

# Social Capital and Climate Change

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## Abstract

Future climate change poses significant challenges for society, not least in terms of how best to adapt to the potential impacts to which the world is already committed. Adaptation is a dynamic social process and the ability of societies to adapt is determined in part by the ability to act collectively. This paper reviews emerging perspectives on social capital and collective action and argues that insights from these areas inform the nature of future adaptation capacity and direction. Case studies are presented of present day collective action for coping with weather extremes in coastal areas in South East Asia, and in community-based coastal management in the Caribbean to demonstrate the importance of social capital in these situations. It is argued that these cases illustrate by analogy the nature of adaptation processes and collective action in adapting to future climate change.

## Introduction

The impacts of observed and future climate change are and will be clearly spatially and socially differentiated. The impacts of future change will be felt on resource dependent communities and in a multitude of primary and secondary effects cascading through natural and social systems. A huge body of researchers have been exercised in assessing the consequences of climate change through creating and modelling future scenarios, through learning from past climate change, and through normative analyses of technological and other options for adaptation. Faced with the likelihood of significant warming in this century on a scale unprecedented in the era of modern human history (in the range of 1.4 to 5.8°C by 2100) (IPCC, 2001), and the associated changes in precipitation, sea level rise and extreme weather events, adaptation to such changes becomes a key question for all communities.

The world does not remain static, however, over the period of decades to centuries, and the impacts of climate change present a challenge to the sustainability and vulnerability of particular groups only in as much as it is a compounding factor of economic globalisation and other trends (O'Brien and Leichenko, 2000). Smit *et al.* (2000) and others argue that adaptation processes modify the danger associated with likely future impacts and that adaptation processes can be classified by who undertakes them, whether they are effective, and whether they are anticipative or reactive. In this paper I argue that societies have inherent capacities to adapt to climate change and that this adaptive capacity is bound up in the ability to act collectively. The greatest insights in the social sciences on how the ability to act collectively evolves, is distributed and is utilised comes from the growing interdisciplinary insights into social capital. Social capital is a term that has a catch-all feeling to it, with as many definitions of social capital as there are of sustainable development. At its core the concept encapsulates 'features of social organisation such as trust, norms and networks that can improve the efficiency of society by facilitating co-ordinated actions' (Putnam *et al.*, 1993, p. 167).

The methods available to assess the role that social capital plays in adaptation are diverse. The role that social capital, networks and state-civil society linkages play in adaptive capacity can be observed in historical and present day contexts by examining the institutions of resource management and collective action for climate-sensitive sectors and social groups. In effect, examining social capital becomes a 'reasoning by analogy' approach (Meyer *et al.*, 1998) while retaining a strong emphasis on the policy relevance of social capital formation in adapting to future climate change. In the main the analysis of social capital does not rely on modelling of future states and projecting social change scenarios onto these states. Even within a nuanced notion of the sustainability or global and local consequences of such future states (e.g. Lorenzoni *et al.*, 2000) social capital only becomes relevant in its prescription for institutional change.

This emphasis in social capital on phenomena such as trust and social norms differentiates these theories of adaptive capacity from the economic aspects of adaptive capacity which concentrate on the allocation of scarce resources – resources either held collectively and allocated and regulated by the institutions of government, or held individually and allocated through markets. But the apparent contrast between the lived experience of adaptive capacity and the top-down normative models of neo-classical economics are bridged within emerging insights into the operation of economic systems from the new institutional economics.

But the focus on social phenomena also moves the science of adaptation into territory where measurement, let alone quantification, is difficult. As Ostrom (1997, 2000) has pointed out, 'social capital is not as easy to find, see and measure as is physical capital' (Ostrom, 2000, p.180). Indeed the characteristics of social capital are unlike other forms of capital within the traditional economic typologies in that social capital does not depreciate with use, but rather with disuse and does not involve trade-offs between the future and the present. Arrow (2000) indeed argues that social capital, if it is to remain, should not be breathed in the same sentence as other forms of capital as understood by neo-classical economics. As

will be discussed below, the diverse emphases of social capital analysis lead to some quantifiable and some less-quantifiable phenomena.

The paper proceeds by outlining the major features and debates within the literature on social capital and highlights points of overlap and insights into adaptive capacity. Social capital analysis is diverse and spans work on community and the evolving nature of modern and post-materialist society, through to being more normative and oriented towards economic well-being. It is this latter emphasis, the domain of political scientists and economists, which is the most fruitful for those concerned with climate change and our ability to cope with it. The paper then follows with examples of adaptive capacity from existing studies of coping with climate extremes or managing vulnerable resources and draws out the social capital elements of these examples. These examples are from health research on coping with heat stress, institutional analysis of coping with weather extremes in coastal areas, and finally on co-management between state and non-state actors for coastal management.

