2011

Resilience and Sustainability in the Face of Disasters

Adam Z. Rose
University of Southern California, adam.rose@usc.edu

Environmental Innovation and Societal Transitions 1 (2011) 96–100

Contents lists available at ScienceDirect

Environmental Innovation and Societal Transitions

journal homepage: www.elsevier.com/locate/eist

Resilience and sustainability in the face of disasters☆

Adam Rose

University of Southern California, School of Policy, Planning and Development, 650 Childs Way, Los Angeles, CA 90089, United States

ARTICLE INFO

Article history:
Received 17 December 2010
Received in revised form 5 April 2011
Accepted 8 April 2011

Keywords:
Disasters
Economic resilience
Sustainability
Transitions

ABSTRACT

Very few of the large number of major disasters in recent years have threatened the survival of the host region. Improvements in conditions underlying sustainability have helped in this regard, as has inherent and adaptive resilience associated with disaster recovery. Sharp breaks from the past do not appear to be the norm, but opportunities for major transitions do increase in the aftermath of disasters. This paper examines some major types of resilience that have been effective and encourages their incorporation into long-term recovery and mitigation strategies.

1. Introduction

Burton et al. (1992) make a useful distinction between environmental flows: positive flows are resources, and negative ones are potential hazards as they interact with society. Extreme negative events can jolt the socioeconomic system, and often the remainder of the environment, so as to challenge the sustainability of the host region in the most extreme cases. These events can overwhelm protective measures and resilient capacity. They pose a dilemma for restoration relating to the balance between returning to previous conditions and advancing to newer and better "normals," including being able to withstand future catastrophes. Of course, lack of sustainable development makes a society more vulnerable to hazards as well.

Hurricane Katrina has become a classic example. A strong hurricane event was exacerbated by inadequate mitigation, on top of previous land development blunders, leading to a levee breach and disastrous flooding. Property damage ran close to $100 billion (National Weather Service, 2006), and this impact, coupled with the pre-disaster evacuation and post-disaster flight, are leading to business

☆ The author wishes to thank the Editor, an Associate Editor, and a reviewer for their helpful comments, which led to a strengthening of the manuscript.

E-mail address: adam.rose@usc.edu

2210-4224/$ – see front matter © 2011 Elsevier B.V. All rights reserved.
doi:10.1016/j.eist.2011.04.003

interruption losses of a comparable amount and counting (Hallegatte, 2008). Many believe that the New Orleans area is unlikely to return to its pre-Katrina population levels for more than a generation if ever (see, e.g., McCarthy et al., 2006). Some suggest that New Orleans will be leaner and stronger with the lower population and more focused recovery and reconstruction (Kates et al., 2006), implying that a healthy economy was not sustainable there with the previous population level and mix (Glaeser, 2005). Extrapolating into the future because of the increased frequency and magnitude of hurricanes likely to result from global warming (Mann and Emanuel, 2006), population is likely to decline in coastal areas of the U.S. and many other countries.

Will the future be one of sharp breaks like Katrina or slow transitions? What is the role of resilience and sustainability in the face of natural disasters? These are the questions addressed in this essay. This paper does not address the totality or complexity of all dimensions of sustainability transitions (see, e.g., Geels, forthcoming) but rather focuses on economic considerations.

2. Resilience and sustainability

Mileti (1999) has defined sustainability in relation to disasters in part as the ability of a community to recover by utilizing its own resources. To a great extent, this definition is a reaction to a typical pattern of national and international aid to stricken areas to bail out victims, which often perpetuates their vulnerability. This situation explains why so many areas stricken by a catastrophe have survived. The social and ethical dilemma has always been whether to let afflicted populations suffer, in part for their choices,[1] such as locating in flood plains, tornado alleys or earthquake zones. A formal attempt to break the pattern was part of the legal framework in the establishment of the U.S. Federal Emergency Management Agency (FEMA), which requires that communities develop and implement mitigation plans as a condition of federal government assistance. However, political, ethical, and economic considerations, as well as issues of timing, have usually led to the waiver of this requirement. Even then, it should be noted, most mitigation in the U.S. has been oriented to saving lives and to lessening property damage, and little attention has been applied to protecting the environment (Whitehead and Rose, 2009).[2]

