

# BUILDING RESILIENCE FOR FOOD & NUTRITION SECURITY



## Definitions of Resilience: 1996-present\*

*September 10, 2013 version*

### Dictionary definitions

Resilience: an ability to recover from or adjust easily to misfortune or change

<http://www.merriam-webster.com/dictionary/resilience>

Resilience: (i) ability to recover readily from illness, depression, adversity, or the like; buoyancy, (ii) the ability of an ecosystem to return to its original state after being disturbed

<http://dictionary.reference.com/browse/resilience>

Resilience: The positive ability of a system... to adapt itself to the consequences of a catastrophic failure

<http://en.wiktionary.org/wiki/resilience>

### Maxwell (1996)

The conventional view of food security was of food as a primary need, a lower-order need in Maslow's (1954) hierarchy of needs... In recent years, however, the assumptions underlying this view have been questioned. It has been recognized that food, especially short-term nutritional intake, is only one of the objectives people pursue. Thus, de Waal (1989) found in the 1984/85 famine in Darfur, Sudan, that people chose to go hungry to preserve assets and future livelihood: "people are quite prepared to put up with considerable degrees of hunger, in order to preserve seed for planting, cultivate their own fields or avoid having to sell an animal" (de Waal 1991, p. 68)... Others have similar findings, particularly in the context of analysing the sequence of coping or adaptive strategies people follow in times of drought (Corbett, 1988; Frankenberger and Goldstein, 1990; Davies, 1993).

In part, these findings reflect an issue of time preference: people going hungry now, in order to avoid going (more) hungry later. However, there is a broader issue of livelihood at stake, in which objectives other than nutritional adequacy are pursued (Chambers, 1988a, p. 1; Davies, 1996). Time preference remains important, nevertheless: not just livelihood, but secure and sustainable livelihood (Chambers, 1988b). In this connection, Oshaug has argued that "a society which can be said to enjoy food security is not only one which has reached (a) food norm,... but which has also developed the internal structures that will enable it to sustain the norm in the face of crises threatening to lower the achieved level of food consumption (Oshaug, 1985, pp. 5-13)."

Oshaug identified three kinds of households, "enduring households", which maintain household food security on a continuous basis, "resilient households", which suffer shocks but recover quickly and "fragile households", which become increasingly insecure in response to shocks. Similar approaches are found elsewhere (Benson et al., 1986; Barraclough and Utting, 1987) and have recently been extended with the addition of "sensitivity", a measure of the extent of change following a shock (Blaikie and Brookfield, 1987; Bayliss-Smith, 1991): the interaction between resilience and sensitivity provides a

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\* Preliminary, chronologically ordered list. This list may be incomplete. To suggest a definition to add to the list, please email the definition and its source to [IFPRI-2020Resilience@cgiar.org](mailto:IFPRI-2020Resilience@cgiar.org). IFPRI will review all submissions for suitability, and update the list regularly. This list was compiled by Alexander J. Stein, Research Coordinator, IFPRI.

strong framework for the analysis of food insecurity over time, with the most food insecure households characterized by high sensitivity and low resilience (Swift, 1989; Davies, *ibid*).

### **Wood (1998)—more about sustainability and how it relates to resilience**

The core of the new CGIAR approach to agricultural development is ‘sustainability’, and it is thus important to understand the precise meaning of the term. Conway... has defined sustainability as ‘the ability of a system to maintain productivity in spite of a major disturbance, such as is caused by intensive stress or a large perturbation’, and more recently... as ‘the ability of an agroecosystem to maintain productivity in the face of stress or shock’...

There are three other problems with this concept of ‘sustainability’. Firstly, ‘sustainability’ seems to be exactly equal to the earlier concept of ecosystem ‘stability’ of ecologists, one measure of which is ‘resistance’: ‘the degree to which a system remains at equilibrium when a disturbing force is applied’... The 1985 definition by Conway has already been criticized by Dover and Talbot... as being the same thing as ecosystem resilience, which they define as the ability to recover if the disturbance causes change. With specific reference to Conway’s 1985 definition of sustainability, Lynam and Herdt (1992) noted that ‘All this points to a concept entailing substantial ambiguity in any particular application’.

Secondly, ‘sustainable’ agroecosystems that do not change for the worse in the face of stress are likely also not to change for the better in the face of greater inputs or more optimum conditions: that is, by nature of their stability, they are unresponsive. Is this lack of flexibility what farmers want from agriculture? Perhaps preferred agroecosystems should not just be stable in the face of stress or shock, but should be responsive to greater inputs (whether the labour of farmers or breeders, or addition of manure or inorganic fertilizer). Stable agroecosystems that do not become more productive with greater inputs take away farmers’ incentives to invest in inputs in order to increase yields, and condemn farms to a low productivity ceiling. Much of the success of CGIAR and national scientists has been in making agroecosystems massively responsive to inputs of all kinds and to evolutionary change (for example, triple cropping), thereby rewarding farmers’ investment. Equally massively, this has been accepted by farmers for staple annual crops. Sustainability, as defined by Conway, might therefore be a constraint to annual crop farming, rather than an objective...

Thirdly, while ‘resistance’ and the counterpart idea of ‘resilience’ can be valid properties of natural ecosystems, ‘sustainability’ might best be reserved for managed ecosystems, where human management of the inputs and outputs of ecosystems determines their sustainability. This management has often been based on age-old knowledge of sustainable yield management characteristic of much traditional resource management. To treat sustainability as a natural ecological principle and then make it a paradigm for agriculture is neither good ecology nor good farming.

### **Barnett (2001)**

The resilience approach emphasizes the capacity to cope with uncertainty and surprises while maintaining overall system persistence... resilience is about learning from error how to bounce back in better shape. A strategy of resilience involves building up institutional structures and human resources as these are the first and last requirements of a system able to absorb, learn from, and modify itself to changes. A strategy of resilience entails developing coping capacity which is arguably a better approach to adaptation given scientific uncertainty.

The beginnings of a contemporary theory of resilience can be traced to a paper by C.S. Holling, published in 1973, which defined resilience as “the persistence of relationships within a system” and “the ability of these systems to absorb changes of state variables, driving variables, and parameters, and still persist”...

This ecological approach to the concept has developed over time, and has more recently been applied to policy...

The pursuit of resilience is integral to the development of adaptive capacity. This is because, as a general if not near-universal rule, an integral feature of resilient systems is an ability to learn from, and reorganize to meet, changed conditions. In short, a resilient system carries with it the essential qualities for adaptation... “the extension of the idea of resilience from ecosystems to human systems directs emphasis away from a futile search for equilibrium to the strengthening of social adaptive behaviour”... Resilience is most often cast in terms of response to impacts which are essentially negative in nature, however, a society which is flexible and able to shift rapidly is also able to exploit any positive opportunities that might arise in an uncertain future.

A focus on resilience stands in contrast to the traditional emphasis in environmental and economic policy on the principles of stability and anticipation. These principles very much inform the study of vulnerability and adaptation to climate change, not least because the social science most involved in this process is neoclassical economics, which is itself dominated by the principle of predictable (and increasing) yields. In the main, resource management policies are also anticipatory and emphasize stability, seeking to secure steady and predictable yields... however... resource management practices which seek steady yields restrict the natural fluctuations in a system, and this tends to increase the likelihood of the system to flip into an alternative equilibrium state in the face of surprises. So, conventional resource management practices tend to decrease the ability of a system to persist in the face of surprises (decreases resilience)... Adaptation policies which seek to maintain steady-yields would seem to be increasingly prone to invoke system failure. Thus, a sectorally-based approach to adaptation which seeks to intervene in key sectors to secure steady-yields despite future climatic changes is probably counterproductive in the long term. This implies a shift from sector-based planning to system based planning (from a focus on the parts to a focus on the whole), and from resource management to sustainability...

There are at least six principles of resilient systems... First is the homeostasis principle, which holds that the system is maintained through feedbacks between its components. These feedbacks signal changes, drive responses, and enable learning. Resilience is enhanced when feedbacks are transmitted effectively. The second principle is the omnivory principle, which holds that external shocks are mitigated by the diversification of resources and the diversification of the means by which resources are delivered. Thus, the more diverse the resources and the more diverse the means of delivery, the less likely it is that the supply of vital items will falter. In this way, a crisis of supply in one place does not trigger a crisis in other (overly dependent) places. The third principle is the high flux principle, which holds that the faster the rate of movement of resources through the system the more resources will be available at any given time to help cope with perturbation, and hence, the more resilient the system. The fourth principle is the flatness principle, which refers to the number of hierarchical levels relative to the base in an organization, and holds that the greater the number of participants higher in the system (the more top-heavy), the less resilient a system. Overly hierarchical systems are less flexible and hence less able to cope with surprise and adjust behavior. The fifth principle is the buffering principle, which refers to the surplus or slackness in the system, and holds that a system which has a capacity in excess of its needs can draw on this capacity in times of need, and so is more resilient. Finally there is the redundancy principle, which holds that a degree of overlapping function and redundancy in a system permits the system to change by allowing vital functions to continue while formerly redundant elements take on new functions. Redundancy also allows for interchangeability when one part fails to perform...