## **An introduction to social capital**

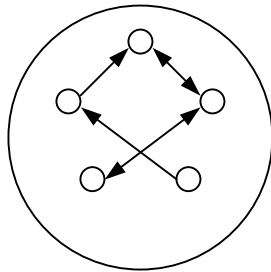
### *Networks as social capital*

As alluded to above, social capital is made up of ‘the norms and networks that enable people to act collectively’ (Woolcock and Narayan, 2000, p. 226). Although this is generally accepted, there are divergent views in two main areas – 1) whether social capital exists only outside the state and 2) whether social capital is a cause or simply a symptom of a progressive and perhaps flexible and adaptive society. Each of these controversies is important for understanding adaptive capacity for climate change. The first issue, on the importance of the state, relates to how important planned adaptation strategies can be. In other words, if governments can provide physical or regulatory infrastructure to minimise the potential impacts of floods or droughts, will this ever be sufficient for adaptation if its use does not resonate with social norms? The second issue of the macro-level functioning of society is again important for adaptive capacity and an area in which there are initial steps towards quantification of the role of social capital (Knack and Keefer, 1997).

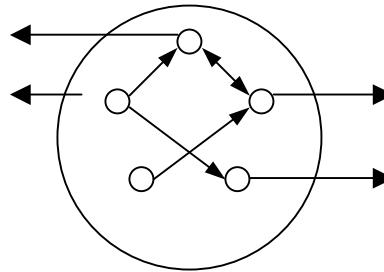
The underlying premise of the importance of social capital appears to have been bought into by a wide range of social science from anthropology to economics, and has an impetus through research on its role in economic development in developing countries (e.g. Dasgupta and Stiglitz, 2000). While the idea that social interaction oils the wheels of collective action is intuitively appealing, it is articulated in different ways by different disciplines. Research in diverse fields relates to the role of social capital in education, social exclusion, social psychology and the functioning of democracy (e.g. Putnam, 2000; Coleman, 2000). Only a subset is relevant to the climate change area, primarily the part of social capital research around economic development and well-being (reviewed in Woolcock and Narayan 2000; Woolcock, 1998). The premise of work in this area is that social capital is a necessary ‘glue’ for economic development, but the prevalence of different types of social capital are important at different times to different social groups.

**Figure 1 The circumstances when bonding and networking social capital are important for adaptive capacity**

Bonding social capital



Networking social capital



When important?

Low income and socially excluded groups  
When state provides social security

When important?

Dynamic mobile communities  
Managing collective resources  
Absence of state

In Figure 1 (left) social capital is shown as the arrows between individuals in a social group – the arrows represent the sharing of knowledge, sharing of financial risk, sharing of market information, or claims for reciprocity in times of crisis. Ties within a defined socio-economic group have come to be known as *bonding social capital* and may be based on family kinship and locality. By contrast Figure 1 (right) demonstrates *networking (or bridging) social capital* which is made up by the economic and other ties external to the group.

Networking social capital tends to be less based on friendship and kinship, but on the weaker bonds of trust and reciprocity. Hence networking social capital has less formal collective action rules of enforcement and sanction and becomes increasingly reliant on legal and formal institutions. Putnam *et al.* (1993) argue that the relative economic performance of regions in Italy in the preceding decades could be attributed to the density of social capital. This they measured through examining regional historical records of participation in civil society institutions such as church, political parties and other indicators. In effect, they examined the presence of networking social capital and to a lesser degree on bonding social capital and argued that this played a part in explaining regional differences in economic growth, employment levels and other economic indicators even though the social capital itself emerges for reasons other than to promote development.

For agricultural traders in Madagascar, Malawi and Benin, Fafchamps and Minten (2001) have shown that presence of high levels of social capital in itself increases the effectiveness and output of traders because their networks minimise transaction costs by speeding up search, increasing trust and facilitating the circulation of information. But, further, they show the origins of such social capital. Some is inherited and hence social capital is vested in the communities themselves (Narayan and Pritchett, 1999). But to a large extent individuals can generate their own social capital over time through building networks for informal credit and risk sharing activities.

The importance of the investigation of the role of social capital in economic activities is that it moves household economic models away from the notion that social relations simply muddy the waters for efficient economic transactions and rational resource allocation. This notion, that social relations always constitute an economic constraint, has long been questioned by political scientists who have shown the patron-client relations in agrarian societies represent a moral economy (Scott, 1976) often in operation at times of hardship. Such peculiar and specific moral economies are often a necessary component of coping with weather extremes and other hazards and their impacts (Adger, 1996; Ribot, 1996; Pelling, 1998).

But this does not mean that more networks, greater reciprocal relations and commitments and generally ‘more’ social capital is always beneficial for all individuals or all situations. There is, in effect, a dark side to the force. Some economic research argues that excessive bonding social capital, while particularly necessary for poorer sections of society, can act as a constraint on economic development. It is the different combinations of bonding and networking social capital that allow

communities to confront poverty and vulnerability, resolve disputes and take advantage of new opportunities (Woolcock and Narayan, 2000). Similarly not all social networks are harmonious with good governance and the operation of society – as Woolcock (1998) points out, criminal gangs and Mafia-style organisations have strong social capital, but their objectives subvert the social capital of others in society and instead may constitute ‘social disorganisation’ (Arrow, 2000).