Resilience has many interpretations, both for ecosystems (Holling, 1973) and the socioeconomic system (Rose, 2007; Norris et al., 2007). Rose (2009) has defined economic resilience in a manner that builds on considerations from other disciplines but focuses on the essence of the economic problem:

Static economic resilience – The ability of a system to maintain function when shocked. This is the heart of the economic problem, where ordinary scarcity is made even more severe than usual, and it is imperative to use the remaining resources as efficiently as possible at any given point in time during the course of recovery. This holds the prospect of decreasing business interruption.
Dynamic economic resilience – Hastening the speed of recovery from a shock. This refers to the efficient utilization of resources for repair and reconstruction. Static resilience pertains to making the best of the existing capital stock (productive capacity), while this aspect is all about enhancing capacity. As such, it is about dynamics, in that it is time-related. Investment decisions involve diverting resources from consumption today in order to reap future gains from enhanced production.

Another important distinction is between *inherent* and *adaptive* resilience (Rose, 2007). The former refers to aspects of resilience already built into the system, such as the availability of inventories, excess capacity, input substitution, contractual arrangements accessing suppliers of goods from outside the affected area (imports), and the workings of the market system in allocating resources to their highest value use on the basis of price signals. Adaptive resilience arises out of ingenuity under stress, such as

[1] Most analysts now concur that earthquakes, floods, hurricanes, etc. disaster outcomes are not simply caused by nature, but rather by the interaction of nature and the human settlement system. Of course, optimal choices in dealing with hazards are constrained by resources at both the individual and community levels.

[2] Exceptions are multi-purpose measures such as dams, levees, and land use planning, which protect both the built and natural environments. Still, for these cases, the environmental benefits are often ignored or undervalued in the decision-making process.

Draconian conservation otherwise not thought possible (e.g., working many weeks without heat or air conditioning), changes in the way goods and services are produced, and new contracting arrangements that match customers who have lost their suppliers with suppliers who have lost their customers.

What is the relationship between resilience and sustainability? Resilience is usually used in the context of responding to specific shocks, and thus relates to short-run survival and recovery. This contributes to long-run survival, a key aspect of sustainability along with improving the quality of life and the environment. However, the distinction is blurred in several key ways:

- Resilience in the short-run can be carried over to adaptation in the long-run.
- Disasters open up opportunities to rebuild and improve outcomes, including mitigating against future disasters.
- Disasters provide a valuable learning experience of how to cope with extreme stress.
- Disasters provide outside economic stimulus to the affected economy through insurance and through private and public sector assistance.[3]

In essence, resilience to disasters is the old aphorism – what doesn't kill you makes you stronger, and thus more likely to survive over the long-run.

While resilience is an oft-used term in economics, it is usually applied in vague terms to situations such as coping with oil embargos or financial meltdowns, and has rarely been measured.[4] One recent exception, however, is very poignant. Rose (2009) found that potential business interruption losses were reduced by 72 percent from a worst case scenario by the rapid relocation of firms in the World Trade Center area in the aftermath of September 11 terrorist attacks. Moreover, this resilient strategy, dependent of course on excess office capacity, saved an expensive rebuilding campaign. This more intensive use of resources is also the theme of the recovery in the current great recession in the U.S. and other countries, as employment recovery significantly lacks the recovery of output. The experience of New Orleans and New York thus signal a significant change in approaches to disaster recovery and long-run sustainability in the U.S., which typically emphasized prompt rebuilding (e.g., the great "Chicago Fire of 1871, the San Francisco Earthquake of 1906, Galveston Flood of 1900, Long Beach Earthquake of 1933, and Hurricane Andrew in 1992).[5] Coupled with stronger requirements for mitigation, and hopefully some general accumulated wisdom, we are recovering less by reflex action and more by intelligent planning (Vale and Campanella, 2005).

Of course, what is ultimately important in the 9/11 case is that New York City, and the U.S. as a whole, clearly survived (Chernick, 2005). Any single disaster taking place in a large industrialized country is unlikely to threaten its sustainability. Of course, severe repeated disastrous events in a concentrated area have not readily been experienced, and this would open up other possibilities. This is one of the reasons that climate change is so important, in that it lays open the possibility of a greatly increasing number of disasters such as hurricanes and floods. At the same time, small developing countries have been significantly affected by disasters, such as the recent Honduran floods and Haiti earthquake, which do threaten their sustainability.