From the perspective of the study of natural disasters, a number of strategies enable systems to both absorb and recover from sudden changes, and to learn from and adapt to changed conditions. As well as

designing slackness, redundancy and speed of supply into social systems (respectively the buffering, redundancy and high flux principles)... and the decentralization of decision making (the flatness principle)... other strategies which enhance resilience to disasters include: mobility, including ability to relocate temporarily and permanently; diversification of supply of food, fiber and income (the omnivory principle); mobilizing social networks and systems of redistribution (the whole insures the parts); alleviation of absolute poverty; learning from past events and changing practices; transmission of knowledge across space and time; experimentation and innovation; and sustainable intensification of resource use.

### **Carter & May (2001)**

There are two forces that interact when households experience an economic shock: resilience and sensitivity. While the former refers to the depth of the impact of a shock on a household's well-being, resilience refers to the ability of the household to recover from the shock. Households that are highly sensitive to shocks, with a low resilience, are in an extremely hazardous state and may be forced to sell off or neglect the accumulation of productive assets in order to survive. In the face of multiple shocks, low-resilience households may thus ratchet down over time to the point at which they become trapped in a situation from which they cannot escape through successful accumulation... what might be termed accumulation failure rests at the heart of persistent poverty.

### **Resilience Alliance (2002, 2005)**

Resilience is the ability to absorb disturbances, to be changed and then to re-organise and still have the same identity (retain the same basic structure and ways of functioning). It includes the ability to learn from the disturbance. A resilient system is forgiving of external shocks. As resilience declines[,] the magnitude of a shock from which it cannot recover gets smaller and smaller. Resilience shifts attention from... growth and efficiency to... recovery and flexibility. Growth and efficiency alone can often lead ecological systems, businesses and societies into fragile rigidities, exposing them to turbulent transformation. Learning, recovery and flexibility open eyes to novelty and new worlds of opportunity.

Resilience is the capacity of a system to absorb disturbance and reorganize while undergoing change so as to still retain essentially the same function, structure, identity, and feedbacks.

### **Walker et al. (2004)**

The concept of resilience has evolved considerably since Holling's (1973) seminal paper. Different interpretations of what is meant by resilience, however, cause confusion. Resilience of a system needs to be considered in terms of the attributes that govern the system's dynamics. Three related attributes of social-ecological systems (SESs) determine their future trajectories: resilience, adaptability, and transformability. Resilience (the capacity of a system to absorb disturbance and reorganize while undergoing change so as to still retain essentially the same function, structure, identity, and feedbacks) has four components—latitude, resistance, precariousness, and panarchy—most readily portrayed using the metaphor of a stability landscape. Adaptability is the capacity of actors in the system to influence resilience (in a SES, essentially to manage it). There are four general ways in which this can be done, corresponding to the four aspects of resilience. Transformability is the capacity to create a fundamentally new system when ecological, economic, or social structures make the existing system untenable.

## **IFRC (2004)**

Factors that enable people to cope with hardship and survive trauma have long been of interest to social and behavioural scientists, covering a wide range of situations, whether the death of a loved one, surviving an accident or the adaptation of Latino immigrant teenagers to the United States. In the last two decades, 'resilience' has become the 'buzz' word to describe this capacity to survive, adapt and bounce back – applied freely to anything from ecosystems to business, at any level from households to countries and global communities...

"Resilience is the capacity to cope with unanticipated dangers after they have become manifest, learning to bounce back." Wildavsky, 1991.

"... several dimensions along which resilience can be measured. These are robustness, resourcefulness, redundancy, and rapidity." Kendra and Wachtendorf, 2002.

"Resilience, for social-ecological systems, is related to (a) the magnitude of shock that the system can absorb and remain within a given state, (b) the degree to which the system is capable of self-organization, and (c) the degree to which the system can build capacity for learning and adaptation." Gov. Sweden, 2002.

"A resilient ecosystem can withstand shocks and rebuild itself when necessary. Resilience in social systems has the added capacity of humans to anticipate and plan for the future... 'Resilience' as applied to ecosystems, or to integrated systems of people and the natural environment, has three defining characteristics: The amount of change the system can undergo and still retain the same controls on function and structure. The degree to which the system is capable of self-organization. The ability to build and increase the capacity for learning and adaptation." Resilience Alliance.

## **UN (2005)**

The capacity of a system, community or society potentially exposed to hazards to adapt, by resisting or changing in order to reach and maintain an acceptable level of functioning and structure This is determined by the degree to which the social system is capable of organising itself to increase this capacity for learning from past disasters for better future protection and to improve risk reduction measures.

## **Folke (2006)**

The resilience approach is concerned with how to persist through continuous development in the face of change and how to innovate and transform into new more desirable configurations. The resilience perspective was revived in the early 1990s through research programs of the Beijer Institute, where it came across as essential in interdisciplinary studies on biodiversity, complex systems, property rights regimes, cross-level interactions and the problem of fit between ecosystems and institutions and in relation to economic growth and socioeconomic systems...

A vulnerable social–ecological system has lost resilience. Losing resilience implies loss of adaptability. Adaptability in a resilience framework does not only imply adaptive capacity to respond within the social domain, but also to respond to and shape ecosystem dynamics and change in an informed manner. The variables and processes that structure ecosystem dynamics and sources of social and ecological resilience have to be understood and actively managed to deal with the interplay of gradual and abrupt change... A major challenge in this context is to build knowledge, incentives, and learning capabilities into institutions and organizations for governance that allow adaptive management of local, regional and global ecosystems. In resilience work adaptability is referred to as the capacity of people in a social–

ecological system to build resilience through collective action whereas transformability is the capacity of people to create a fundamentally new social–ecological system when ecological, political, social, or economic conditions make the existing system untenable.

There is an increased emphasis on transformability into improved social–ecological systems as opposed to adaptation to the current situation. An emphasis on transformability implies extending the focus in social–ecological research to systems of adaptive governance in order to explore the broader social dimension that enables adaptive ecosystem-based management. An adaptive governance framework relies critically on the collaboration of a diverse set of stakeholders operating at different social and ecological scales in multi-level institutions and organizations. Individual actors play essential roles in providing e.g. leadership, trust, vision and meaning, and in social relations e.g. actor groups, knowledge systems, social memory. Social networks serve as the web that seems to tie together the adaptive governance system.

#### **Allison et al. (2007)**

We suggest the following definition of a resilient aquatic resource production system in the developing world. A resilient small-scale fishery in the developing world is one that ‘absorbs shocks and reorganizes itself following stresses and disturbance while still delivering benefits for poverty reduction’... management to maintain resilience should prevent a fishery from failing to deliver benefits by nurturing and preserving ecological and social features that enable it to renew and reorganize itself... The growing consensus in the literature on climate change is that the poor are more vulnerable and less able to adapt. In other words, poverty undermines the resilience of social-ecological systems such as fisheries.

#### **Stockholm Resilience Centre (2007)**

Resilience is the capacity of a system to continually change and adapt yet remain within critical thresholds. Resilience is the long-term capacity of a system to deal with change and continue to develop. For an ecosystem such as a forest, this can involve dealing with storms, fires and pollution, while for a society it involves an ability to deal with political uncertainty or natural disasters in a way that is sustainable in the long-term.

Increased knowledge of how we can strengthen resilience in society and nature is becoming increasingly important in coping with the stresses caused by climate change and other environmental impacts...

Sometimes change is gradual and things move forward in roughly continuous and predictable ways. At other times, change is sudden, disorganizing and turbulent reflected in climate impacts, earth system science challenges and vulnerable regions. Evidence points to a situation where periods of such abrupt change are likely to increase in frequency and magnitude. This challenges the adaptive capacity of societies.

The resilience approach focuses on the dynamic interplay between periods of gradual and sudden change and how to adapt to and shape change... to generate a deeper understanding of interdependent social-ecological systems for improved governance and policy.