Networking social capital, based on informal institutions utilised to allocate resources, but relying on legal sanctions, describe in essence common and hybrid property management regimes. Community groups, particularly but not exclusively in developing countries, often provide basic health care and manage weather-related risks. They undertake resource management of fisheries, forests and irrigation systems and use the institutions to resolve disputes and allocated benefits, potentially enhancing the resilience of both social and natural systems (reviewed extensively in Baland and Platteau, 1996, Adger, 2000b). It is clear in these examples how networking social capital is important to adaptive capacity in the context of climate change – through managing risk.

**Table 1 Dying alone: Socio-economic status and social contacts of cases of heat related deaths during the 1995 heat wave in Chicago**

Variable	Odds ratio of risk of death (95 % CI)
<i>Living conditions</i>	
Lived on top floor	4.7 (1.7-12.8)
Lived alone	2.3 (1.4-3.5)
Visited cooling shelters	0.5 (0.3-1.2)
Working air-conditioner	0.2 (0.2-0.4)
<i>Residence type</i>	
Single family home	1.0
Apartment building	2.5 (1.5-4.2)
Other kind of building	8.1 (1.4-45.8)
Lived in building with flat roof	2.0 (1.2-3.2)
<i>Social contact</i>	
Did not leave home	6.7 (3.0-15.0)
Participated in group activities (church, support groups)	0.7 (0.5-0.9)
Had pet in home	0.6 (0.4-0.9)
Access to transportation	0.4 (0.2-0.6)
Had friends in Chicago	0.3 (0.1-0.6)

Source: Semenza *et al.* (1996)

Notes: Odds ratios are calculated as the risk of death among subjects with the characteristic in question compared to those without it for 339 matched pairs of case subjects and controls. The July 1995 heat wave resulted in over 700 excess deaths classified as heat-related.

But bonding social capital has also been recognised to be an important component of coping with the adverse impacts of climate change. Epidemiologists concerned with environmental triggers to ill health also necessarily include the social context and characteristics of both populations and individuals in their analyses. Table 1 reports results of research into over 300 cases among the estimated 700 excess deaths in Chicago as a result of a heat wave in July 1995. It shows, by calculating the odds ratios of being a victim compared to a control sample, the impact of various socio-economic characteristics of the cases. The results show that, leaving aside pre-existing medical risks, the factor most significantly increasing the risk of mortality is location (living in the top floor of poor housing or in hotels) along with absence of working air-conditioning. But also increasing the risk of mortality is whether the individuals lived alone and stayed at home through the heat wave. Social interaction, or bonding social capital, decreases the risk of mortality from cardio-vascular related illness in these cases. Attending a church or social group, or visiting friends may not in themselves enhance the ability of at-risk groups to cope with heat waves, but clearly they are important for collective coping with such stresses. In his book on the decline of democratic civil society in the US, Putnam (2000) invokes the metaphor of citizens ‘bowling

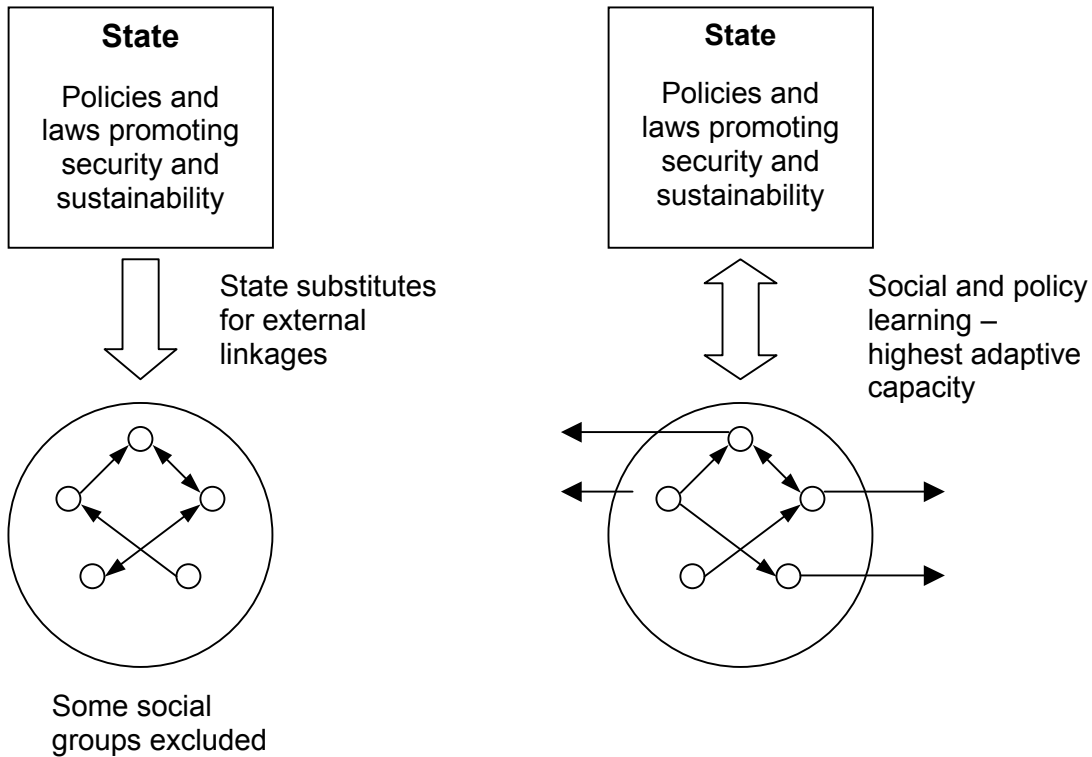
alone': where in past decades they participated in bowling clubs, now they bowl alone, a reflection of disengagement with civil and public life. Similar engagement in civil society reduced the risk of Chicago citizens from dying alone.

