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Planning for a Large Dam Project: The Case of Traveston Crossing Dam

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Abstract The approval for a large dam project proposal these days predominantly involves satisfying broadly the criteria of economic development, social equity, and environmental sustainability. It is justified that the criterion of economic development seeks full project cost recovery as well as significant contribution to economic growth of a region. Cost–benefit analysis is normally used as the yardstick for economic development but it has limitations and a better method is warranted. Social equity considerations should embody the need to address the concerns of all sections in communities to be impacted by a project and involve them in the decision-making process. The lapse of this aspect in project planning of the past has led, at least as being partly responsible, to disastrous consequences. Environmental sustainability should seek to ensure that the vital components of the environment are preserved such that the future generation can use the natural resources to their benefit at least as much as the current generation. Environmental sustainability is arguably the most contentious criteria among these. The vagueness in the concept of environmental sustainability and the tendency of the society to err on the safe side have caused many large dam project proposals not reach their fruition. An attempt is made in this paper to define environmental sustainability in a more meaningful way from an analytic viewpoint. The case of Traveston Crossing Dam project in southeast Queensland, Australia is presented as an illustrative example and to evaluate the performance and relevance of the three broad criteria in a real-world application. The case study is also an example of the fact that environmental awareness can lead to enormous level of socio-political forces which can create many hurdles to cross by a democratic government.

Keywords Large dam project · Economic development · Social equity · Environmental sustainability

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1 Introduction

A large dam project such as the Hoover Dam in USA, Aswan Dam in Egypt, Three Gorges Dam in China, Tarbela dam in Pakistan, or the Snowy River Project in Australia can be a symbol of national pride, and can transform the socioeconomic landscape of a region. Indeed, the benefits of a large dam project especially in the developing world extend to the core of the society such as food and water security, clean energy, and price stability of produce (Shah and Kumar 2008). Conversely, a large dam project can upset the social fabric of a region by population displacement (Mata-Lima 2009) and create adverse environmental effects such as decline of migratory species population (Rosenberg et al. 1997), increased outbreaks of parasites/diseases (Bonetto et al. 1987), and extirpation of endangered species (Dudley and Platania 2007). The focus of this study is only on large dams as defined by ICOLD (www.icold-cigb.net) such as dams with a height of 15 m or more, height between 10 and 15 m having a crest length over 500 m, or height 5 m or above with a reservoir volume of three million cubic meters. Any new large dam project proposal these days as demonstrated through experiences throughout the world faces stiff opposition especially from environmental groups, and the reality that galvanizes the opposition is the fact that a dam project is essentially irreversible—once constructed, it is almost impossible to restore original conditions in nature even if the dam is decommissioned. The rectifying measures of the adverse effects of a dam can be enormously expensive or even beyond the reach of modern science. Lessons learnt from the past demonstrate that not too long ago, dam constructions had been essentially publicly funded engineering projects with little regard to interdisciplinary and transdisciplinary aspects such as combining interscientific and local community knowledge, which resulted in many cases in enormous social and environmental costs (Mata-Lima 2009). The unfavourable experiences and unresolved social issues in many parts of the world are making it increasingly difficult to initiate a new large dam project proposal.

The last four decades saw radical transformation in thinking and planning for large dam projects in particular and water resources projects in general influenced to a great extent by eight international conventions, which are the United Nations Conference on Water in Mar del Plata in 1977, the International Conference on Water and Environment in Dublin in 1992, the United Nations Conference on Environment and Development (also known as the Earth Summit) in Rio de Janeiro in 1992, the Second World Water Forum and Ministerial Conference in The Hague in 2000, the International Conference on Freshwater in Bonn in 2001, the World Summit on Sustainable Development in Johannesburg in 2002, The Third World Water Forum in Kyoto in 2003, and The Fourth World Water Forum in Mexico in 2006 (Rahman and Varis 2008; Biswas and Tortajada 2007). The emergent policy framework from this transformation process resulted in setting of strategic priorities which have been summarized by UNEP (2006) as the need for a water resources project proposal to address broadly three types of criteria, which are: economic development, social equity, and environmental sustainability. In 1997, the World Bank and the International Union for the Conservation of Nature sponsored a meeting which led to the creation of the World Commission on Dams (WCD). WCD in November 2000 released the publication *Dams and Development*: *A New Framework for Decision-Making*, which encapsulates this three criteria in the framework of seven

strategic priorities and related policy principles. WCD (2000) has translated these priorities and principles into a set of corresponding guidelines for key decision points, which are (1) gaining public acceptance, (2) comprehensive options assessment, (3) addressing existing dams, (4) sustaining rivers and livelihood, (5) recognizing entitlements and sharing benefits, (6) ensuing compliance, and (7) sharing rivers for peace, development and security. WCD was disbanded in 2001 and the role was taken over by UNEP's Dams and Development Project (DDP). In 2007 DDP published a compendium *Dams and Development*: *Relevant Practices for Improved Decision Making* which devotes a chapter to each of the above key decision points as a non-prescriptive practical information tool from 105 case studies around the globe with special emphasis on participatory decision making and stakeholder participation. WCD (2000) and DDP (2007) reports form the basis upon which the present study builds on. In the sequel a key decision point is alluded to by the symbol § preceding it.

Laws and regulations of many nations have enshrined at least in intent these concepts. The pioneering efforts in this regard came from the European Union's Water Framework Directive. Lind (1997) points out that the US has been particularly slow in this regard. After the Principles and Guidelines (P&G) adopted by the US Water Resources Council in 1983 no major policy framework emerged in the US (Griffin 2008). In Oceania, the COAG meeting of 1994 set the scene to adopt the aspirational goals and targets of the international conventions. This paper takes a closer look at the scope, implications, and ramifications as well as what should constitute the best practice of the three criteria on economic development, social equity, and environmental sustainability in the context of a large dam project planning as is understood in international conventions and revised policies of many nations. Other criteria and objectives which have found frequent use are captured in the three-dimensional diagram of these three criteria in Fig. 1. In this paper the three criteria are addressed separately and no attempt has been made to integrate those though considerable literature exists for an integrated look through multi-criteria decision making which has two major ramifications (Bernroider and Stix 2007), one is multi-attribute decision making where one or more variables are discrete and a

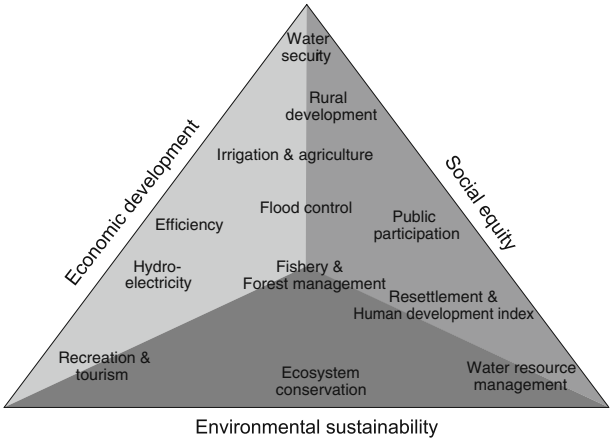

Fig. 1 Three-dimensional diagram of economic development, social equity, and environmental sustainability which captures other large dam project criteria and objectives frequently used

ranking of the alternatives is done (Flug et al. 2000; Joubert et al. 1997), and the other is multi-objective decision making where the variables are continuous and a Paretian analysis is conducted (Mahmoud and Garcia 2000). The major criticism of multicriteria decision making is the need to assign relative importance to different criteria which is contentious and can be avoided by treating each criterion in its own right and using alternative methods such as Arrowian framework of decision making (Arrow 1963), setting of lower bound for a criterion, or invoking precautionary principle. Principle 15 of the "Earth Summit" in Rio forms the primary foundation of the precautionary principle. This paper also does not address the engineering and financial aspects, which are reasonably well understood.