#### **UNISDR (2007)**

The ability of a system, community or society exposed to hazards to resist, absorb, accommodate to and recover from the effects of a hazard in a timely and efficient manner, including through the preservation and restoration of its essential basic structures and functions... Resilience means the ability to ‘resile from’ or ‘spring back from’ a shock. The resilience of a community in respect to potential hazard events

is determined by the degree to which the community has the necessary resources and is capable of organizing itself both prior to and during times of need.

### **WRI, UNDP, UNEP & World Bank (2008)**

Resilience is the capacity to adapt and to thrive in the face of challenge. This report contends that when the poor successfully (and sustainably) scale up ecosystem-based enterprises, their resilience can increase in three dimensions: They can become more economically resilient—better able to face economic risks. They—and their communities—can become more socially resilient—better able to work together for mutual benefit. And the ecosystems they live in can become more biologically resilient—more productive and stable...

Capabilities and connections to accommodate... systemic changes... is the definition of resilience...

Resilience is usually defined as the capacity of a system to tolerate shocks or disturbances and recover. In human systems, this is closely linked to the adaptive capacity of the system—the ability of individuals and the group to adapt to changing conditions through learning, planning, or reorganization. In the context of rural communities, we can speak of three forms or dimensions of resilience...

- Ecological resilience is the level of disturbance that an ecosystem can absorb without crossing a threshold to a different ecosystem structure or state... The disturbance may be natural, like a storm, or human-caused, like deforestation, pollution, or climate change. The new ecosystem structure that results after crossing a threshold may have lower productivity or may produce different things that are not as desirable to those remaining in the ecosystem. Overfishing, forest clearance, and overgrazing are typical disturbances that can challenge ecosystems and ultimately overwhelm their ability to recover, forcing them over the threshold to a new and, from the standpoint of nature-based livelihoods, less desirable state.
- Social resilience is the ability to face internal or external crises and effectively resolve them. In the best cases it may allow groups to not simply resolve crises but also learn from and be strengthened by them... It implies an ability to cohere as a community and to solve problems together in spite of differences within the community. Social capital and a shared sense of identity and common purpose support this aspect of resilience.
- Economic resilience is the ability to recover from adverse economic conditions or economic shocks... It encompasses having a variety of economic options available if a particular economic activity fails or being able to create more options if necessary. It benefits from being able to call on a wide variety of skill sets and contacts.

### **Korhonen and Seager (2008)**

The concept of resilience was first developed in ecology to describe the capacity of a natural system to recover from perturbation or injury. Compared with EE [eco-efficiency], which lends itself to development of operational management metrics, the concept of resilience is less precise. The specific attributes of resilient systems are context dependent and there is no single consensus view of resilience that informs all systems. In particular, there is a contrast between interpretations of resilience in technological and ecological systems (Holling, 1996).

In engineering, Fiksel (2003) lists diversity, efficiency, adaptability and cohesion as characteristic of resilience. 'Diversity' implies a wide range of alternatives, such as multiple product offerings or production sites. 'Efficiency' refers to resource productivity, including eco-efficiency. 'Adaptability' describes the ability of an organization to change practices, resource allocations, designs, relationships

or other aspects of the business in response to changing conditions. 'Cohesion' is taken to mean the strength of relationships internal and external to the organization such as customer loyalty, supplier relationships, corporate culture and employee identity.

Walker et al. (2004) construct a different understanding of resilience applicable more directly to natural systems. They describe the critical aspects of resilience as latitude, resistance, precariousness and panarchy. 'Latitude' refers to the elastic range in which a system can be perturbed or deformed without losing the ability to return to its original form. 'Resistance' is the difficulty or force required to create a unit change in the system – such as stiffness in material engineering. 'Precariousness' describes how close the system is to exceeding the elastic threshold and undergoing a permanent restructuring. Last, 'panarchy' refers to cross-scale interactions and how perturbations at one scale may create regime shifts at some other scale of observation.

### **Boyd et al. (2008)**

In general, resilience refers to a system's capacity to deal with change and to continue to develop. Resilience is used as a concept in many disciplines, including ecology (Holling, 1973), healthcare (Carthey et al., 2001), disaster management (Pelling, 2003; Paton and Johnston, 2006) and so on. To better reflect the interdependence of human and environmental well-being, the notion of resilience is increasingly examined in the broader context of politics and social change (Berkes et al., 2003; Folke et al., 2005). In the context of climate change, a resilience approach is one that allows undesirable socioeconomic states (for example a system characterized by deep deficits in income, power, education and social capital) to be transformed into more desirable ones without threatening the integrity of the atmosphere or the ecological systems on which humans depend...

Resilience ideas overlap with the ultimate goals of development and adaptation to climate change, in that resilience focuses on how the social and the ecological systems together buffer disturbance, organize to form functioning and effective supporting institutions, and generate adaptive capacity...

In the case of food security, resilience thinking forces us to examine how well coupled food systems are performing their key functions of contributing to food security, social welfare and ecosystem security, and may help us to limit the tradeoffs among these objectives. A resilience approach demonstrates that we can only maintain ecosystem services such as food provisioning through fostering social institutions that monitor feedbacks from food production activities to other ecosystem services and negotiate among the objectives of different food system actors...

The downside of resilience is that it is nearly impossible to measure or evaluate, and there are few examples of resilient managed systems in developing/poor countries. It is useful as a conceptual lens, but the practice of resilience is less well examined.

### **Cannon (2008)**

The concept of resilience is similar in some ways to the idea of capacity. It reflects both the fact that people (some people?) can show an amazing capability to bounce back after a hazard has struck, and also that their 'non-victimhood' deserves to be acknowledged. Resilience involves the ability of systems to restart quickly after a hazard has struck, and to 'adapt existing resources and skills to new systems and operating conditions'... the ability of an actor to cope with or adapt to hazard stress. It is a product of the degree of planned preparation undertaken in the light of a potential hazard, and of spontaneous or premeditated adjustments made in response to felt hazard, including relief and rescue (Pelling 2003: 48).

This suggests that it involves people's conditions before a hazard strikes, as well as their ability to respond and recover afterwards. In other words, like vulnerability it has a predictive aspect: it should be possible—on the basis of the characteristics of a group of people who are exposed to a particular hazard—to identify their capacity for resilience. In fact, if people have a high level of resilience, they will not be so vulnerable. The two concepts can by and large be seen as the two ends of a spectrum. High levels of vulnerability imply a low resilience, and vice versa.

### **Massa et al. (2009)**

Distinguishing: (i) exposure to shocks, or vulnerability; and (ii) ability to react to shocks, or resilience. While vulnerability is a structural characteristic of a country (i.e. something independent of its current political will and outside of its control), economic resilience is the policy-induced ability of a country to withstand or recover from the adverse effects of shocks (Briguglio et al., 2006). It is the latter that determines the severity of the damages for any external shock. In other words, resilience is the result of a deliberate policy developed and introduced in order to manage shocks (resilience-building).

### **Bapna et al. (2009)**

Resilience is the ability to handle stresses or recover from disturbances or shocks. In the most positive sense, it is the capacity to thrive in the face of challenge. Resilience in the context of rural resource-dependent communities is comprised of ecological resilience, social resilience, and economic resilience.

### **Fraser and Stringer (2009)**

Dictionaries generally define resilience as the ability to bounce back. In academic circles, this resonates with the widely cited "Pimm's" definition that defines resilience as the time it takes for a system to return to its pre-disturbance state after a shock. Seen in this way, an ecosystem that "bounces back" very quickly after a disturbance (like a flood or fire) is considered resilient. When it comes to agro-ecosystems, however, this is problematic because if a drought destroys a crop, then a farmer may lose a year's income and choose to leave farming entirely. In this case, Holling's (1973) definition, that resilience is the size of a perturbation required to shift a system, is more pertinent. Where a large perturbation causes only a small impact, then the system may be considered resilient and vice versa...

The literature suggests that resilient systems should also be able to self-organise or display high levels of adaptive capacity to help them move smoothly from one type of system to another... this emphasis on adaptability is itself a synthesis of a number of different bodies of literature including entitlement theory and livelihoods, the study of natural hazards and political ecology, and development work on the ways in which households responded in the past to droughts. Terms like social capital, trust, social networks and community coping strategies are all important when describing resilient social groups that have the ability to respond to disturbances.

Other important aspects in understanding resilience are the institutional factors that may either provide direct assistance in times of crisis or help empower groups to be pro-active in preparing for future problems...