### *Synergy between state and networks*

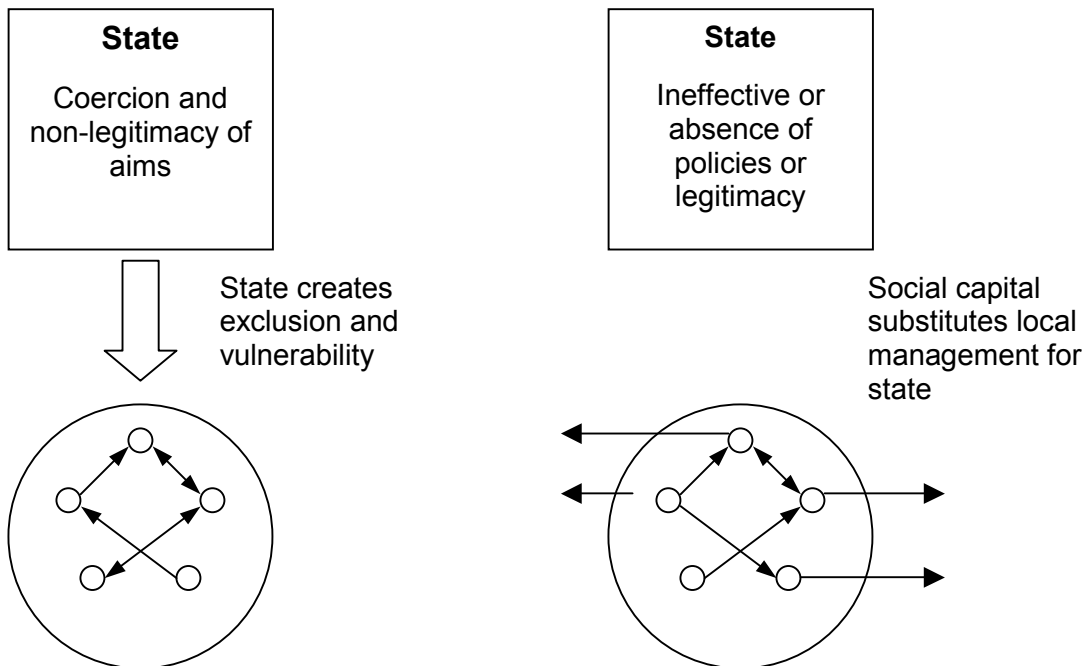
The discussion to date has been on the social capital of non-state actors. But this view, it is argued, fails to account for the role of higher level formal institutions in promoting and facilitating social capital. A further issue in the area of social capital is, therefore, the interaction of individuals and groups with the organisations of the state. As discussed above, it is important to understand this relationship because states have a key role in planned adaptation to climate change. But the state may not always be in a position to provide such resources, and should, for the sake of effectiveness, undertake adaptation in partnership with civil society. An institutional view of social capital argues that 'the very capacity of social groups to act in their collective interest depends on the quality of the formal institutions under which they reside' (Woolcock and Narayan, 2000, p. 234). Quantitative cross-national studies on government effectiveness and other proxies of social capital have been undertaken to examine how these macro-level social capital pre-requisites affect economic growth. They typically use political freedom and related variables on government performance (bureaucratic indicators) to explain economic growth and typically find that apparently well-functioning social capital is associated with lower rates of poverty and rates of inequality in societies (e.g. Knack and Keefer, 1997). At the same time such analysis is used to examine specific environmental performance. Deacon (1994), Bhattarai and Hammig (2001) and others have examined the role of social capital proxies in deforestation rates, finding them significant in explaining differences in rates of tropical forest cover loss between Latin America and other regions. In many cases the simplest proxies are cross-country indicators of political freedom, or more specific indicators of adherence to law or risks associated with asset ownership.