The description of Traveston Crossing Dam (TCD) project is presented in this study as an illustrative example. The objective of this study is to contribute towards development of a more informed perspective on how to plan a large dam project well with up-to-date knowledge in a given setting. With that in mind, Section 2 gives a brief overview on economic development, which is followed by a section on social equity which in turn is followed by a section on environmental sustainability. In Section 5 the case study of TCD project in southeast Queensland, Australia is presented. Section 6 on discussion is a critique on the three criteria and explains the opposition to the TCD project. The paper ends with some final remarks.

2 Economic Development

A common belief is that economic prosperity is well linked to water availability and that water scarcity problems are water supply problems best remedied by supply developments (Griffin 2008). Large-scale water resources projects such as large dams are the obvious choice because of the economy of scale and their inherent multipurpose nature. Historically, large dam projects have always remained as publicly funded projects because of the huge investment need and slow return. Cost–benefit analysis is a methodology designed to provide an economic evaluation procedure for public projects. It is analogous to the profitability criterion used in the private sector for decision-making in an investment scenario. The primary difference of cost–benefit analysis from profitability is the need to assign monetary attributes to all benefits and costs irrespective of their marketability. There are tools such as precedents, government policies, and international conventions to assist in the process which are more acceptable than methods such as contingent valuation. The theoretical underpinning of cost–benefit analysis comprise assigning price to all benefits and costs based on willingness of people to pay given a perfectly competitive economy, discounting all future values to present value using a discount rate, and selecting only those projects which have positive net present values. The basic rationale for selecting a project with positive net present value is that those who receive the benefits can at least potentially compensate those who incur the costs. In economics, this is commonly referred to as the *Kaldor–Hicks* compensation test (Lind 1997). If full compensation were paid this would result in net gain to the society and everyone would be better off. Bulk of the practitioners who are unconvinced with this utilitarian view would change their opinion if a process could be established to satisfactorily translate 'potential' to 'actionable' compensation payments. DDP notes that "fundamental elements for successful monetary benefit-sharing schemes are (a) existence of an economic rent and overcoming financial

constraints; (b) reconciling the goals of stakeholders; (c) ensuring the efficiency of redistribution of benefits; (d) ensuring the involvement of local communities; and (e) ensuring the accountability of agencies entrusted with the redistribution of benefits."

A major criticism of cost–benefit analysis is that it compares the future with the present. If no action is selected as an option, it does not imply in real-world that the current situation will not change in future. In fact, economic conditions such as income, opportunities, output, et cetera are never static—they evolve with time. This requires that benefits should be net benefits as a difference between benefits with the project and benefits without the project in the same timeframe, which makes realistic assessment of the benefits of a large-scale water resources project difficult because we have to extrapolate the current economic state into the future in the absence of the project. Nevertheless, future periods should not be regarded as repetitions of past periods (US National Research Council 1999, p. 50).

At the heart of cost–benefit analysis lies the discount rate to be applied. The discount rate is set nationally. From neoclassical economic theory, economic development of a nation calls for improving or at least maintaining productive capacity per head over time. It tests if the national economy is setting aside sufficient savings to replace or add to their reproducible assets. To achieve a sustainable living standard, an economy's productive capacity must prove capable of delivering a stream of consumption over time which allows future generations to fare at least as well as the current generation (Jackson 2007). It is something that the politicians have to demonstrate often for their survival and they have at their disposal many economic tools. Choosing a discount rate is one such tool, which can greatly vary depending on the assumptions. There are many interactions from local economy to global economy which add to the complexity of the problem and economists are forever unlikely to reach a consensus. Nevertheless, from microeconomic viewpoint, the discounting rate should equal the marginal rate of return on private investment (Lind 1997). But those who oppose this view argue that this marginal rate is distorted by taxes, and public funded projects have significant externalities which would influence the rate. Lind opines that the discounting rate should be 5–7% in real terms in the US. In Australia, the discounting rate used by the government now for publicly funded projects is 4%.

No doubt, cost–benefit analysis is a rough tool for the assessment of economic development because of market distortions and non-market valuations, nevertheless it remains a popular tool perhaps because it can identify big winners and losers and going through the process itself provides a learning curve of the complexities that exist in reality. WCD and DDP emphasize that opportunities often exist to improve benefits from many existing dams, which should be considered first before a new project, and management and operation practices must adapt continuously to changing circumstances to optimize benefits (§ (3)).

3 Social Equity

Social equity is grounded in the fundamental human rights framework agreed upon in international conventions. In simple words in the context of water resources, social equity can be described as providing fair access to nature's water to each individual in a society. At the very base it points to the responsibility of the government in

any society to provide water supply and sanitation needs to each individual to fulfil the requirements of basic living standards irrespective of one's ability to pay for the benefits and services. In Great Britain it has been found that such utility costs account for about 3% of living expenses (Chappells and Medd 2008). UK has provisions for social security payment and there have been suggestions that these costs be paid out through dole payment to those who cannot afford. Those who oppose this suggestion argue that such an approach is not satisfactory because the actual costs vary greatly from region to region whereas social security payments are determined at the national level and tend to be uniform across regions, and cannot account for the real need of an individual. They suggest other ways of paying for such utilities which would account for the variability of costs. In countries where there is no dole payment such as India, free water is provided to slum dwellers for example through stand posts, and full cost recovery is attempted through increased block-rate pricing of water supply (Majumdar and Gupta 2007). Full cost recovery not only makes economic sense but it also makes social sense (Bithas 2008) because many nations owing to fiscal limitations are unable to replace ageing water infrastructure and meet increased water supply costs of growing population. There are numerous examples where people's basic water needs are unmet (Majumdar and Gupta 2007; Salman et al. 2008) because of the fiscal limitations. In Dhaka, Bangladesh for example water gets into many households in trickles and it needs to be boiled for drinking purposes because of the contamination from leaked pipes.

When the context is extended from citizens to communities, social equity implies providing equitable share of water resources and ancillary amenities to different sectors of economic activity such as agriculture, fishery, industry, et cetera so that no segment of the population is disadvantaged more than others both at intrageneration and intergeneration levels. There are goals and priorities in societies, which should no doubt be reflected in the allocation of the water resources, but if a segment of the population is disadvantaged due to a project, it should be adequately compensated or alternative strategies should be devised such that the disadvantaged community can continue its sustenance in undiminished ways. A top-down approach is not the right way to achieve this as has been proven time and again, rather community consultation is a necessary step to find the right ways (Kangas and Palme 2009). Where the influence of a project straddles an international border external financial agencies support the principles of good faith negotiations between riparian States (§ (7)).

When it comes to application, social equity implies involving all communities including the poor and the vulnerable in the decision-making process (Cai 2008). Mata-Lima (2009) states that, in order to minimize negative effects, it is imperative to incorporate public participation into all stages of the decision-making process; all stakeholders—including project operators, government agencies and members of the local community—must work together; and all must be provided with equal access to information and opportunities for participation. History tells us that this has not been the case often especially in developing countries—the weak had been ignored in many project planning. There are examples where attempts to involve communities entailed political lobbying and the groups with high political clout often dictated the terms (Fadlelmawla 2008). Even in the US, Deason et al. (2001) demonstrate that until recently major philosophical and legal underpinnings of water policies were expressions of the goals and aspirations only of those constituencies who exercised

the greatest control over the law and policy process. The primary deterrent of full engagement as reflected in past experiences is that it is at best a challenging if not a very drawn out process to engage all communities to participate fully, and as Petts (2008) states that there is no 'holy grail' to gain public trust, though deliberate engagement of the public has emerged as the right thing to do. Kangas and Palme (2009) state that grassroots participation helps to create and fortify a general feeling of inclusion and belonging resulting in the creation of a 'virtuous circle'.