We suggest that there are at least three important generic factors that characterise resilient or adaptive rural economies and the land use systems they depend on. The first is ecological and draws on Gunderson and Holling's work. If a landscape loses diversity but gains in connectivity and biomass then the land use system is likely to be losing resilience. The second dimension is socio-economic and suggests that if a region loses wealth, social networks, trust between individuals, or access to different types of capital, then it is less likely to be able to adapt to disturbances. The third factor is institutional

and refers to the ability of formal and informal institutions to help mitigate perturbations. Although there is some overlap between these concepts (especially the social and institutional elements) and these elements are inter-related, a considerable body of work on vulnerability suggests that it is appropriate to disaggregate case study data along these lines.

### **ADB & IFPRI (2009)**

Resilience is used to describe the magnitude of a disturbance that a system can withstand without crossing a threshold into a new structure or dynamic. In human systems, resilience refers to the ability of communities to withstand and recover from stress, such as environmental change or social, economic, or political upheaval, while for natural systems, it is a measure of how much disturbance (e.g., storms, fire, and pollutants) an ecosystem can handle without shifting into a qualitatively different state. This definition implies that social systems have the additional ability to anticipate and plan according to perceived and real changes. Therefore, the ability of institutions and individuals to avoid potential damage and to take advantage of opportunities will be a critical factor in building resilience to climate change. In addition, building resilience to climate change requires simultaneously building resilience in human systems and in the interlinked ecosystems on which they depend.

The concept of resilience has emerged in response to the need to manage interactions between human systems and ecosystems sustainably. Humans depend on ecosystem services (e.g., water filtration, carbon sequestration, and soil formation) for survival, yet the ability of institutions to manage these natural systems sustainably has not kept pace with the changes occurring within these systems. Socioeconomic institutions have considered ecosystems and the services they provide to be infinite and largely in a steady cycle of regeneration. This attitude has led to the creation of economic instruments and incentives that use ecosystems deterministically, from extraction to consumption. The concept of resilience, however, recognizes that social and environmental systems are interlinked, complex, and adaptive; process dependent—rather than input dependent—and self-organizing rather than predictable. The lens of resilience is useful in analyzing climate change because it is founded on the recognition that human existence within ecological systems is complex, unpredictable, and dynamic, and that institutional measures and responses should be based on this principle.

### **Oxfam (2009)**

A resilient farm can cope effectively with climate shocks while also producing more... Resilience is also the capacity of farmers to respond to and learn from shocks...

Resilience is the ability of a joint social and ecological system – such as a farm – to withstand shocks, coupled with the capacity to learn from them and evolve in response to changing conditions. Building resilience involves creating strength, flexibility, and adaptability.

A resilient farm can cope effectively with climate shocks such as droughts or floods, continuing to produce and sustain its capacity for future responsiveness and production. By contrast, a vulnerable farm hit by climate shocks could see its crops fail or its livestock die, with potentially lasting effects. On degraded lands, building resilience can also sharply raise a farm's baseline productivity.

### **Miller et al. (2010)**

Resilience and vulnerability represent two related yet different approaches to understanding the response of systems and actors to change; to shocks and surprises, as well as slow creeping changes. Their respective origins in ecological and social theory largely explain the continuing differences in

approach to social-ecological dimensions of change. However, there are many areas of strong convergence...

Although each [research] community shares a similar lexicon, concepts are often imbued with different meanings. Interpretations of vulnerability within the resilience community have tended to focus on the physical vulnerability of ecosystems and ecosystem functions and services, rather than taking an integrated perspective... Likewise, narrow interpretations of resilience in the vulnerability research community have tended to stress social aspects such as access to assets, social support systems, networks, institutions, and learning... rather than the interconnections between social and ecological systems...

Despite a history of little dialogue among researchers in the fields of resilience, vulnerability, and adaptation... there is currently growing engagement between both communities. Miscommunications and misunderstandings, however, persist both in the semantic and the epistemic arenas. There remains some conceptual fuzziness, as well as overlap, for example, in the use of key terms and concepts within each field. A common interpretation of vulnerability, for example, is that it is the antonym of resilience... Whereas in... vulnerability analysis, resilience is not considered the flipside of vulnerability, but rather one of three dimensions of vulnerability, the other two being exposure and sensitivity. Logically, one can therefore have high resilience, but if exposure and sensitivity are high, then a system is nevertheless considered vulnerable.

#### **Alinovi et al. (2010)**

Traditionally, most research in the field of food security has focused on the development and refining of the methods of analysis chosen to predict more accurately the likelihood of experiencing future loss of adequate food, i.e., vulnerability to food security. However, more recently a new concept has been proposed, i.e., resilience to food insecurity, that is the ability of the household to maintain a certain level of well-being (for example, food security) withstanding shocks and stresses, depending on the options available to the household to make a living and its ability to handle risks.

Resilience is a related, but different, concept from vulnerability. Both share a common set of parameters such as the shocks and stresses to which a social-economic system is exposed, and the response and adaptive capacity of the system. Nevertheless, vulnerability analysis often tends to measure only the susceptibility of an individual/household to harm and the immediate coping mechanisms adopted.

Resilience analysis tries to identify the different responses adopted by a household and capture the “dynamic” components of the adopted strategies. A resilience approach investigates not only how disturbances and change might influence the structure of a system (for example, a household or a community), but also how its functionality in meeting these needs might change...

The concept of resilience, originally proposed in the ecological literature (Holling, 1973) was successively proposed to explore the relative persistence of different states of nature in complex dynamic systems such as socio-economic systems (Levin et al. 1998). The concept of resilience has two main variants. One, called

“engineering” resilience... is the ability of the system to return to the steady-state after a perturbation. It focuses on efficiency, constancy, and predictability, and it is the concept which engineers turn to in their attempt to develop optimal designs (“fail-safe” designs). The other definition, we can refer to as “ecological” resilience, is the magnitude of disturbance that can be absorbed before the system re-defines its structure by changing the variables and processes that control behaviour. It focuses on conditions away from any stable steady-state, where instabilities can flip the system into another regime of behaviour (i.e., to another stability domain).

Both variants deal with aspects of the stability of system equilibria, offering alternative measures of the capacity of a system to retain their functions following disturbance. However, each definition emphasises different aspects of stability that “can become alternative paradigms whose devotees reflect traditions of a discipline or of an attitude more than of a reality of nature” (Gunderson et al., 1997: 3).

In conclusion, the two definitions reflect two different views of the world: engineers want to make things work, while ecologists acknowledge that things can break down and change their behaviour. Now, what about economists? Traditionally, economists have primarily tended to consider conditions close to a single stable state. However, the issue of ecological resilience has also begun to emerge in economics with the identification of multi-stable states due to path-dependency, “chreodic” development and production non-convexities such as increasing return to scale. Levin et al., (1998) argue that resilience offers a helpful way of thinking about the evolution of social systems, partly because it provides a means of analysing, measuring and implementing the sustainability of such systems. This is largely because resilience shifts attention away from long-term equilibria and towards the system’s capacity to respond to short-term shocks and stresses in a constructive and creative way.

### **Walker et al. (2010)**

Many definitions of resilience exist. For the purposes of this paper, we will use the definitions adopted by Walker et al. (2004), “the capacity to absorb disturbance and reorganize while undergoing change so as to still retain essentially the same function, structure, identity, and feedbacks,” and Cumming et al. (2005, p. 976), “the ability of the system to maintain its identity in the face of internal change and external shocks and disturbances.”

These definitions imply that resilience is a desirable attribute. However, agricultural research for development is often addressing the needs of the extreme poor who are struggling to escape from agricultural systems that are highly resistant to change. In the context of poor developing country farmers, the need is clearly to change but to do so in ways that do not increase exposure to risks. The challenge is therefore to progress to more productive systems while at the same time retaining or increasing resilience to external shocks. Walker et al. (2004) discuss a number of attributes of natural resource systems that influence resilience. The ones that are of most significance for agriculture are the following.

Thresholds and Tipping Points... Specified and General Resilience... Enhancing Resilience vs. Transformation... Changing to Persist... Estimating or Measuring Resilience...

### **Bahadur et al. (2010)**

The idea of resilience exists in a number of disciplines. In the field of Psychology, resilience is seen as the capacity to withstand the impact of stressors and fight stress. ‘Resilience is the capacity to recover following a stress. From a genetic perspective, resilience is defined as the quality that prevents individuals who are at genetic risk for maladaptation and psychopathology from being affected by these problems’.