**Figure 2 Permutations of vertical linkages between state and society**

***With a well functioning state***



***With a dysfunctional or absent state***



Clearly the role of states in providing social capital and observable networks at local levels are intertwined. A set of potential interactions between networks and the state is shown in Figure 2, building on the ideas of Woolcock and Narayan

(2000). There are some types of adaptation to climate change (e.g. provision of large-scale infrastructure), which are only easily realisable by the state. In Figure 2 (top) with a well functioning state, the state can provide the necessary underpinning and social security for marginalised groups (left). The idealised situation is a synergy between state and civil society (Evans 1996) that promotes social and policy learning (upper right). Social learning is a composite of individual adaptation, and is that part of adaptation that comes about through collective activities such as discourse, imitation and conflict resolution. It should be stressed that collective action is not necessarily for everyone's benefit. Social hierarchies and resource and entitlement inequalities are rarely overturned in the course of adaptation, and external changes such as climatic extremes and other natural hazards tend to reinforce those inequalities (Adger et al., 2001). As individuals and groups interact synergistically with the state, so the institutions of the state also evolve in a process often characterised as policy learning. Adaptation in the political sphere involves periodic shocks to ideologies and paradigms of policy intervention such that these external shocks are conduits of social learning and adaptation.

An example of the situation portrayed in Figure 2 (upper right) is the need for legitimacy in partnerships in planning for coastal defence. In the UK inclusionary and participatory planning processes are novel but increasingly utilised when long-term decisions on adaptation require vested interests to be subjugated. O'Riordan (2001) and O'Riordan and Ward (1997) report on the building of trust between local stakeholders and government agencies in planning for set-back of the East Anglian coast. In this case both nature conservation organisations and local economic interests came to a compromise in designing coastal protection schemes. Social learning in this case came about through the widespread recognition and validation of differential perceptions of risk of local stakeholders.

Figure 2 (bottom) illustrates the undesirable circumstances in which social capital on occasions is not allowed to function (left) or is the only means of survival (right). When a state is driven by ideology, subjected to colonialism or provoked by other circumstances to be in conflict with civil society, conflict ensues and the most marginal sections of society are made vulnerable. In these circumstances civil strife and population displacement can occur, sometimes triggering famine even in the absence of a fall in food production or an environmental catastrophe. This situation explains some of the major famines of the 20<sup>th</sup> century including those in India and China in the 1940s and 1950s (Nolan, 1993; Sen, 1993) and the horn of Africa in the 1970s and 1980s (e.g. Glantz, 1987)

In the absence of an effective state, networking social capital is forced to substitute for some or many of the roles provided by governments. But the outcomes are often far from desirable. The most widely discussed examples of such a situation is the collapse of many aspects of government at the end of the Soviet Union. Here a new network economy has been strikingly identified (Grabher and Stark, 1998). Criminal and corruption networks dominates aspects of this economic system to the detriment of virtually all of the population.

**Table 2 Views of social capital and implications for adaptive capacity in the context of climate change**

Emphasis in social capital literature	Features applied to well-being and welfare	Implications for adaptive capacity
Networks	Stresses horizontal linkages and the role of non-state actors. The density of social capital leads to measurable outcomes in terms of material well-being.	Social capital of individuals and groups important for geographical and social manifestations of vulnerability and coping with risks.
Institutional approaches	Civil society operates to the degree that institutions of the state facilitate it.	The role of the state remains important for planned adaptation and sustainable development. Governance vital in managing global environmental risks and mitigative capacity.
Synergy approaches	Argues that state-society links and density are key. Addresses the complementarity and potential substitution of state and non-state and the normative issues of promoting environment for social learning.	State-society linkages important both for wider sustainable development and the co-management of resources. States can facilitate sustainable and resilient resource management and enhance adaptive capacity.

A summary of the issues raised thus far is presented in Table 2. This outlines the pertinent features (following Woolcock and Narayan, 2000) of the horizontal networking approaches to social capital (Figure 1), the institutional approaches, and the synergistic approaches (Figure 2) and their implications for adaptive capacity to climate change. First the networks view assumes that social capital is a phenomenon outwith the reaches of the state – social capital often substitutes for state involvement in the provision of public goods and is synonymous with what we normally refer to as civil society. This perspective on social capital has widespread currency in diverse social science disciplines and, as discussed above, has also been used in the analyses of comparative performance economic systems. Second, institutional approaches to social capital emphasise structure rather than agency. These insights are also used in comparative analysis of national economic performance, but only as macro-variables. These macro-variables (political freedom, bureaucratic performance and others) are readily measureable at the national level, and more easily quantifiable than civil society phenomena (other than participation rates in political processes or other areas where individuals are regulated by the state). Third, the synergistic approaches to social capital recognise the limitations of both but are less focussed on measuring the presence, absence or density of social capital than on the processes by which state and civil society interact through their embeddedness and complementarity (Evans, 1996).