The UK Parliamentary Office of Science and Technology (Kass et al. 2001) reviewed recent developments in public dialogue and recommended 'dialogue' where people are brought together in small groups to deliberate on national or local issues in addition to more common forms of consultation such as written questionnaires, interviewer opinion polls and invitations for written submissions. DDP states "there are some excellent regulatory frameworks on which to ground stakeholder participation and there is a wide range of cost-effective techniques for engaging the community to improve decisions," but "these techniques are not being widely or consistently applied, either globally or within all stages of dam projects," and it provides exemplars of stakeholder mapping, spectrum of public participation, and the core values of the International Association of Public Participation (IAP2). Furthermore, WCD emphasizes that gaining public acceptance emerges from recognizing rights, addressing risks, and safeguarding the entitlements of all groups of affected people, particularly indigenous and tribal peoples, women and other vulnerable groups (§ (1)). Moreover, successful mitigation, resettlement and development are fundamental commitments and responsibilities of the State and the developer; and they bear the onus to satisfy all affected people that moving from their current context and resources will improve their livelihood (§ (5)).

Social equity is difficult to measure. The Brundtland Report (WCED 1987) brought social equity into international prominence by identifying the persistence of global poverty alongside material abundance and pointed that it is a moral imperative to share the fruits of development within and between economies, to ensure that those less well-endowed are offered more equitable access. Since then a measurable concept that has evolved is 'social capital'. Moldan et al. (1997, p. 256) define social capital as "the ability of people to work together for common purposes in groups and organisations", which includes "features of social organisation, such as networks, norms and social trust, that facilitate coordination and cooperation for mutual benefit".

4 Environmental Sustainability

Environmental sustainability can be defined as the situation in which vital environmental functions are safeguarded for the future generations (Hueting 2009). In the early days when people became conscious of the environment, environmental sustainability implied maintaining physical and chemical pollution of natural water bodies within acceptable limits so as not to degrade the environment, and keep it suitable for the future generation to use. It soon was realized that this definition is inadequate because there are other aspects than contamination in water that can adversely affect the environment. For example, low discharges in rivers or high water table in groundwater can seriously impact the natural environment

without any degradation of physical and chemical properties of the water. Nowadays environmental sustainability embraces ecology, and many nations have articulated environmental goals expressed in laws and policies such as the US Federal Water Pollution Control Act or 'Clean Water Act' (CWA), the European Union's Water Framework Directive (WFD), and Australia's Water Reform Framework. CWA provides the long-term national objective to "restore and maintain the chemical, physical and biological integrity of the Nation's waters" but does not go far enough to define components, attributes or indicators (Davies and Jackson 2006). Despite the United Nations' best efforts after the Earth Summit in Rio de Janeiro in 1992, there is no universal agreement as to what the environmental indicators should be—the matter remains a very complex issue. One of the key concepts in deciding on the environmental indicators is the 'reference condition' or benchmarking to which direction the indicators should show improved performance in the evaluation of a project proposal. Reference condition is important because it creates clearly defined goals and objectives by which the success of a project can be measured (Trowbridge 2007). The WFD defines reference condition in terms of "no or minimal anthropogenic stress" and satisfying the requirements: (1) reflecting undisturbed conditions for hydromorphological elements, general physicochemical elements, and biological quality elements; (2) having concentrations of specific synthetic pollutants close to zero or below the limit of detection of advanced analytical techniques in general use; and (3) exhibiting concentrations of specific nonsynthetic pollutants within the range normally associated with background levels (Stoddard et al. 2006). The oft cited and debated reference to target 'undisturbed' or 'pristine' condition warrants some explanation. Throughout history human beings have altered nature, and additionally since the beginning of the industrial revolution, anthropogenic forcing has contributed to climate change so that no part of the world with human presence is really undisturbed (IPCC 2007). The world is changing irreversibly, and to attempt to go back, which may not necessarily be a desirable outcome, would at best be a costly exercise if not impossible (Trowbridge 2007). Realizing this reality, some experts choose as reference condition sampling sites which are considered "the best from what's left" and others use multiple definitions to delineate pre-intensive agriculture era, least disturbed condition, best attainable condition, etc. (Stoddard et al. 2006).

It is relatively easy to set physical and chemical environmental quality standards based on properties of water that can be measured, but preservation of biodiversity can be a much more challenging task to quantify. An attempt is made here by the author to address the latter. Let us consider a set of focal species (or bio-indicators of environmental quality) for a particular region, which need not be very many because as Mangel et al. (2006) point out that not all species are essential or of particular concern for conservation. Figure 2 has been constructed to depict the relationship between health of the matrix of species (or a biological index score) as a distribution against the degree of alteration in habitat that could occur through a project. The conditions between a and b are acceptable, and the pre-project condition if acceptable, could reside anywhere between a and b. The regions between ac and bd capture the resiliency of the ecosystem and implies that the ecosystem would be under stress but can recover to normalcy when suitable environment returns. Outside the zone c to d there is permanent damage from which the ecosystem cannot recover fully. Determination of the locations of the points a, b, c, and d requires expert knowledge and significant amount of data collection and analysis. The shape of the

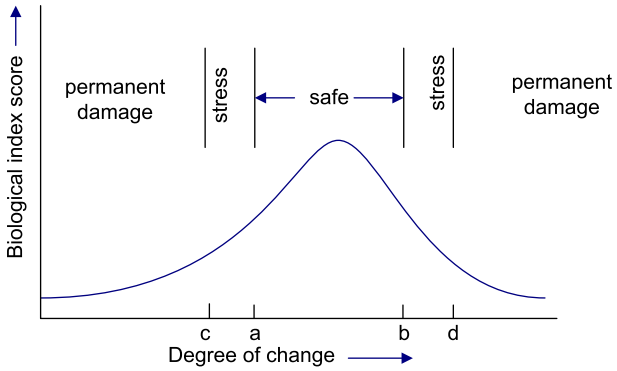

Fig. 2 Response of the health of a matrix of bio-indicator species (biological index score) to the increases in the value of parameters that define the eco-system (degree of change)

curve is derived from studies such as by Huston (2005), Kadmon et al. (2003), Wintle and Bardos (2006), Davies and Jackson (2006), and Bowman et al. (2006). These authors from field investigations established different sections of the curve.

The author further proposes that the region *a* to *b* should be the reference condition taking into account process and observational uncertainties. The important hypothesis intended to be established through Fig. 2 is that the 'reference condition' should not be a fixed point in an ecological response curve, but rather it should be a domain or range of values where we should not have any preferences. Support for this view can be found in the works of Stoddard et al. (2006) from which we can infer that there should be considerable leeway based on prudent scientific judgment to alter the environment. This should however not be used as a compromise of the principle of avoiding impact through good site selection and project design as the top priority (§ (4)). Lind (1997) argues that the future generation is expected to be better equipped to handle the environmental problems than us, and accepting his argument the domain can actually be expanded to extend from *c* to *d*. The only causes of deviation from this hypothesis can be the presence of EVR (Endangered, vulnerable and rare) species and legislations.The presence of EVR species would require construction of separate ecological response curves because few species benefit from efforts directed at rare species owing to their restricted distribution and idiosyncratic habitat needs (Possingham et al. 2002). Nevertheless, Pearman et al. (2006) suggests a methodology which can be used to integrate the ecological response curves. In such a situation, it is also worthwhile to investigate why is the species endangered, and whether the dynamics that contributed to the species' imperilment still persist. If the risks are there, it may be desirable to adopt adaptive management strategies (Rout et al. 2009) which may call for translocation or changes in environment where a water resources project can be beneficial rather than disruptive for the habitation of the EVR species. To make analytical use of Fig. 2, field surveys are required to establish the values of the points *a*, *b*, *c*, and *d*.