3. The market as a stabilizing influence

The role of markets in disaster recovery is not often appreciated. Horwich (1995) and Boettke et al. (2007) have emphasized their important role in recovery following the Kobe Earthquake and Hurricane Katrina, respectively. The market has actually served as a stabilizing influence in these cases and has usually set resource allocation on the right course. This implies that there are in fact

[3] It is often the case that the economy of a disaster-stricken area booms after the event due to these infusions of resources. Of course, the funds come from elsewhere in a nation or the world at large, upon which they are a drain. Note also that, although these injections are a positive stimulus, they are not always sufficient for full recovery to take place.

[4] Resilience has been measured successfully by those in other disciplines (see, e.g., Chang and Shinozuka, 2004; Miles and Chang, 2006).

[5] Some exceptions include the Alaska Earthquake of 1967, where the (small) town of Valdez was relocated several miles away.

features in economies that will keep them from being entirely transformed by a disaster.[6] A related feature is the growing use of insurance, and broader re-insurance markets, to spread the losses from disasters. This is yet another stabilizing influence.

Individual businesses and supply chains are also highly resilient (Sheffi, 2005). Recent disasters have caused firms to rethink strategies such as just-in-time inventories, and to focus on a broader picture, including improved emergency planning; however, they have not radically changed the way of doing business. Economies are composed of many atomistic decision-makers, and their adaptive behavior is likely to help lead to a smooth transition in the aftermath of disasters.

Of course, many local and even regional markets are especially challenged in the aftermath of a major disaster. Some short term centralized planning may be required. Otherwise, the major long-term role of planning is during the course of repair and reconstruction, when a comprehensive approach may be preferred to the patchwork quilt outcome of economic decisions (Blanco et al., 2009). The planning approach in this instance has the advantage of being able to incorporate the various aspects of externalities and public goods so that the built environment is structured in society's overall best interest.

4. Disaster as an opportunity

Disasters are both human and economic tragedies.[7] However, they afford the opportunity to make the best of a bad situation. Disasters can destroy the built environment and open up great possibilities for improvement in terms of "how much", "how" and "for whom" we rebuild. Disasters can set in motion some sharp and relatively quick changes in part by dislodging what Geels (forthcoming) refers to as "lock-in mechanisms," or more broadly eliminating a major basis for systems failure (Rotmans and Loorbach, 2009). To the extent that recovery is successful, they make the case for drastic change, though not necessarily at a short timescale. The best of the short-term resilient responses, especially the cheaper and most effective ones, can be integrated into long-run behavior and planning.

Reconstruction following disaster can take into account special needs populations, such as the aged, infirm, and poor. At the same time these groups are not known for their political clout, so that an ideal equitable outcome is not assured.

A valuable perspective for coping with disasters is to view resilience as empowering the population. Flynn (2008) suggests this stems from several sources, including personal responsibility and its potential effectiveness. Individuals can play an important role in coping with disasters both in the preparedness and recovery. Their actions can reduce losses and take some of the onus off of government in terms of the scope and magnitude of its involvement, thereby reducing moral hazard and the burden of government assistance. This point is consistent with that of Rose (2009) who emphasizes the demand-side versus the supply-side of resilience. For example, in the provision of utility services (e.g., electricity or water) the emphasis is often on supplier action, such as building redundant systems or having expensive spare parts on hand. There are many ways that customers can be resilient and at much lower expense. Conservation more than pays for itself, import substitution often simply just requires increased transportation cost, and the recapturing of lost production when the electricity is restored often requires only the additional cost of overtime pay for workers. Sustaining this increased participation for the long-term makes for broader and more knowledgeable input into private sector and public sector decision processes relating to resource allocation. Increased public participation can also help ensure more equitable outcomes in recovering from disasters.

5. Conclusion

Although the world has witnessed a large number of major disasters in recent years, only those related to nuclear contamination (Chernobyl and Fukushima) seem to have threatened the survival

[6] Of course, disasters in developing countries have caused political instability that has led to major regime changes, including major changes in economic institutions and economic policy.