These approaches are not mutually exclusive and all have, I would argue, useful perspectives on adaptive capacity in the area of climate change. Networking social capital is clearly important at the local level for understanding social differentiation in vulnerability. Bonding social capital, such as networks of reciprocity, can clearly be an important asset for coping with the impacts of weather extremes and catastrophic events. In the discussions of network views of social capital, such bonding capital, although important for coping, does not necessarily facilitate pro-active adaptation and enhancement

of well-being (Fafchamps and Binten, 2001). Networked social ties to external agents are also clearly important both for coping and for evolutionary adaptation. In the case of the small island micro-states, international migration assists in coping when extreme weather events occur and in furthering the stability and resilience of island populations. Such migration strategies have been utilised throughout human history in such regions to promote resilience, though have often been seen through the lens of dependency and negative social and cultural impacts (see Barnett and Adger, 2001). Thus social capital perspectives can have direct policy recommendations. Civil society institutions, although not specifically designed for the purpose, can play an important role in coping with the impacts of climate variability and change and can be encouraged through appropriate interventions.

But there are some public goods which can only easily be provided by state, including major infrastructural changes necessary when the impacts of climate change are significant or are risky for large populations. The synergistic approaches to social capital suggest that the implementation of planned adaptation to climate change is best brought about through the co-management of resources such that stakeholders from civil society buy into a shared vision of risk and adaptation in the long run and sustainable resource management in the immediate term. This issue is addressed in the case study of coastal management below.

### **Examples of Social Capital Perspectives on Adaptive Capacity**

#### *Evolution of collective action*

To reiterate the important central message – the social dynamics of adaptive capacity are defined through the ability to act collectively. There have been decades of research observing the efficiency and effectiveness of collective action and the pre-requisites for its emergence and persistence (e.g. Baland and Platteau, 1996). Resource dependent communities in coastal areas have historically managed their resources in some collective fashion because of the nature of the fugitive, fluctuating and seasonal resources on which their livelihoods depend. At the same time, governments intervene to manage and regulate coastal resources and often designate protected areas, no-take fishing areas, development zoning and other means of top-down management with the expectation that these designations will reverse resource decline or keep coastal populations safe. Deterioration of the marine and coastal environments in many areas continues apace and there has been much soul-searching over making management more inclusive. When vertical linkages between civil society and the state are strengthened, novel institutional arrangements such as co-management emerge. Such synergistic social capital, I would argue, promotes the adaptive capacity of societies to cope with climate change.

This set of circumstances is illustrated with reference to the management of a marine protected area in Tobago in the eastern Caribbean. There is much evidence that designating marine protected areas in the Caribbean, and more widely, have not arrested environmental degradation which amplifies the impacts of gradual but persistent environmental stress. Protected areas often fail in their stated objectives because of the marginalisation of important stakeholders who feel excluded and hence withhold support from co-management of protected areas (see Brown et al., 2001). Including coastal zone stakeholders appears to be an important element in developing supported integrated conservation and development initiatives.

Over the course of four years of observational and action research an interdisciplinary team facilitated institutional innovation towards co-management. Part of this was through development of a participatory trade-off analysis of the conflicts and sustainability of marine park management (Brown et al., 2001). Trinidad and Tobago is a twin island state in the southeast Caribbean. The islands have a relatively large coastal zone of economic, social, cultural and ecological importance. There are multiple uses of the coastal zone, a diverse set of stakeholders and an increasing incidence of use-conflicts.

For one specific marine protected area, Buccoo Reef Marine Park in Tobago, the trade-offs were identified between expansive tourism development, which threatens the integrity particularly of the coral reef through eutrophication, and more limited tourism development which maintains fringing mangrove and seagrass areas. Engagement with stakeholder groups provides information on their explicit priorities and allows these groups to move beyond short-term conflicts. Research in Trinidad and Tobago took this further by examining how synergistic social capital emerged and the institutional constraints and opportunities for such social capital to promote adaptive capacity (Tompkins et al., 2001).

The initial part of the process of building social capital involved building trust between elements of civil society and the state regulatory authorities. By informing all stakeholders about the implications of resource use and the acceptability of changing practices, directly resolving conflicts between users of the resource and building trust between the stakeholders, it was possible for the stakeholders themselves to have an input into the management of the marine protected area. By

working closely throughout with the regulatory agency and the decision-makers within the responsible government agencies meant that not only were the stakeholders using their collective voice to urge action, but that regulators were engaged and willing to respond. This represents a departure from traditional protected area management, but one which we would argue to be necessary given past conflicts and the general failure of those protected areas based on exclusion of stakeholders.

The stakeholders (Village Councils, dive operators, government regulators, local tourism interests and others) formed themselves in a Buccoo Reef Action Group and through negotiation with government, began to discuss the possibilities for co-management arrangements such as voluntary wardens, lobbying for sewage waste disposal improvements and other regulatory tasks. But much analysis of coastal resources and the social institutions that manage them largely ignores the issue of different institutional scales. Are there limits to integrated and inclusive coastal zone management in terms of the complexity of the resource, the size of the user pool or the geographical area? Theoretical research in this area suggests that the factors determining whether integrated and inclusive management can exist and flourish are scale-dependent, where scale refers to different spatial layers within the political economy. In this context, 'scale-dependence' suggests that the interaction between and engagement of different institutions at different scales determine success. Tompkins *et al.* (2001) develop a framework that distinguishes between institutions at the community, formal-organisational and national-regulatory levels and characterises the means by which institutions adapt to and learn about new issues in terms of networks of dependence and exchange. Social capital theories suggest that the density of networks and the ability of social actors to combine information and resources outside the local sphere of institutions are important means by which integrated and inclusive processes are maintained. Thus networking social capital can be facilitated in a synergistic manner by the state (Figure 2 to right) with many of the networks and contacts being contacts to individuals and institutions outside the local resource management scale.

