le Page, C., and Perez, P., (eds) *Symposium issue of Simulation & Gaming: An Interdisciplinary Journal of Theory, Practice and Research on Simulation/Gaming in natural resource management* (NRM).

Larsson, N., (2020) Killed for defending the planet: Murder of environmental activists reaches record high *The Independent* 19th August

Li, F., Pan, B., Wu, Y., and Shan, L., (2017) Application of game model for stakeholder management in construction of ecological

corridors: A case study on Yangtze River Basin in China *Habitat International* **63** 113-121

Lin, N., (2001) "Social capital: a theory of social structure", Cambridge, Cambridge University Press

Liu, B., Li, Y., Xue, B., Li, Q., Zou, P.X.W., and Li, L., (2018) Why do individuals engage in collective actions against major construction projects? —An empirical analysis based on Chinese data *International Journal of Project Management* **36** 612–626

Louvière, J.J., Hensher, D.A., and Swait, J.D., (2000) *Stated choice methods: analysis and application* Cambridge, Cambridge University Press

Mayer, I.S., (2009) The gaming of policy and the politics of gaming: a review, *Simulation and Gaming* **40** 825-862

Mertha, A.C., (2009) From 'rustless screws' to 'nail houses': the evolution of property rights in China *Orbis* **53/2** 233-249

Miceli, T.J., (2011) *The economic theory of eminent domain* New York, Cambridge University Press

Millennium Ecosystem Assessment (2005) *Ecosystems and Human Well-being: Synthesis* Washington DC, Island Press

Norton, B.G., (2017) A Situational Understanding of Environmental Values and Evaluation *Ecological Economics* **138** 242–248

Onencan, A., Van de Walle, B., Enserink, B., Chelang'a, J., and Kulei, F., (2016) WeShareIt Game: Strategic foresight for climate-change induced disaster risk reduction *Procedia Engineering* **159** 307 – 315

Owen, J.R., Zhang, R., and Arratia-Solar, A., (2020) On the economics of project-induced displacement: A critique of the externality principle in resource development projects *Journal of Cleaner Production* **276** 123247

Pahl-Wostl, C., Jeffrey, P., Isendahl, N., and Brugnach, M., (2011) Maturing the new water management paradigm: progressing from aspiration to practice, *Water Resources Management* **25** 837-856

Raganathan, V., (1993) Hydropower and environment in India, *Energy Policy* **25** 435-438

Rosenberger, R.S., and Loomis, J.B., (2003) Benefit transfer, in Champ *et al.* (2003)

Robbins, L., (1938) Interpersonal Comparisons of Utility: A Comment *Economic Journal* **48/192** 635-641

Ryskamp, J., (2007) *The eminent domain revolt: changing perceptions in a new constitutional epoch*, New York, Algora Publishing

Saaty, T.L., (1980) *The Analytic Hierarchy Process: planning, priority setting, resource allocation*, New York, McGraw-Hill

Schaeffer, R., and Szklo, A.S., (2001) Future electric power technology choices of Brazil: a possible conflict between local pollution and global climate change, *Energy Policy* **29** 355-369

Schmidt, P., and Lilliestam, J., (2015) Reducing or fostering public opposition? A critical reflection on the neutrality of pan-European cost–benefit analysis in electricity transmission planning *Energy Research & Social Science* **10** 114–122

Sermet, Y., Demir, I., and Muste, M. (2020) A serious gaming framework for decision support on hydrological hazards *Science of the Total Environment* **728** 138895

Skyrms, B., (2004) *The stag hunt and evolution of social structure Cambridge*, Cambridge University Press

Souchère, V., Millair, L., Echeverria, J., Bousquet, F., Le Page, C., and Etienne, M., (2010) Co-constructing with stakeholders a role-playing game to initiate collective management of erosive runoff risks at the watershed scale *Environmental Modelling & Software* **25** 1359–1370

Sovacool, B.K., and Bulan, L.C., (2011) Behind an ambitious megaproject in Asia: the history and implications of the Bakun hydroelectric dam in Borneo, *Energy Policy* **39** 4842-4859

Stoekl, N., Hicks, C., Farr, M., Grainger, D., Esparon, M., Thomas, J., and Larson, S., (2018) The Crowding Out of Complex Social Goods *Ecological Economics* **144** 65–72

Syagga, P.M., and Olima, W.H.A., (1996) The Impact of Compulsory Land Acquisition on Displaced Household: The Case of the Third Nairobi Water Supply Project *Habitat International* **20/1** 61-75

Taylor, J.L., (1971) *Instructional planning systems: a gaming simulation approach to urban planning problems* Cambridge, Cambridge University Press

Turaga, U., (2000) Damming waters and wisdom: protest in the Narmada River Valley *Technology in Society* **22** 237-253

Tversky, A., and Simonson, I., (1993) Context-dependent preferences, *Management Science* **39** 117-185

UN (2008*) United Nations Declaration on the Rights of Indigenous Peoples* Geneva, United Nations

Venkatachalam, L., (2008) Behavioral economics for environmental policy *Ecological Economics* **67** 640–645

Wang, K., and Davies, E.G.R., (2015) A water resources simulation gaming model for the Invitational Drought Tournament *Journal of Environmental Management* **160** 167-183

Wellington, A. (2018) Water Ethics *Encyclopedia of the Anthropocene* **4** 227-238

World Bank, (1994) *World development report 1994: Infrastructure for development*, Washington DC, World Bank

World Bank (2017) The World Bank environmental and social framework, Washington DC, World Bank

World Commission on Dams, (2000) *Dams and development: a new framework for decision-making*, London, Earthscan

Worrapimphong, K., Gajaseni, N., Le Page, C., and Bousquet, F., (2010) A companion modeling approach applied to fishery management *Environmental Modelling and Software* **25/11** 1334-1344

Xia, B., Qiang, M., Chen, W., Fan, Q., Jiang, H., An, N., (2018) A benefit-sharing model for hydropower projects based on stakeholder input-output analysis: A case study of the Xiluodu Project in China *Land Use Policy* **73** 341-352

Xu, H., Windsor, M., Muste, M., and Demir, I., (2020) A web-based decision support system for collaborative mitigation of multiple water-related hazards using serious gaming *Journal of Environmental Management* **255** 109887

Finito di stampare
GieGi srl - Triuggio (MB)
Ottobre 2020


9788834344149