Humanistic psychology, the branch of the subject that stresses the importance of personal choice and responsibility takes a slightly wider perspective of resilience and understands it to be, ‘... an individual’s capacity to thrive and fulfill potential despite or perhaps even because of such stressors... resilient individuals seem not only to cope well with unusual strains and stressors but actually to experience such challenges as learning and development opportunities’.

Structural and engineering science is another field to employ the idea of resilience, for example the concept of seismic resilience of buildings understands it to be the property of a system which has: '1. Reduced failure probabilities; 2. Reduced consequences from failures, in terms of lives lost, damage, and negative economic and social consequences; 3. Reduced time to recovery'.

The concept of resilience has also found its way into the body of knowledge on corporate strategy where the idea of 'enterprise resilience' is being employed to make a case for mainstreaming 'risk management' into the everyday operations of a firm: '... enterprise resilience marries risk assessment, information reporting, and governance processes with strategic and business planning to create an enterprise-wide early warning capability'.

In the social sciences, resilience is largely discussed in terms of society and ecology – in the context of social and ecological systems. There is widespread consensus amongst social and natural scientists that studying resilience involves the adoption of cross-disciplinary and multidisciplinary methods, as natural and social systems are highly integrated. This acknowledges the need to employ instruments such as systems thinking and complexity theory.

While a high degree of interconnectedness between social and ecological systems is undisputed, theorists from different backgrounds understand resilience in different ways. This consequently affects their notions of the components, characteristics and indicators of resilient systems. Theories have emerged that are based variously on an understanding of resilience in social systems or social resilience, those that stress resilience in ecological systems, and those that see the two as highly interconnected. These provide the core focus of this paper's analysis of the anatomy of the concept.

Where theorists have stressed interconnectedness, some have created the Socio-ecological System (SES) as a specific conceptual entity in order to give the two the same weight in their analysis. These are '... linked systems of people and nature. The term emphasizes that humans must be seen as a part of, not apart from, nature – that the delineation between social and ecological systems is artificial and arbitrary' (Simon 2009). A good example of this division is the 'Five Capitals' approach that acknowledges the interconnection of human and ecological systems by stating that both natural capital (air, soil, etc.) and social capital (trust, norms and networks) have a role in determining the resilience of a system. This is in contrast to the 'Disturbance as Opportunity' approach which does not isolate human/social and natural/ecological factors, seeing them instead as a highly integrated, systemic 'whole'. These concepts have been increasingly applied in the context of resilience to natural hazards and climate change.

### **Cadman et al. (2010)**

The concept of ecosystem resilience emerged in the 1980s, building on the "systems thinking" of the 1970s. In the broadest sense, resilience can be described as that property that enables ecosystems to absorb both expected and unforeseen change. A key principle underlying resilience thinking is the likelihood of the ecosystem crossing a threshold or "tipping point", beyond which it will become fundamentally and often irreversibly different. At the same time, it is important to recognise that change is an inevitable part of natural systems and that they pass through adaptive cycles.

Over the past three decades, the concept of resilience has been used beyond its original focus on the ability of landscapes and ecological communities to absorb disturbances and maintain function. More recently, for example, it has been used to describe the ability of countries, regions and communities to withstand the negative effects of climate change, giving rise to the short-hand term "climate-resilience"...

Resilience: the capacity of an ecosystem to absorb change and re-organise itself, whilst undergoing change, in order to retain its character and ecological functioning.

### **Jones et al. (2010)**

Another term that is increasingly common in these debates is resilience. Even though the term is widely used by practitioners, there is no accepted definition across the different disciplines. Holling (1973) defined resilience as a 'measure of the persistence of systems and of their ability to absorb change and disturbance and still maintain the same relationships between populations or state variables'. In short, resilience can be defined as 'the capacity of a system to anticipate, prepare for, respond to and quickly recover from changes in the system – be it climate shock and stresses or other drivers of change' (Badahur, 2009).

Definitions used in DRR and LH [livelihoods] are similar to this but have taken the focus from the higher systems level to ground it in people and society. In LH approaches, resilience is seen as the opposite of vulnerability. Resilience is considered a key feature of sustainable livelihoods, which means the ability to cope with, avoid or resist stresses and shocks. A household's assets may be chosen with the aim of reducing vulnerability to such shocks and stresses (Chambers and Conway, 1991). LH approaches also encourage the promotion of resilience by ensuring that policies and institutions are responsive to the needs of the poor, as well as by building up assets.

### **Otobi (2010)**

Resilience is "a multi-dimensional construct defined as the capacity of individuals, families, communities and institutions to anticipate, withstand, and/or judiciously engage with a catastrophic event and/or experience; actively making meaning out of adversity, with the goal of maintaining normal functions without losing identity." Norris et al. defined community resilience as a process linking a network of adaptive capacities (resources with dynamic attributes) to adaptation after a disturbance or adversity. Thus, "Communities have the potential to function effectively and adapt successfully in the aftermath of disasters. Community adaptation is manifest in population wellness, defined as high and non-disparate levels of mental and behavioral health, functioning, and quality of life. Community resilience emerges from four primary sets of adaptive capacities—Economic Development, Social Capital, Information and Communication, and Community Competence— that together provide a strategy for disaster readiness. To build collective resilience, communities must reduce risk and resource inequities, engage local people in mitigation, create organizational linkages, boost and protect social supports, and plan for not having a plan, which requires flexibility, decision-making skills, and trusted sources of information that function in the face of unknowns". However, "resiliency is not a global characteristic of a system; it can meaningfully be determined only with reference to an identified system and particular challenges".

### **FAO (2011)**

Through its disaster risk reduction activities, the Food and Agriculture Organization of the United Nations (FAO) seeks to protect livelihoods from shocks, to make food production systems more resilient and more capable of absorbing the impact of, and recovering from, disruptive events...

The multiple threats to FNS [food and nutrition security] and the clear link between shocks and hunger reveal the fragility of current food production systems and their vulnerability to disruptions. In order to break this cycle, it is necessary to protect livelihoods from shocks, and to make food production systems more resilient and more capable of absorbing the impact of, and recovering from, disruptive events and to secure sustainable development gains...

Resilience: the ability of a system, community or society exposed to hazards to resist, absorb, accommodate to and recover from the effects of a hazard in a timely and efficient manner, including through the preservation and restoration of its essential basic structures and functions.

### **DFID (2011)**

Definitions of resilience: “The ability of a system, community or society exposed to hazards to resist, absorb, accommodate to and recover from the effects of a hazard in a timely and efficient manner”

United Nations International Strategy for Disaster Reduction. “The ability of a social or ecological system to absorb disturbances while retaining the same basic structure and ways of functioning, the capacity for self-organisation, and the capacity to adapt to stress and change” Intergovernmental Panel on Climate Change. “The capacity of a system to absorb disturbance and reorganize while undergoing change” The Resilience Alliance.

DFID has adopted a working definition: Disaster Resilience is the ability of countries, communities and households to manage change, by maintaining or transforming living standards in the face of shocks or stresses – such as earthquakes, drought or violent conflict – without compromising their long-term prospects.

### **Martin-Breen & Anderies (2011)**

It is important to note that due to the multifaceted and multidisciplinary nature of the resilience concept, presenting different definitions out of context is not that useful. Thus, before presenting the definitions of resilience from various fields, we present a short discussion of the development of the term through the 20<sup>th</sup> century...

The key feature of resilience (in complex adaptive systems) is “adaptive capacity or **adaptability**. It is not just adaptation—change—in response to conditions. It is the ability of systems—households, people, communities, ecosystems, nations—to generate new ways of operating, new systemic relationships. If we consider that parts or connections in systems fail or become untenable, adaptive capacity is a key determiner of resilience. Hence in complex adaptive systems, resilience is best defined as **the ability to withstand, recover from, and reorganize in response to crises**. Function is maintained, but system structure may not be. Self-organization is related to novelty and innovation: it generates inherently new ways of operating, ones that previously may not have been considered; certainly not predicted...

Three key systems properties contribute to its resilience: **Diversity and Redundancy, Modular Networks, and Responsive, Regulatory Feedbacks**... Improved redundancy and diversity of the functions of parts, increased modularity and decreased interdependency in the networks of the subsystem, and increasing the responsiveness of a regulatory feedback mechanism all build resilience. Management would then focus on correcting and manipulating these variables...