But a key question remains as to whether the development of co-management in coastal zones enhances the adaptive capacity in the context of climate change. From the example in Tobago it appears that inclusionary and integrated coastal management contributes to adaptive capacity in two ways. First the networking social capital and the institutions surrounding it can act as a resource in coping with weather extremes. Although Trinidad and Tobago only rarely experience hurricane landfall, many of the individuals with responsibility for disaster planning are the same individuals who now work more closely to promote marine protected area management. The existence of the networks themselves therefore promotes adaptive capacity.

Second, the sustainable management of resources promotes the resilience of the natural systems on which the population of Tobago depends. For coral reef ecosystems it is clear that high sea surface temperature events such as those experienced in ENSO years, and which may become more frequent over time with climate change, pose a threat to their continued widespread existence in tropical coastal waters (Reaser *et al.*, 2000). 1998 sea surface temperatures reached the highest on record during the major El Niño-La Niña change in climate (Reaser *et al.*, 2000). In the same year coral reefs around the world suffered the most severe bleaching on record. Large scale bleaching episodes, such as the 1998 event, are usually attributable to high sea surface temperatures, whereas small scale bleaching is more like to result from direct anthropogenic impacts, such as high turbidity and sedimentation from pollution.

Although coral and species composition can quickly recover from bleaching (Brown *et al.*, 2000), evidence suggests that corals weakened by other stressors may be more susceptible to bleaching events, and hence less able to recover. Hence human activities can transform the natural disturbance of reef systems to a situation of additional anthropogenic disturbance events (e.g. sediment from land use changes) and of chronic stress (Nyström *et al.*, 2000). For human welfare, coral reef decline has been shown to result in fishing yield decline as reef viability decreases, and as the reef ecosystem becomes less productive there will be a knock-on effect on birds and marine animals (Hoegh-Guldberg, 1999) and ultimately on protein sources for small islands that depend on reefs for their subsistence, and on nature and coastal tourism. Avoiding the impacts of unsustainable resource use through inclusive management enhances the capacity to adapt to climate change impact as manifested through periodic extremes in sea surface temperatures and gradual changes in sea level.

#### *Substitute social capital as adaptive capacity*

Like social and ecological resilience, social capital is often only observable when there is some perturbation to the social or ecological system in focus. With regard to the impacts of hazards, social networks play a primary role in coping and recovery. Where government intervention to plan for, forewarn, and assist in recovery is largely absent, social capital – both bonding and networking – in effect takes over as a substitute for such external intervention. This is the situation described in the lower right panel of Figure 2. As highlighted in that discussion, the rolling back of the state in times of crisis or 'adjustment' presents communities with the necessity to provide alternative social security and other functions.

Such rolling back of the state is evident in the post-socialist countries where many functions previously provided by the state have collapsed. This poses major challenges for managing all resources and for the evolution of new institutions to provide social resilience (Adger et al., 2001). In the mid 1990s the local level hazard planning and coastal defence system in Vietnam was suddenly confronted with decentralisation and the break up of agricultural co-operatives. The resulting institutional response proved to be an example of social capital substituting for the state (detailed in Adger, 2000a).

Sea dikes constructed for coastal defence in coastal northern Vietnam are the principal physical infrastructure investment to ameliorate the threat of climatic hazards associated with typhoons and coastal storms, and until the mid 1990s were the major responsibility of the coastal Communes and Districts. Agricultural co-operatives during the collectivisation period had the responsibility for managing these defences. Each adult allocated ten days of labour to the task of repairing and maintaining the sea dike system. Since the decollectivisation of agriculture, this role of the agricultural co-operatives has largely been made redundant and the sea defences in many areas were for a number of years not being maintained, exacerbating vulnerability to present day climatic extremes.

Field research in 1996 and 1997 documented the new institutions and networks for collective maintenance of the defences. Decentralised Communes engaged in obfuscation and non-decision-making to divert remaining resources away from coastal defence towards their higher priorities of aquaculture development. Thus the decentralisation process, far from increasing local accountability, simply further exacerbated vulnerability to coastal storms.