[7] They are also increasingly ecological tragedies as more toxic materials are released to the environment during the course of the event and even during recovery and reconstruction.

of the host region. Improvements in conditions underlying sustainability have helped in this regard, as has inherent and adaptive resilience associated with disaster recovery. Sharp breaks from the past do not appear to be the norm, but opportunities for major transitions do increase in the aftermath of disasters. More research and improved practice would be helpful. Integration of key aspects of transition and disaster studies began more than a decade ago (see, e.g., Comfort, 1999), but, despite the potential, progress has been slow.

References

Blanco, H., et al., 2009. Shaken, shrinking, hot, improvised and informal: emerging research agendas in planning. Progress in Planning 72, 195–250.
Boettke, P., Chamlee-Wright, E., Gordon, P., Ikeda, S., Leson II, P., Sobel, R., 2007. Political, economic and social aspects of Katrina. Southern Economic Journal 74 (2), 363–376.
Burton, I., Kates, R.G., White, G., 1992. The Environment as Hazard, 2nd ed. Guilford Press, New York.
Chang, S., Shinozuka, M., 2004. Measuring and improving the disaster resilience of communities. Earthquake Spectra 20, 739–755.
Chernick, H. (Ed.), 2005. Resilient City. Russell Sage Foundation, New York.
Comfort, L., 1999. Shared Risk: Complex Seismic Response. Pergamon, New York.
Flynn, S., 2008. America the resilient: defying terrorism and mitigating natural resources. Foreign Affairs 87 (2), 2.
Glaeser, E., 2005. Should the government rebuild New Orleans, or just give residents checks? The Economists' Voice 2 (4), Article 4.
Geels, F.W. The multi-level perspective on sustainability transitions: Responses to seven criticisms. Environmental Innovation and Societal Transitions, forthcoming.
Hallegatte, S., 2008. An adaptive input–output model and its application to the assessment of the economic cost of Katrina. Risk Analysis 28 (3), 779–799.
Holling, C., 1973. Resilience and stability of ecological systems. Annual Review of Ecology and Systematics 4, 1–23.
Horwich, G., 1995. Economic lessons of the Kobe earthquake. Economic Development and Cultrual Change 48 (3), 521–542.
Kates, R., Colten, C., Laska, S., Leatherman, S., 2006. Reconstruction of New Orleans after Hurricane Katrina: a research perspective. Proceedings of the National Academy of Sciences of the United States of America 103 (40), 14653–14660.
Mann, M.E., Emanuel, K.A., 2006. Atlantic hurricane trends linked to climate change. Eos 87 (4), 13.
McCarthy, K., Peterson, D.J., Sastry, N., Pollard, M., 2006. The Repopulation of New Orleans after Hurricane Katrina. RAND Gulf States Policy Institute.
Miles, S.B., Chang, S.E., 2006. Modeling community recovery from earthquakes. Earthquake Spectra 22 (2), 439–458.
Mileti, D., 1999. Disasters by Design. Joseph Henry Press, Washington, DC.
National Weather Service (NWS), 2006. Service assessment: Hurricane Katrina, August 23–31, 2005. National Oceanic and Atmospheric Administration, U.S. Department of Commerce, Silver Spring, MD.
Norris, F., Stevens, S., Pfefferbaum, V., Whyche, K., Pfefferbaum, R., 2007. Community resilience as a metaphor, theory, set of capacities and strategy for disaster readiness. American Journal of Community Psychology 41, 127–150.
Rose, A, 2007. Economic resilience to disasters: multidisciplinary origins and contextual dimensions. Environmental Hazards: Human and Social Dimensions 7 (4), 383–398.
Rose, A., 2009. Economic Resilience to Disasters. Community and Regional Resilience Institute, Oak Ridge, TN, Report No. 8.
Rotmans, J., Loorbach, D., 2009. Complexity and transition management. Journal of Industrial Ecology 13 (2), 184–196.
Sheffi, Y., 2005. The Resilient Enterprise. MIT Press, Cambridge, MA.
Vale, L., Campanella, T., 2005. The Resilient City: How Modern Cities Recover from Disaster. Oxford, New York.
Whitehead, J., Rose, A., 2009. Estimating environmental benefits of natural hazard mitigation: results from a benefit–cost analysis of FEMA mitigation grants. Mitigation and Adaptation Strategies for Global Change 14 (7), 655–676.