There is also the question about what one should be building the resilience of. Clearly it is not always desirable; chronic poverty is a highly resilient state. Those excluded from the process of governance may not wish to see current functioning sustained. And, given limited resources, one may have to decide, for instance, whether to promote the resilience of a city or an ecosystem... Like natural resources, human resources are limited, and difficult decisions about what we most value, what we most want sustained, must still be faced, and made. One not only needs to answer the questions ‘Resilience of what?’ and ‘Resilience to what?’, but also ‘Resilience for whom?’

### **Dahlman (2011)**

Resilience is a notion borrowed from material sciences and describes the ability of a material to recover its shape after a deformation. Many technical systems behave in a linear way, with a direct relation between the size of a disturbance and the effect on the system. This is not true for a system with complex non-linear relations between its elements. Such systems might be facing discontinuities and uncertainties that make them totally fail if a disturbance exceeds a critical threshold. A non-linear system must be analyzed in terms of its ability to adapt to changes and recover from disturbances while providing options for future developments...

The resilience concept has over the last few decades been introduced to describe complex systems, especially systems where human interaction has a significant influence. It was introduced into the analysis of ecological systems by Holling (1973) and a number of interesting studies of such systems have been reported since. An overview developed by many experts was given by Folke et al (2002), and there are several other published studies related to resilience of social-ecological systems...

Resilience has been described in terms of a number of defining characteristics (Walker et al, 2002): (i) The amount of change a system can undergo and still be in the same configuration - retain the same controls on functions and structure. A more resilient system can absorb larger shocks without changing in a fundamental way; (ii) The degree to which the system is capable of self-organization; and (iii) The degree to which the system expresses capacity for learning and adaptation.

As Carpenter et al (2001) highlighted, resilience must be considered in a specific context: resilience of “what to what”? This means that we have to define what functions or elements of a system are resilient to what changes. If a system is composed of elements forming different system levels, it can be resilient at some of the levels but not necessarily at others. How can an enterprise or a state be resilient without having resilient sub-systems? A large-scale system, such as a nation state, could be overall resilient even if a number of systems in the society fail. A nation state could, on the other hand fail due to a large-scale political or economic crisis, even if many of its systems are intact.

### **Fordham et al. (2011)**

Resilience is a community’s capacity to organize itself in order to reduce the impacts of natural hazards and climate change by protecting resources such as lives, livelihoods, homes, assets, services, and infrastructure. Resilience includes a community’s capacities to advance those development processes, social networks and institutional partnerships that strengthen its ability to anticipate, cope with, resist and recover from disaster. Central to a grassroots women-friendly approach is the belief that vulnerability and resilience are shaped by the ability to claim rights, resources and decision-making power. In pre-disaster contexts, resilience includes proactive measures that reduce exposure, vulnerabilities and risks. In post-disaster contexts, resilience includes the ability to organize effective relief and recovery processes.

Community resilience depends on more than financial resources—resilience cannot simply be bought. Though technological and financial investments play an important role, an intangible resource—adaptability—is a critical factor in a community’s ability to withstand disaster. Poor women are experts in resilience. As the case studies will show, they are proficient in adapting to changing social and natural environments, organizing to collectively address problems, drawing on traditional knowledge and improvising skills to face difficulties. Though the enormity of the stresses and shocks often overwhelms their efforts, experience demonstrates that poverty and marginalization do not necessarily mean passivity in the face of disasters, extreme events or development challenges.

### **Grady (2011)**

A lot of thinking has been done about resilience in ecosystems theory, and some of that is useful when applied to the challenge of climate change. First is the recognition that ecosystems are naturally dynamic and subject to change through disturbance. Second is that change is not always directional, linear or aimed toward a point of equilibrium. And third is that ecological disturbance is not necessarily a disaster in need of human intervention, but can also be a process that brings renewal and positive change.

For psychologists, resilience has included ideas about how well individuals adapt to adverse situations - a dynamic and changeable process in which people are continually engaged – rather than merely an innate set of characteristics.

For sociologists, resilience is the strength of one or more communities measured by their ability to solve problems, often related to the degree of civic participation, trust among community members, and trust of government authorities...

Resilience goes beyond, referring to the capacity over time of a system, organization, community, or individual to create and implement multiple adaptive actions. We think that resilience is a more accurate, positive, and comprehensive term, describing the dynamic, systemic transformation that is needed to respond to the consequences of climate change, especially future impacts that are difficult to predict.

### **Montalbano (2011)**

Another common misconception in vulnerability analysis concerns precisely the distinction between “resilience” or “adaptability” and “responsiveness” or “coping capacity.” Notwithstanding their obvious interconnection, they are different concepts and cannot be considered as a single one. The term “resilience” refers to “the capacity of a system, community or society potentially exposed to hazards to adapt, by resisting or changing in order to reach and maintain an acceptable level of functioning and structure” (UN/ISDR, 2004). “Responsiveness,” on the other hand, measures the availability of policy tools and institutions to cope with, mitigate, or avoid the negative effects of external shocks.

In the first case, we are dealing with a structural phenomenon given by the complex of individual actions undertaken collectively mainly by private agents, to cope with, mitigate or avoid the negative effects of external shocks. These actions will depend strongly on assets, and levels of education and health and open the way to new conceptual developments—for instance, in the recent debate on adaptation to “climate change.” In the second case, we are dealing with policies and institutions capable of strengthening or reducing a country’s ability to cope and/or recover from negative shocks.

### **Pain & Levine (2012)**

‘Resilience’ has been described as ‘the capacity of people or “systems” to cope with stresses and shocks by anticipating them, preparing for them, responding to them and recovering from them’. This definition is consistent with others drawn from different perspectives and indicators of assessment, which put at their centre the concepts of ‘absorbing’, ‘accommodating’ and ‘responding to’ disturbance. Three widely used definitions illustrate this:

- The capacity of a system to absorb disturbance and reorganise while undergoing change...
- The capacity of a system, community or society potentially exposed to hazards to adapt by resisting or changing in order to reach and maintain an acceptable level of functioning and structure...

- The ability of a social or ecological system to absorb disturbances while retaining the same basic structure and ways of functioning, the capacity for self-organisation, and the capacity to adapt to stress and change...

Unlike the first definition quoted, these three mainstream definitions have in common a focus on ‘systems’ of a social or ecological nature, with no evident attention to the individual or the household. Resilience is thus seen to be a collective property – of the community rather than the individual. The [first two] definitions emphasise resilience in the face of disturbance and stress and the capacity to change and adapt – seeing resilience as a transformative capacity. The [third] definition is more conservative, focusing more on retaining the same basic structures and functions: recovery to the status quo ante... DFID’s definition, emanating from a more obviously practical perspective, is thus clearly different:

Disaster Resilience is the ability of countries, communities and households to manage change, by maintaining or transforming living standards in the face of shocks or stresses – such as earthquakes, drought or violent conflict – without compromising their long-term prospects...

Not only is there no talk of ‘systems’, but both the transformative and conservative dimensions are explicitly included. The term ‘resilience’ is widely used in the literature on crisis contexts. In many cases, it has been used almost as an equivalent to food security... Although ‘food security’ is often applied to people’s short-term ability to meet their food needs, it is supposed to refer to the degree of security people have that they will continue to be able to meet their needs (‘access ... at all times’).

#### **Frankenberger et al. (2012)**

The ability of countries, communities, and households to efficiently anticipate, adapt to, and/or recover from the effects of a potentially hazardous occurrences (natural disasters, economic instability, conflict) in a manner that protects livelihoods, accelerates and sustains recovery, and supports economic growth.

It is important to emphasize that resilience is not synonymous with coping capacity. Whereas coping capacity typically refers to the ability of households to return to their previous state in the wake of disaster, resilience programming must focus on strengthening the adaptive capacity of vulnerable households. In the context of protracted crisis, this entails taking incremental steps to reduce their exposure to a variety shocks so that they can eventually escape poverty and continually improve their wellbeing.

#### **Béné et al. (2012)**

The ‘capacity to recover’ and ‘degree of preparedness’ mentioned above are usually part of what people define technically as ‘resilience’. Cutter et al. for instance, in their analysis of community resilience to disasters explain that ‘resilience within hazards research is generally focused on engineered and social systems, and includes pre-event measures to prevent hazard-related damage and losses (preparedness) and post-event strategies to help cope with and minimise disaster impacts’ (Cutter et al. 2008: 600). In the recent ‘Special report on managing the risks of extreme events and disasters’, the IPCC defines resilience as the ‘ability of a system and its component parts to anticipate, absorb, accommodate, or recover from the effects of a hazardous event in a timely and efficient manner’ (IPCC 2012: 5). Many other technical definitions have been proposed in the literature, which reflect the wide range of disciplines that have embraced the concept of resilience – see Manyena (2006) for an earlier review, and Bahadur, Ibrahim, and Tanner (2010) for a more recent one.