5 Traveston Crossing Dam Project

Traveston Crossing Dam (TCD) project is a large dam project proposed on the Mary River in southeast Queensland, Australia. A map of the Mary River catchment

showing the proposed dam site is given in Fig. 3. TCD project is an example of the intense scrutiny that any major water resources project proposal has to go through these days and the very many hurdles that a proposal has to overcome to reach fruition — perhaps all fully justified nevertheless. The construction of the

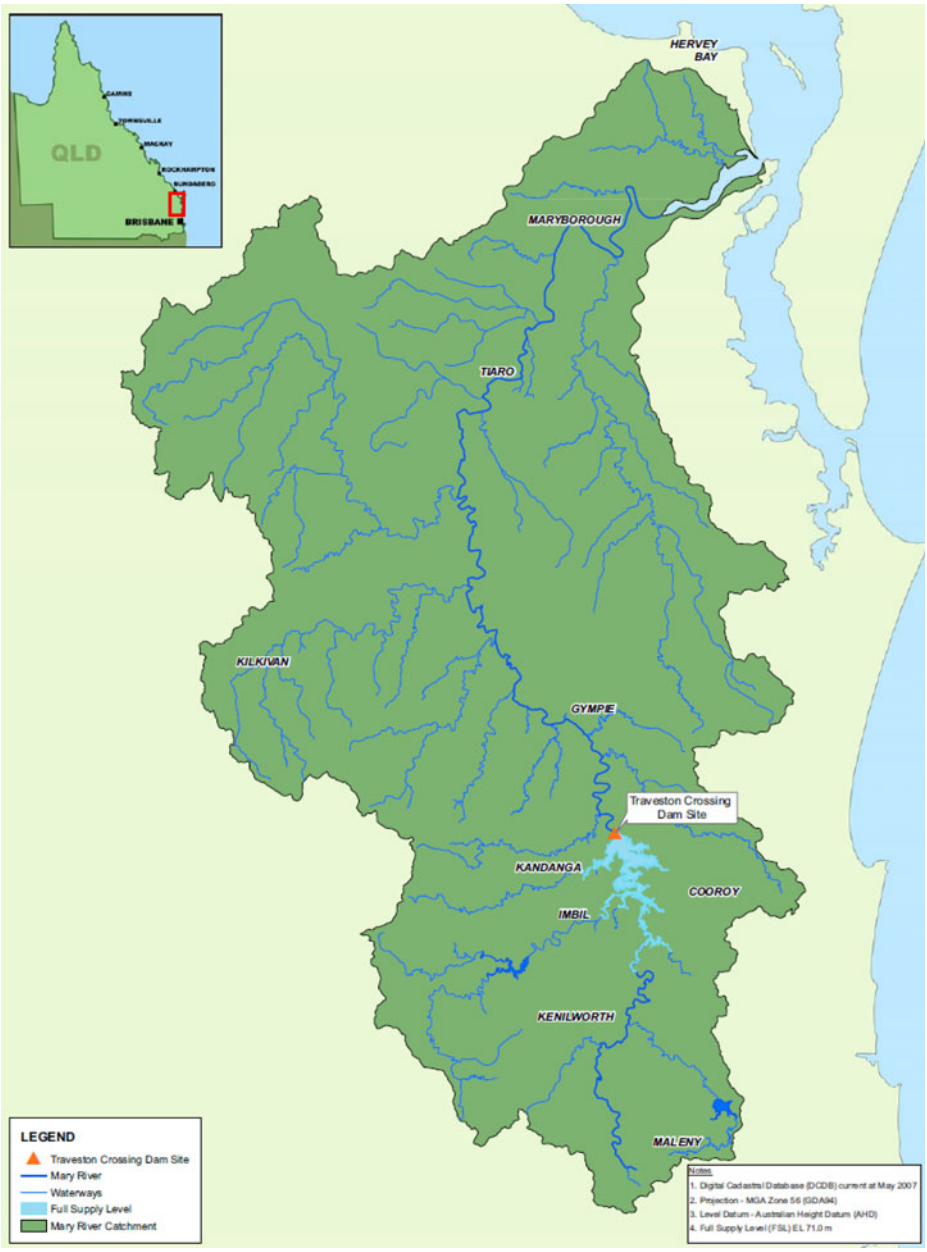

Fig. 3 The Mary River catchment and the Traveston Crossing Dam site

dam is facing opposition but the Government of Queensland contends that it has done the right things and the project should go ahead. The information presented in this section is obtained mostly from the websites of Queensland government (www.dip.qld.gov.au), Environmental Impact Statement (EIS) on public display by QWI, and local council bulletins.

In Queensland, the majority of development assessment and approval processes of major projects occur through the Integrated Development Assessment System (IDAS) established under the Integrated Planning Act 1997. IDAS requires consultation with relevant government agencies and public notification along with meeting the requirements of the Federal government's Environment Protection and Biodiversity Conservation Act 1999 (EPBC) and the State government's State Development and Public Works Organization Act 1971 (SDPWO). SDPWO Regulation 1999 under a bilateral agreement between the Federal and State governments is accepted to include EPBC Act and exempt a 'significant project' from further assessment by the relevant local governments. To meet the legal requirements TCD project proposal needed to address the following issues:

- Description of the need for the project, nature of the project, and its potential environmental, social and economic impacts both beneficial and adverse;
- Comparison with alternative projects including the option of no action;
- Assessment of the significance of potential environmental, social and economic impacts along with proposal of acceptable standards and levels of impacts;
- Suggestion of measures to mitigate or avoid any significant adverse impacts;
- Description of the outcomes of consultation with the stakeholders about the project; and
- Reporting of submissions from the public and referral agencies obtained after public display of the proposal for a reasonable length of time.

The planning phase of the project adopted the best practices that are known in the industry with comprehensive options assessment (§ (2)), and from a planning perspective the following considerations were accounted for:

5.1 Economic Development Considerations

The TCD project was conceived by the desperate need to find water for over a million people of the city of Brisbane when the worst drought in 100 years prevailed in southeast Queensland. Surface storage reservoirs that supplied the city were less than 20% full. The urban and industrial water requirement was to the tune of 480 billion litres per year but the region's 19 surface water storages and some groundwater could provide only a prudent yield of 440 billion litres per year. Even with a high water saving scenario of 230 l per person per day and moderate population growth, year 2026 urban and industrial water requirement was projected to be 520 billion litres per year (QWI 2009). To fill the gap, a number of feasible alternatives was identified in accordance with WCD's comprehensive options assessment (§ (2)). Initially a cost–benefit analysis which included no action yielded top five alternatives, which are listed in Table 1 along with their net present values (NPVs). The discount rate used to calculate the NPVs is 4%. The TCD project came out at the top of all the alternatives from the cost–benefit analysis. The project capital costs included dam construction, roads, power and telecommunication relocations, land acquisitions,

Table 1 Present value cost estimates in million dollars (Australian) of water supply portfolios for southeast Queensland, 2007–2056 (QWI 2009)

	Traveston Crossing Dam	Desalination plants	Mary River series of small dams	NSW dam + Wyaralong	Small dams in several catchments
Total capital expenditure	7,364	7,173	8,087	7,684	7,898
Fixed operating costs	1,589	1,887	1,827	1,747	1,963
Variable operating costs	737	949	817	910	839
Total cost	9,690	10,008	10,731	10,341	10,700
Difference in total cost from TCD	Benchmark	+318	+1,040	+651	+1,009
Ranking	1st	2nd	5th	3rd	4th

connection pipelines to the Northern Pipeline Interconnector, pumping stations and water treatment plant, mitigation costs, and risk and contingency costs. The project proposal claimed that the dam would contribute $244 million to real Gross Regional Product and would create 1,750 jobs during construction and about 780 jobs once fully operational. Through implementation of the project, the proposal further claimed, losses of 20,000 jobs and $3.895 billion to southeast Queensland economy can be avoided by more secure provision of water.