But emerging social capital offset these trends towards greater vulnerability by creating networks for coping with present day weather extremes. The private property resolutions of Vietnam's 1992 Constitution, and the subsequent reform of the land allocation system under the 1993 Land Law, have been paralleled by a relaxation in the legality of private credit systems in rural areas. In the collectivised period, formal credit was only permissible through the Commune co-operative. Informal, but illegal, credit systems have always been an integral part of the coastal fishing economy in this part of the world. This phenomenon is common to many artisanal fishing communities. The role of credit in recovery from stress and disruption of livelihoods, is particularly important where external assistance is not available for immediate injection of resources. Street Associations are informal associations of neighbours within hamlets who have traditionally maintained religious buildings and funeral and marriage ceremonies. Associations, along with reciprocal feasting and gift-exchange, have become revitalised in northern Vietnam – it has long been recognised that these processes promote security in times of crisis. Informal collective decision-making for coastal defence and new bonding and networking social capital have been shown in this instance to substitute for the loss of state planning. Undoubtedly the adaptive capacity of many areas of the world when faced with climate changes will be to fall back on the local level social networks. Hence sustaining the pre-conditions for the emergence and promotion of social capital remains an important element in overall adaptive capacity.

## **Conclusions**

This paper has introduced the concepts of social capital and reviewed related research and demonstrated the usefulness of the approach of investigating collective action to adapt to the risks posed by climate change. I highlight three lessons from this rich agenda on collective action, social capital and adaptive capacity. First, the nature of adaptive capacity is such that it has culture and place specific characteristics which can only be identified through culture and place specific research. Further, policy interventions for planned adaptation at national and other levels of efficient policy-making may not be sensitive to these nuances and hence adaptive capacity will be differentially affected by such policies. But this does not mean that the lessons from research on social capital are not generalisable.

So a second lesson is that in order to generalise there is a need to learn from theoretical insights into institutions. In particular research on the institutional pre-requisites for the evolution and persistence of collective action and its relative importance compared to state intervention (Agrawal, 2001) can provide insights into adaptive processes. From such literature it is clear that the size of the group undertaking the collective action, the boundaries of the resource at risk, the homogeneity of the decision-making group, the distribution of benefits of management and other factors are all important in determining the ultimate success of collective management. Research is required on how collective action is central to adaptive capacity at various scales. At present these insights are only used in the climate change area to examine national level co-operative action to reduce greenhouse gas emissions under the UN Framework Convention on Climate Change. Collective action dilemmas form the basis of theories of regime formation and global action on mitigation. But such research can also be applied to dilemmas of adaptation: it needs to be both place and culture specific, but is also amenable at all scales to game theoretic approaches (Becker and Ostrom, 1995).

A third lesson is that institutional theories of social capital provide a means to generalise on the macro determinants of adaptive capacity. A large body of research argues that the state is central to the facilitation of social capital, whether

planned or inadvertently. If this is accepted then clearly appropriate proxies for the performance of the state can be utilised to compare the prior conditions for adaptive capacity to climate change across states. This is the theoretical underpinning, though not always recognised, of a number of projects seeking to identify the determinants of adaptive capacity at the national level (Moss et al., 2001). The measurement and observation of social capital remains a problematic area. Bonding and networking social capital are not easily quantifiable phenomena. In many studies their presence or absence is approached through the number and extent of contacts, memberships and other proxies. At the macro-level there are more easily quantifiable proxies but these become more loosely correlated with the social capital phenomenon in question. In terms of adaptation to climate change, many activities that enhance social resilience are not obviously climate related, for example through spreading risk over time.

Assessing vulnerability, adaptation options and the contribution social capital makes to adaptive capacity to climate change are, therefore, contested policy and research areas. Assessments of the future impacts of climate change often utilise modelling of alternative future scenarios to quantify impacts, risks, or people at risk from particular impacts (Parry et al., 2001). From this review of social capital I would argue that is that many aspects of adaptive capacity are, in effect, latent in the networks and information of those likely to be affected. This suggests, though has yet to be tested, that some groups within society may be less at risk than modelling studies portray because of this latent ability to cope in times of stress (see also Ribot, 1996).

Although social capital and collective action insights can inform the processes of adaptation, societies dependent on climate-sensitive resources are themselves heterogeneous and will have variable experience and success in coping with similar amounts of stress brought on through climatic changes. This is clearly shown by historical insights into coping with decadal-scale climate changes. Haberle and Lusty (2000) show that in the past 10 000 years of human history there have been climatic changes which, although not causing cultural change in themselves, may have 'provided the impetus or necessity to alter the way resources were managed' (Haberle and Lusty, 2000, p. 363) from the collapse of wetland agricultural systems in the highlands of Guinea to the demise of society in Easter Island. Importantly, however, these same historical climate change stresses do not lead to a particular singular outcome. The same long period of low rainfall associated with intense ENSO activity in the 1700s which played a part in the demise of the Easter Island resource base, also led to migration, new forms of sustainable production and other adaptations in similarly affected parts of the Pacific (Haberle and Lusty, 2000).

So when faced with significant changes in climate regimes and weather extremes in the future, different societies will clearly adopt radically different strategies. Their ability to make a sustainable transition will, I argue, be determined in part by their networks and social capital.

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