Although all of these definitions differ slightly in their wordings, most of them (at least the most recent ones) highlight similar elements. First, although resilience has sometimes been presented or understood

in the past as an outcome that can be measured and monitored, an increasing number of academics and practitioners now recognise that a more useful way to conceptualise resilience is to understand it as an ability. To be more precise, it is the ability to deal with adverse changes and shocks. In fact, the literature suggests that it is the 'ability to resist, recover from, or adapt to the effects of a shock or a change' (Mitchell and Harris 2012: 2). This dynamic nature (the recognition that things are not static, but change, adapt and evolve) is in itself a progression with respect to previous conceptions of the world which might have relied too heavily on an assumption of equilibrium and immobility.

Reflecting on this definition, some would argue, however, that what is necessary to resist a shock may be quite different from what is needed to adapt to it. This apparent 'inconsistency' between different characteristics of a resilient system, is possibly the main unresolved issue relating to resilience and, is something that we shall examine later in greater length. Finally, the review of the literature also indicates that a last element present in most definitions is that resilience exists at multiple levels or scales: individual, household, community, system, society, etc.

### **Venton et al. (2012)**

According to DFID, "disaster resilience is the ability of countries, communities and households to manage change, by maintaining or transforming living standards in the face of shocks or stresses - such as earthquakes, drought or violent conflict – without compromising their long-term prospects."

Or, in other words, according to John Twigg's "characteristics of a disaster resilient community": "A focus on resilience means putting greater emphasis on what communities can do for themselves and how to strengthen their capacities, rather than concentrating on their vulnerability to disaster or their needs in an emergency." ...

Many attempts have been made to define "resilience" and as a result many agencies report confusion over what constitutes a resilience building activity, and how one measures when a community is "resilient".

Resilience is not an end-point - no community is immune to the impacts of shocks, and those factors that affect vulnerability and resilience are constantly changing. Rather, the aim is to engage in a process that is building the resilience of people to cope with shocks, and that allows for flexibility and choice so that people can adapt and make good decisions as circumstances change.

### **Harris (2012)**

First, it is important to make clear that the term resilience means different things to different people. There is substantial diversity in how the term is understood and employed between disciplines, and consequently different understandings of the term have different implications when translated into policy or action. On a casual basis, i.e. in everyday language, the term resilience may be used simply as a noun to mean 'the ability of a substance or object to spring back into shape; the capacity to recover quickly from difficulties'.

However, from a theoretical perspective there are significant and important variations in how the term is understood. One of the most useful mappings of the term comes from Bahadur et al. (2010), outlining sixteen different conceptualisations of resilience ranging from the psychological, social and ecological to the economic. This is not simply an academic exercise, as Bahadur et al. (2010: 2) note: '... there has been little attempt to scrutinise the literature to examine how it might underpin an operational approach to resilience'.

What can be seen is the adoption of a term that is varied and in some cases loosely defined, and perhaps more worryingly there is often a lack of awareness that such diversity of interpretation exists. This has real significance when it comes to operationalising the term: different understandings lead to different ‘...notions of the components, characteristics and indicators of resilient systems’ (Bahadur et al., 2010: 5).

### **Gitz & Meybeck (2012)**

‘Risk’ is used here to designate the potential of shocks and stresses to affect, in different ways, the state of systems, communities, households or individuals. Probability, uncertainty (when probabilities of occurrence or even nature of impacts are unknown), severity, economic scale, time scales and direct and indirect costs should be taken into account.

‘Vulnerability’ is the propensity or predisposition to be adversely affected. It is a dynamic concept, varying across temporal and spatial scales and depends on economic, social, geographic, demographic, cultural, institutional, governance and environmental factors. Measuring vulnerability is complex as it needs to be considered across various dimensions.

‘Resilience’ is the ability of a system and its component parts to anticipate, absorb, accommodate or recover from the effects of a hazardous event in a timely and efficient manner, including through ensuring the preservation, restoration or improvement of its essential basic structures and functions.

‘Adaptive capacity’, the capacity of a system to adapt in order to be less vulnerable, is a dynamic notion. It is shaped by the interaction of environmental, social, cultural, political and economic forces that determine vulnerability through exposures and sensitivities, and the way the system’s components are internally reacting to shocks. In fact, it has two dimensions: adaptive capacity to shocks (coping ability) and adaptive capacity to change. The first dimension is related to the coping ability (absorption of the shock), the second dimension is related to time (adaptability, management capacity). Adaptations are manifestations of adaptive capacity.

Importantly, these notions of vulnerability and resilience are applied to systems, which means that first the system(s) to be considered (its components, their boundaries and delineation) has to be clarified in order to assess its vulnerability and/or resilience. Systems can be embedded into one another, meaning that one system can be a component of a major system. Systems can be delineated according to various perspectives (including expected functions), environmental, economic or social (including political and institutional), even though they are linked. Food systems are by nature ecological, economic and social. Each dimension has its own organization and interacts with the others.

### **Mitchell and Harris (2012)**

Resilience: The ability of a system and its component parts to anticipate, absorb, accommodate, or recover from the effects of a shock or stress in a timely and efficient manner.

### **IFRC (2012)**

The sector-wide concept of resilience is rooted in material sciences and ecology but has been applied in various social disciplines and psychology too. It typically relates to the ability of systems to respond and adapt effectively to changing circumstances. In concrete terms, it is the ability of critical physical infrastructure to absorb shocks. From a more psychological point of view, it is the process of adaptation and a set of skills, capacities, behaviours and actions in order to deal with adversity.

For the IFRC, resilience is defined as: The ability of individuals, communities, organisations, or countries exposed to disasters and crises and underlying vulnerabilities to: anticipate, reduce the impact of, cope with, and recover from the effects of adversity without compromising their longterm prospects...

Resilience can be seen as ability of an individual, community, organisation or a country. A comprehensive approach to resilience requires understanding the interconnectedness of these different levels and their link with regional and global levels. The Red Cross Red Crescent analysis often starts at the community level and focuses on community resilience. A comprehensive analysis requires understanding individuals and households and their resilience within the community. In addition, we need to understand the external environment and its impact on the resilience of individuals and their communities. Interventions to strengthen resilience can be taken on different levels and reinforce each other.

### **EU (2012a/b)**

Resilience is the ability of an individual, a household, a community, a country or a region to withstand, adapt, and quickly recover from stresses and shocks such as drought, violence, conflict or natural disaster.

The concept of resilience has two dimensions: the inherent strength of an entity – an individual, a household, a community or a larger structure – to better resist stress and shock and the capacity of this entity to bounce back rapidly from the impact.

Increasing resilience (and reducing vulnerability) can therefore be achieved either by enhancing the entity's strength, or by reducing the intensity of the impact, or both. It requires a multifaceted strategy and a broad systems perspective aimed at both reducing the multiple risks of a crisis and at the same time improving rapid coping and adaptation mechanisms at local, national and regional level. Strengthening resilience lies at the interface of humanitarian and development assistance.

Enhancing resilience calls for a long-term approach, based on alleviating the underlying causes conducive to crises, and enhancing capacities to better manage future uncertainty and change.

### **FAO, IFAD & WFP (2012)**

Definitions of resilience vary but have the common elements of capacity to bounce back after a shock and the capacity to adapt to change. While it is not easy to define resilience in general, resilient communities tend to share the characteristics of having sufficient physical and social assets and technical knowledge to be able to innovate and respond flexibly to shocks.

### **U.S. Agency for International Development (2012, 2013)**

What is resilience? For USAID, resilience to recurrent crisis is the ability of people, households, communities, countries, and systems to mitigate, adapt to, and recover from shocks and stresses in a manner that reduces chronic vulnerability and facilitates inclusive growth.

While the concept of resilience has broad applicability to many of the environments in which our Agency works, this guidance is specifically focused on areas where chronic poverty intersects with shocks and stresses to produce recurrent crises and undermine development gains. In these places, we must increase adaptive capacity – the ability to respond quickly and effectively to new circumstances – and improve the ability to address and reduce risk...

USAID views resilience in the face of recurrent crisis as: the ability of people, households, communities, countries, and systems to mitigate, adapt to, and recover from shocks and stresses in a manner that reduces chronic vulnerability and facilitates inclusive growth.