The dam site is in a coastal rainfall catchment (Mary Valley) of about 2,100 km^2 area 160 km north of Brisbane (26.3354° S, 152.7090° E). Mary Valley is a hydrologically efficient catchment which receives up to 55% more rain on average per year than the Wivenhoe Dam catchment, which is the principal source of water for Brisbane. The site was chosen after a comprehensive review of 80 potential sites across southeast Queensland. The review established that no other site could provide water in similar sustainable quantities. It was anticipated the project would to yield 70 billion litres per year (in Stage 1) with a reservoir capacity of 153 billion litres. The second best option with similar yield was desalination plant which would require lower capital expenditure but more operating cost. A criticism associated with desalination plants is that they are essentially single purpose projects in contrast to dams which are multipurpose. Desalination plants also consume more power and create more waste than surface supply options. Furthermore, the proposed desalination plant would require costly maintenance works every several years whereas the proposed dam would operate without maintenance for hundreds of years because the sediment load in inflow streams would fill the reservoir only at the rate of 0.15 cm/year (QWI 2009).

5.2 Social Equity Considerations

The project planning addressed social equity considerations from several fronts. SIA (Social Impact Assessment) was made through consultation with different community representatives, survey of residents in affected regions, workshops and information sessions in different towns in addition to collecting data available with government bodies. Formal structures to conduct public dialogue as is alluded to in

the report by UK Parliamentary Office of Science and Technology (Kass et al. 2001) does not exist in Queensland but Queensland Government has gained experience through Wivenhoe Dam project of best practice which has been cited in DDP detailing the methods which has also been applied to TCD project. The project plan includes use of rural land in Mary Valley which has for many years been used for grazing, dairy and crop production. Sixty percent of the local population, who would see 3,039 ha of picturesque countryside inundated affecting 334 properties and loss of 76 dwellings, objected to the project. A map showing the properties that would be affected by the proposed project is given in Fig. 4, wherein land use primarily are intensive animal production (predominantly dairying) 48.4%, grazing 29.5%, water body 10.2%, cropping 4.2%, and rural residential 1.9%. The Australian Land Use and Management (ALUM) system is used here to describe land use. The Community concerns in addition to environmental concerns were (1) loss of 'good farming land'; (2) unemployment especially in diary industry; (3) impact on local businesses that supply and receive goods and services from rural uses (i.e. rural supply stores, equipment suppliers, mechanic); (4) displacement of farming families, some of which have lived in the Mary Valley for several generations; (5) difficulty for some farmers in getting work elsewhere or in alternative industries; (6) loss of areas rural heritage, relating to agricultural and timber industries; (7) potential increases in prices of produce, particularly milk and dairy products; and (8) loss of opportunity for those who seek 'tree-change'.

As outcome of the consultative process and to allay community concerns the project adopted the following: (1) voluntary purchase of land at market value and leaseback to owners with some restrictions on use such that the water quality in the reservoir does not degrade to unacceptable standards (85% of land has already been purchased according to ABC News posted on 26 April 2009. http://www.abc.net.au/news/stories/2009/04/26/2552803.htm. Accessed on 12 September 2009); (2) support community networks through funding and in-kind assistance in initiatives by incorporated community, sporting, recreation, education and cultural groups; (3) constitute Worker Assistance Program (WAS) which would provide access to training, job preparation, relocation, and wage subsidy assistance for eligible workers who have lost their jobs as a result of the planning or implementation of the project; (4) business disturbance payment paid directly to affected businesses, and constitute Business Assistance Scheme (BAS) for businesses indirectly affected that would assist in development and implementation of strategies to improve their ongoing viability; and (5) capacity building through assistance, research and development, subsidies, field trials, farm management education and training, and workshops.

5.3 Environmental Sustainability Considerations

Environmental considerations stemmed primarily from the facts that the dam would inundate 3,039 ha of land, divert 4% of annual flow of Mary river's 2,300 trillion litres of average annual flow in addition to 6% of existing water entitlements, interfere with terrestrial and aquatic flora and fauna, and require diversion of a major highway (Bruce Highway). The controlling provisions of EPBC were world and national heritage, Ramsar wetlands, listed threatened species and communities, and listed migratory species. The core objective of environmental sustainability comprised of

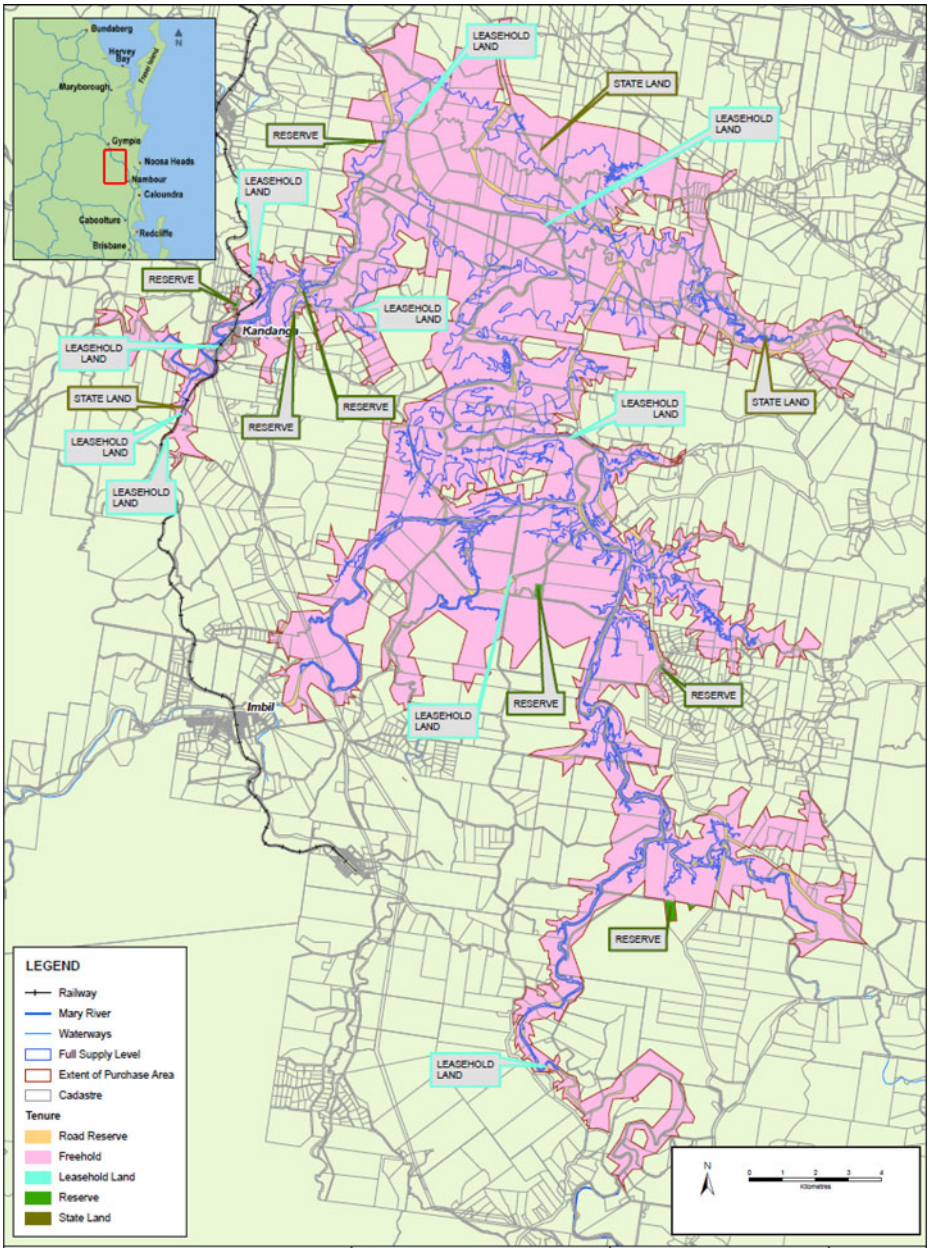

Fig. 4 A map showing the properties that would be affected by the proposed Traveston Crossing Dam project

protecting biodiversity and maintaining essential ecological processes and life support systems. However, the terrestrial and aquatic environment in the Mary Valley is far from pristine—it has been for quite sometime a highly disturbed catchment

heavily impacted by human activity. The catchment experienced substantial clearing for agricultural and forestry purposes (85% of the inundation area has already been cleared for agriculture and pasture) and have a substantially diminished riparian zone with exotic species, including weeds and noxious plants. The river system has been significantly impacted by sand and gravel extraction, agricultural and urban runoff, and carried significantly more sediment to the Great Sandy Straits (a Ramsar wetland) than pre-European settlement time (QWI 2009).

The high nature-value terrestrial flora identified in the project area were silky milkvine and giant ironwood. According to a CSIRO study (2006) the impact on silky milkvine would not be significant because directly affected population would be small and mitigation measure can be adopted through establishment of ex situ population by translocation. No mitigation measure is suggested for giant ironwood because the loss would occur only in the inundated area which is small compared to the extent of their growth area. Seven EVR (endangered, vulnerable or rare) native fauna species were identified in the area, which included tusked frog, giant barred frog, elf skink, challenger skink, grey goshawk, cotton pigmy-goose, and koala. The combined strategies of rehabilitation of riparian areas for frog habitat, creation of island refuges, re-vegetation of disturbed areas, retention of habitat logs and branches, weed and pest control, provision of vegetation management offsets to promote vegetation connectivity, and installation of fauna friendly road crossing should be adequate to mitigate any adverse impacts of the project according to the CSIRO study.

Regarding aquatic ecology, a healthy macrophyte community is considered a positive ecological attribute (Engelhardt 2006). Assessment indicated that the shape of the dam, good sediment base and elevated nutrient levels would foster abundant mixed submerged macrophyte and fringing/emergent vegetation in shallow areas of the dam. The EVR aquatic fauna identified were Mary River cod, Queensland lungfish, and Mary River turtle. Maintaining environmental flows in downstream channel, construction of fishway and turtle ramp, would ensure a healthy population. Turtle nest banks would be inundated, but those can be relocated recreating nesting and habitat requirements. However, to address the concerns of the environmentalists, the project proposal included the construction of a $35 million world-class Freshwater Species Conservation Centre to be operated by The University of Queensland.

5.4 Compliance with Legislation

WCD (§ (6)) recommends compliance with all applicable regulations at all critical stages in project planning and implementation. Construction of the TCD project would take 3 years, which includes mobilization, pre-construction works, and all infrastructure relocation. During the construction phase it is imperative that due care is taken in managing of construction sites, air quality, noise and vibration, and waste disposal (QWI 2009). There are quite a few legislations applicable in managing of construction sites which are captured in the *Guidelines for Queensland Construction Sites* (a compilation of publications from different agencies of the Queensland government) which dictates measures such as rapid revegetation of disturbed sites, controlling runoff through sedimentation dams, bunding stockpiled material, confining traffic to defined roads, etc. Air quality provisions include adopt-

Table 2 SWOT analysis at a glance of the Traveston Crossing Dam project proposal

Strengths	Weaknesses	Opportunities	Threats
Development of the project included WCD and DDP recommendations and known industry best practices	Cost–benefit analysis did not include benefits that would occur in the absence of the project	Additional funds would be invested into local economy, which should see economic growth	Dairy and timber industries in the locality may face demise
Economic analysis favoured the project	A powerful section of the community though minority remained unconvinced	Tourism industry likely to flourish	People with many years of experience in the diary and timber industries may not find employment elsewhere
Best practices for social consultation were adopted	Environmental sustainability aspect remained unproven in few issues. Adverse environmental mitigation measures could not be argued to be effective with reasonable certainty	Additional clubs and sporting grounds are likely to enhance social cohesion	Environmental damage can be irreversible unless rigorous study can establish reasonable certainty
A reputable institution CSIRO was engaged to study environmental sustainability. Their recommendations were adopted	Population displacement and loss of rural heritage are unavoidable	Diversification of economy and skills of local people is expected	Loss of 'tree-change' opportunity

ing the performance criteria of limiting PM_{10}(24-h average) to 50 $\mu g/m^3$, notifying community prior to work, adaptive management of community complaints, etc. Noise and vibration considerations include maximization of shielding and distance from sensitive areas, limiting noise levels to 55 dB(A) during day and evening and to 52 dB(A) during night, peak particle velocity to 10 m/s for any blast, peak air blast overpressure to 120 dB(linear), etc. Waste management considerations include implementation of waste management principles RRR (Reduce, Re-use, Recycle), management of regulated wastes (collection, transport, tracking, treatment and disposal) in accordance with EPA guidelines, transport of waste material to occur only during designated hours, etc. The EIS of the project stated that TCD project would adhere to all the guidelines for Queensland Construction Sites.

During both construction and operation phases the project would not impact directly on any area of conservation significance such as National Parks, State Forests, designated wildlife corridors, or areas of scientific importance. WCD (§ (1)) recommends safeguarding the entitlements of all groups of affected people, particularly indigenous and tribal peoples. From that consideration there are no native title

claims on the project area. There was one registered claim, Gubbi Gubbi People #2 (Queensland Courts ref: QC99/35, QUD 6034/99) which was voluntarily withdrawn in February 2005.

Strengths, weaknesses, opportunities, and threats (SWOT) analysis of the TCD project proposal at a glance are captured in Table 2.

6 Assessment of Planning Strategies

Economic development, social equity, and environmental sustainability should overarch the planning strategies for large dams which forms the foundation of WCD and DDP reports and has been supported in many international conventions and consultative processes that involved experts from many nations. The broad implications of these three criteria have been presented earlier in this paper. A critique in the context of TCD project follows. It is not the intention of this paper to try to dictate what should be the official standards but rather propose practical approaches needed and best practices that emerge correspondingly. Although the Premier of Queensland Anna Bligh has been sanguine that the TCD project will eventually go ahead (published in The Australian of 10 July 2009, http://www.theaustralian.news.com.au/story/0,25197,25226667-5006786,00.html. Accessed on 12 September 2009), it has an uncertain future. In the process of delving the reasons that are causing hindrance to the project's implementation, identification of the deficiencies that may exist in a large dam project proposal is made and where appropriate suggestions for improvement are proposed.

6.1 On Economic Development

The economic criterion that is used for the justification of a project is the cost–benefit analysis. On surface, it is an intuitive, easily comprehensible, and outright appealing analytical tool. In reality it is lacking in many ways. History shows that dam projects commonly do not allow full cost recovery, and consistently inflate the benefits (Mata-Lima 2009). One of the reasons for an inflated value is its failure to account for the economic development that would occur in the absence of the project. Thus the net benefit claimed by the cost–benefit analysis when post-project scenario is compared with pre-project scenario would actually be less than when with and without project scenarios are compared in one time frame. Another deficiency of the tool is its lack of multiobjective dimensionality. Experience has demonstrated that regional advantages promised by dam projects do not materialize in most cases since jobs created are filled by outside workers rather than by members of the local community, and the projected economic growth does not occur (WCD 2000). Cost–benefit analysis cannot separate different sectors of economy from global economy and fail to demonstrate to a specific community what benefits are there for them. The need for the development of an appropriate econometric analytical tool or revision of the cost–benefit analysis tool highlighted by these deficiencies is reflected in TCD experience. TCD experience demonstrates that people in general no longer have much confidence in cost–benefit analysis results, obvious from the fact that they were not swayed much by the rosy economic picture in spite of rather urgent need of an economic boost for the region. The independent review of federally performed cost–

benefit analyses being mandated by the US Water Resources Development Act 2007 (US Congress 2007, section 2034) and revisions to the 1983 Principles and Guidelines are long overdue (Griffin 2008). There is an expectation that a lead should come from the US or the European Union in this regard. Considerable good research exist in published literature on the topic (Shah and Kumar 2008), governments have to translate those into policies.

6.2 On Social Equity

As much as economic benefits are over-emphasized for large dam projects social equity is under-emphasized with similar culpability especially for least developed nations. Social equity is about building trust between government and regulatory bodies with the public. This is a long process especially if there are outstanding social issues, but inclusiveness of community members in decision-making process is essential. Social acceptance of a dam project would have higher chances and negative impacts minimized if community inclusion is adopted during all phases of a project proposal development. However, an unavoidable element in any democratic society is the presence of a section of the public who would always harbour mistrust of the government and its instruments, and manifestly so for an irreversible project such as a major dam (anecdotal evidence cited in Queensland Water Infrastructue Website http://www.qldwi.com.au/TravestonCrossingDam.aspx. Accessed on 9 September 2009). What transpired from public dialogue is that, due to lack of understanding of the complexities associated with a large dam project, many people believe that the safe strategy to resolve uncertainty and perceived threats to security and local values is not to proceed with the project. As pointed out in Report 153 of Parliamentary Office of Science and Technology (Kass et al. 2001) there are "no one, homogeneous public" rather "multiple publics holding a wide variety of divergent views", and therefore, convincing the public can be a frustratingly difficult task, but the alternatives can be costly. Evidence of violent social unrest leading to civil war due to lack of proper community engagement can be found in the case of Kaptai and Ataturk dams (Parveen and Faisal 2002). Kaptai dam was built in Bangladesh without consulting the Chakma tribal population and 100,000 people were displaced. This resulted in a civil war that lasted for 22 years. For Ataturk dam 60,000 Kurdish people were displaced which saw the rise of PKK, a guerilla group that is still fighting the Turkish army. The Itoiz dam of Spain reveals another dimension. Although the dam proposal had unanimous support of all political parties and enacted in Spanish Law 22/1977, failure to properly engage the residents of nine villages that would be inundated resulted in legal rigmarole that is draining government funds and the court proceedings are delaying work many years beyond the expected completion date. TCD project took the right steps in this direction by following the guidelines of the *Aarhus Convention* (UN Economic Commission for Europe 1998) and promising to retain social capital by promoting sporting, social, educational, and cultural groups. However, it encountered another problem that it failed to foresee which is described in the following paragraph.

TCD is proposed at a site which possesses exquisite natural beauty, as is often the case elsewhere in the world with dam project sites. Many city dwellers moved to the site for life-style change. These people genuinely resent what they consider as violation of mother nature. If relocation of such population to alternative acceptable

similar sites is not given consideration the socio-political forces that this section of the community can generate can be enormous. The magnitude of the strength of this socio-political force can be gauged from the fact that the local Member of Parliament, Cate Molloy, who belonged to the Labor government quit her party and joined the group protesting the TCD project. This section of the community is usually not the weak, and addressing their grievances can be an expensive proposition. Many issues of the TCD project were raised in State and Federal Parliaments and strong lobbying made almost all Members of Parliament and Senators take a closer look at the project. Such scrutiny with a dam project is unprecedented in Australia and posed many hurdles which the government had to cross. The Queensland election of 2009 showed that the opinion of this group, though very powerful, is not the reflection of that of the majority as is evidenced from the fact that the Labor government was returned to power in spite of the opposition LN party's promise to stop the dam. However, it may be a concern for the developed world only. Tilt et al. (2009) mentions about SIA for projects in Southern Africa, China, India, and Guatemala, and identifies Lesotho Highlands Water Project and China's Manwan Dam as ranked among the most contentious in recent history. Their detailed social survey did not capture such concerns.

6.3 On Environmental Sustainability

Sustainability is a concept easily understood but difficult to define and capture precisely in a project proposal. Bell and Morse (1999) argue that we may never have an exhaustive definition of sustainability. It is like trying to define truth and justice. We all want truth and justice, but justice to one may be exploitation to another. Kidd (1992) state: "there is not, and should not be, any single definition of sustainability that is more logical and productive than other definitions." Due to this vagueness in the definition of sustainability in general and environmental sustainability in particular, perhaps, there would always be a group of environmental activists who would oppose a large dam project. The Australian Conservation Foundation embarked on a vigorous campaign stating that the TCD project would negatively impact endangered and vulnerable species (the Foundation's website http://www.acfonline.org.au/articles/news.asp?news_id=2097 accessed on 8 September 2009). An independent expert Professor Keith Walker, called on by Federal Environment Minister Peter Garrett, stated that "mitigation and offset strategies (in the project proposal) such as the Freshwater Species Conservation Centre were inadequate, risky and ill-defined and the fish and turtle ladders were unproven." (Published in The Brisbane Times on 26 November 2008. http://www.brisbanetimes.com.au/news/queensland/breport-to-garrett-says-dam-species-will-dieb/2008/11/26/1227491610440.html. Accessed on 13 September 2009). This goes to show that even the experts can be divided in their opinion. Professor Keith Walker's comments are a reflection of the opinion that environment should not be altered unless it can be enhanced in proven ways, and he is opposed to the concept of environmental sustainability as captured in Fig. 2. This raises the need for an open threadbare scientific debate on the issue and major societies like The Ecological Society of America (ESA) should take an appropriate stance that can guide the rest of the world—similar to what NOAA did about speculation of hurricane frequency and intensity increasing with global warming (Holland and Webster 2007).

Even if ESA takes a stance in favour of a position similar to Fig. 2, critics may still argue that there are not very many basins of the world where an ecosystem response curve like that of Fig. 2 can be delineated. Most streams are not gauged. Nations especially developing countries may not have adequate budget or time for such an ecological investigation. Fortunately, there is a partial response that exists to this criticism. Many ecologically based stream classifications have been developed worldwide, including in the US, Australia , and New Zealand and they have been studied in detail (Arthington et al. 2006). Each stream class differs from another in its hydrologic variability and ecosystem diversity, and once a stream class has been identified, the ecosystem response curve that is developed for a basin can be transferred to a similar basin (Arthington et al. 2006) as long as there are no high nature-value species unique to the basin and the basin does not constitute the habitat of an endangered species. For the ecosystem response curve to be used effectively, it is essential that project operation and management strategies be in-built in the planning phase of the project so that the curve's domain can be accurately captured. Advances in ecological study methods in the past few years have been so rapid that it is no longer a very expensive proposition to perform a thorough ecological investigation to convince those who believe environmental flows cannot be translated and each basin has unique political/normative criterion concerning the maximum level of alteration that a community accepts.

6.4 Other Considerations

There is increasing awareness about the environment amongst the public these days. Australia is no exception which can be evidenced from the fact that the Greens political party now occupies the highest number of seats in the Senate in the history of Australia. Greens' leader Senator Bob Brown "said the dam (TCD) should be opposed because it would flood thousands of hectares of prime food producing land near Brisbane, Aboriginal heritage sites and the main nursery for the world famous Australian Lungfish. I've told the minister there is no way he should allow the major breeding ground for the Queensland Lungfish or the Mary River Turtle, or Mary River Cod, to be obliterated". (Published in National Indigenous Times, Australia on 6 September 2008. http://www.nit.com.au/breakingNews/story.aspx?id=15976. Accessed on 13 September 2009). Perhaps the overriding factors which accelerated the awareness about the environment among the public are regular media coverage of global warming and unprecedented intensities of flood, drought and heat waves experienced throughout the world. The effects of the European summer of 2003 that killed between 22,000 and 35,000 people in heat wave and the winter 2001 flooding of England and Wales are described by van Aalst (2006) which transformed the opinion of European people. People are now more sensitive to any suggestion that the environment may be adversely affected. Politicians are reacting to this sensitivity and are changing their rhetoric to reflect environmental concerns. On November 27, 2008 the Australian Federal Senate passed a non-binding motion seeking to permanently stop the dam's construction. "The motion received the support of all of the Coalition, all of the Greens and the independent Senators in the Senate." (ABC news posted on 27 November 2008. http://www.abc.net.au/news/stories/2008/11/27/2430942.htm?section=justin. Accessed on 13 September 2009). It was a conscience vote which demonstrates the unprece-

dented scrutiny that the project faced, where each Senator of the Nation had to take a closer look at the project. How to champion a proposal for a large dam project through legislation in this age of growing environmental awareness can warrant adoption of innovative ways for any government. TCD project experience is yet another example of the effectiveness of such innovative ways. The groundswell of opposition to the project that existed just a year ago appears to be diminishing and a plausible explanation is that the Queensland government is projecting itself as an eco-friendly government by taking a few bold steps such as a recent moratorium on tree clearing and declaring many rivers as wild rivers in accordance with the *Wild Rivers Act* 2005 to protect rivers with especial heritage value from any development work.

Even if a large dam project demonstrably meets the criterion of environmental sustainability in public's perception, the project can still experience delays from actions of environmental activists which have been witnessed all over the world. Perhaps it is appropriate that provisions for such delays are incorporated in the project planning and costing. The 'Save the Mary River Coordinating Group' (http://www.savethemaryriver.com/. Accessed on 9 September 2009) which won an award in a Spanish environmental exhibition for its 'indefatigable' efforts is frequently organizing anti-dam campaigns against the TCD project. The group Solidari@s con Itoiz has disrupted construction work of Itoiz dam on many occasions by cutting cables and damaging construction equipments. The 'Narmada Bachao Andolan' is stalling the construction of Narmada dam in India (Khagram 2004). Khagram states that the power of the environmental activists should not be underestimated because we have seen evidence of that power between 1972 and 1983, when groups such as EPC/EPI and ARCC helped stop more than 100 large dams from being constructed in the US. Experience suggests that any government behoves vigilance such that any anti-dam campaign does not gather momentum. Two examples that are relevant in this context from the TCD project and rather proves the point are: the rumour about the construction work being started without the approval of the Federal government (http://www.savethemaryriver.com/forum/viewtopic.php?t=4265&sid=41fcf9017d5f5553c48cd849ce78f558 and also published in Sunshine Coast Daily, Australia on 14 November 2008. http://www.thedaily.com.au/news/2008/nov/14/traveston-dam-surveys-have-started/. Accessed on 12 September 2009) and the news that Mary river would be allowed to run dry downstream of TCD (http://www.thedaily.com.au/news/2008/aug/07/government-admits-traveston-dam-letter-mistake/. Accessed on 12 September 2009). Both the news caused quite a bit of stir in the community but the government was quick to quell any community concern by clarifying the matter in the media and in the parliament. The quick intervention by the government did not give the environmental activists the opportunity to capitalize.

7 Final Remarks

Economic motivation drove the construction of large dams in the past, and social and environmental considerations received little attention. These days without proper social and environmental considerations any large dam project proposal is likely to face stiff resistance and possible demise. The three criteria address entirely three different aspects in the society—in brief economic criterion aims at 'prosperity',

social equity at 'fairness' and environmental sustainability at 'quality of life for the future generation'. They are each very different yet very important and it is perhaps not ethical for an analyst or practitioner to prompt how to lump them together as one objective function where one is enhanced at the expense of another. It is a prerogative of the society (or a representative government that exercised due diligence) to decide whether to aggregate the decision variables in some way or, for example, to impose acceptable level of equity and lower bound on environmental sustainability, and maximize economic benefit. Social consultations should aim at inclusiveness of all communities in the affected region in the decision-making process. Concerns of all communities should be addressed in the context of cultural identities and values of the population. Environmental sustainability is easily understood but when it comes to application, the concept of environmental sustainability is still fraught with vagueness. If meaningful interpretations of environmental sustainability are not made that is comprehensible and acceptable by the society, a truly beneficial large dam project may not go ahead and citizens would be deprived of the genuine opportunities of prosperity that may arise through the implementation of the project. A modest attempt is made in this paper to diminish this vagueness. A working definition of environmental sustainability is presented. The constructed definition is a new contribution in this paper based on the findings of many researchers. Hopefully this contribution will find some beneficial use in future studies.

An important aspect that has been highlighted through the case study of Traveston Crossing Dam project is the need to revisit the cost–benefit analysis strategy. The review has been mandated by the US Water Resources Development Act 2007 but nothing has been done yet. Other nations are treating this as a moot question. The need is manifest in that the public's perception of benefits are significantly different from the government's interpretation of the benefits as can be witnessed from the fact that during community consultation process for TCD project support for the project remained at best subdued despite the much needed economic boost in the region.

Traveston Crossing Dam project experience further demonstrates that engagement of all sections of communities in the decision making process is the right thing to do. It is a difficult task especially to build trust among all sections of the communities, but in the long run the effort pays off. In other parts of the world where governments took short cuts to avoid such responsibility resulted in governments' paying a heavy price—examples abound such as Kaptai dam in Bangladesh, Ataturk dam in Turkey, and Lawpita dam in Burma. In fact, DDP notes that outstanding social issues "remain unresolved for a number of existing dams in all regions of the world. Dealing with such legacy is imperative if new undertakings are expected to gain the acceptance of the public." Whereas in Queensland the Labor government took in its stride the promise to build the dam in 2009 election, the opposition Liberal National party used as its ticket the promise of not building the dam. The Labor government was returned to power with a comfortable majority. People may oppose the project but they still have a trust in the government—thus the hypothesis proposed by Kangas and Palme (2009) of creation of 'virtuous circle' by engaging all communities stand verified at least in one example.

The opposition to any large dam project by environmental activists is universal. Even if a project proposal enjoys the support of the affected community and the government, the environmental activists will invariably disrupt the construction

works. This necessitates making provisions for delays in construction in the project proposal. There could be additional costs in policing and legal battles as has been observed with the Itoiz dam project in Spain. This would increase the cost estimate of a project and provisions should exist for cost overrun.

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