USAID defines resilience as the ability of people, households, communities, countries, and systems to mitigate, adapt to and recover from shocks and stresses in a manner that reduces chronic vulnerability and facilitates inclusive growth.

### **UN (2013)**

Disasters caused by earthquakes, floods, droughts, hurricanes, tsunamis and more can have devastating impacts on people, environments and economies. But resilience – the ability of people and places to withstand these impacts and recover quickly – remains possible.

### **OECD (2013)**

Resilience is most often defined as the ability of individuals, communities and states and their institutions to absorb and recover from shocks, whilst positively adapting and transforming their structures and means for living in the face of long-term changes and uncertainty.

Often, these three capacities are used at the same time. For example, a coastal community may use its absorptive capacity to protect livelihoods against annual flooding, using knowledge passed down from generation to generation. It can also use its adaptive skills to change how it cultivates crops and manages drinking water resources as a response to growing climate change-related water salinisation. Finally, the community can transform itself by seeking alternative income sources and/or by strengthening conflict resolution mechanisms.

Building resilience in a developing country context, therefore means enhancing the capacity of individuals, communities and states to absorb, adapt and transform to the shocks and risks that they should normally be expected to deal with.

### **Rockefeller Foundation (2013)**

Resilience means different things across a variety of disciplines, but all definitions are linked to the ability of a system, entity, community or person to withstand shocks while still maintaining its essential functions. Resilience also refers to an ability to recover quickly and effectively from catastrophe, and a capability of enduring greater stress.

Humans are not born resilient – we learn it, adapt it, improve upon it. The same is true for organizations, systems, and societies. But what makes some people or organizations more resilient than others? Through research, practice, and experience – including The Rockefeller Foundation’s 100 years of work – we have learned that resilient systems share five core characteristics:

- Spare capacity, which ensures that there is a back-up or alternative available when a vital component of a system fails.
- Flexibility, the ability to change, evolve, and adapt in the face of disaster.
- Limited or ‘safe’ failure, which prevents failures from rippling across systems.
- Rapid rebound, the capacity to re-establish function and avoid longterm disruptions.
- Constant learning, with robust feedback loops that sense and allow new solutions as conditions change.

...

To strengthen manufacturing and build a more resilient global economy, we must nurture the next generation of scientific talent...

Resilience-building strengthens the capacities of vulnerable households and communities to adapt to changing circumstances, manage an increasingly complex risk environment, and cope with shocks they are unable to prevent... Resilience – the ability to absorb and bounce back from chronic shocks and stresses.

### **World Economic Forum (2013)**

In the wake of unprecedented disasters in recent years, “resilience” has become a popular buzzword across a wide range of disciplines, with each discipline attributing its own working definition to the term. A definition that has long been used in engineering is that resilience is the capacity for “bouncing back faster after stress, enduring greater stresses, and being disturbed less by a given amount of stress”. This definition is commonly applied to objects, such as bridges or skyscrapers. However, most global risks are systemic in nature, and a system – unlike an object – may show resilience not by returning exactly to its previous state, but instead by finding different ways to carry out essential functions; that is, by adapting. For a system, an additional definition of resilience is “maintaining system function in the event of disturbance”... The working definition of a resilient country for this report is, therefore, one that has the capability to 1) adapt to changing contexts, 2) withstand sudden shocks and 3) recover to a desired equilibrium, either the previous one or a new one, while preserving the continuity of its operations. The three elements in this definition encompass both recoverability (the capacity for speedy recovery after a crisis) and adaptability (timely adaptation in response to a changing environment).

### **BMZ (2013)**

Resilience is the ability of people and institutions – whether individuals, households, local communities or states – to withstand acute shocks or chronic stress caused by fragile situations, crises, violent conflict or extreme natural events, and to adapt and recover quickly without compromising their medium and longer-term prospects.

### **Bahadur et al. (2013)**

The term resilience is encountered in many disciplines, but no definition is common to all. Different elements or attributes of resilience are emphasized, but all definitions speak in a general way to the continued ability of a person, group, or system to adapt to stress – such, as any sort of disturbance – so that it may continue to function, or quickly recover its ability to function, during and after stress. (CPPSC, 2011, p. 13)

In the field of psychology, ‘...resilience is defined as the quality that prevents individuals who are at genetic risk for maladaptation and psychopathology from being affected by these problems’ (Cicchetti & Blender, 2004, p. 17325). The field of structural and engineering science has also explored and employed resilience. For example, the concept of seismic resilience of buildings understands it to be the property of a system which has: ‘1. Reduced failure probabilities; 2. Reduced consequences from failures, in terms of lives lost, damage, and negative economic and social consequences; 3. Reduced time to recovery’ (Bruneau & Reinhorn, 2006, p. 1). This has underpinned ideas around climate resilient design that dominate adaptation discussions related to infrastructure (McDaniels, Chang, Cole, Mikawoz, & Longstaff, 2008).

Economic theory has incorporated resilience thinking in terms of the internal motivation and stimulus of private or public policy that enables a system to recover from a severe shock (Rose, 2004). Economic

resilience has been applied at micro level (individual firms, households or organisations), meso level (economic sectors, individual markets, cooperative groups or cities) and macroeconomic (all individual units and markets combined) (Rose, 2004). At the county level, this has been particularly significant in small island economies in relation to economic openness and natural hazard-induced disaster events, as well as to regional and urban development elsewhere (Briguglio, Cordina, & Farrugia, 2009). Business management approaches have also drawn on resilience as a strategy to manage disaster impacts, including from property damage to stocks and indirect business interruption to flows (Webb, Tierney, & Dahlhamer, 2000).

Moser (2008, p. 5) reviews understandings of resilience in the social sciences to argue that most theories in this domain are ‘...derivative of the ecological theories from which resilience first emerged’. There is widespread consensus among social and natural scientists that studying resilience involves the adoption of cross-disciplinary and multi-disciplinary methods, as natural and social systems are highly integrated (Folke, 2006). While a high degree of interconnectedness between social and ecological systems is widely acknowledged, theories have emerged that are based variously on an understanding of resilience in social systems (or social resilience), those that stress resilience in ecological systems, and those that see the two as highly interconnected.

The socio-ecological system (SES) has emerged as a conceptual entity that can give the social and ecological systems the same weight in their analysis (Folke, 2006). These are ‘... linked systems of people and nature. The term emphasizes that humans must be seen as a part of, not apart from, nature – that the delineation between social and ecological systems is artificial and arbitrary’ (Simon, 2009). Mayunga (2007) acknowledges the interconnection of human and ecological systems by stating that both natural capital (air, soil, etc.) and social capital (trust, norms and networks) have a role in determining the resilience of a system. This is in contrast to Folke (2006), who does not isolate human/social and natural/eco- logical factors, seeing them instead as a highly integrated, systemic ‘whole’. Central to resilience thinking in socio- ecological systems is the adaptive cycle through which all systems go through four phases – ‘exploitation, conservation, release and renewal’ (Gunderson & Holling, 2001, p. 5). Closely associated with this is the notion of Panarchy that explains how adaptive cycles are simultaneously taking place within system components at different scales (Gunderson & Holling, 2001).

### **Anderies et al. (2013)**

Most people have an intuitive notion of resilience: the capacity to sustain a shock and continue to function and, more generally, cope with change (Walker et al. 2004, 2006). Within the scientific domain, resilience has evolved into an intellectual framework for understanding how complex systems self-organize and change over time. Carpenter and Brock (2008) describe resilience as a “broad, multifaceted, and loosely organized cluster of concepts, each one related to some aspect of the interplay of transformation and persistence.” Understanding this interplay and the related concepts of strong nonlinearities, critical thresholds, and irreversibility in human-environment systems is obviously important for characterizing the sustainability decision- making context. Resilience is a powerful tool in this regard.

It is important to point out that resilience is a system-level concept and is distinct from sustainability in that it is not normative, i.e., it does not include specific choices about performance measures: We seldom hear of sustainable dictatorships, but there are resilient dictatorships. The use of resilience concepts for decision making requires the addition of performance measures. Often, the performance measure is implied. For example, Catchment Management Authorities in New South Wales, Australia, now state that their goal is “to develop resilient communities and agricultural systems”... However, from the context in which such statements are made, a sustainability performance measure is implied, and

the goal of developing resilience is an acknowledgment that catchments are operating in a sustainability decision-making context. Resilience researchers have recognized the need to address the question of “resilience of what to what” (Carpenter et al. 2001) in relation to particular regime shifts (e.g., specific measures of early warning signals or functional diversity; Elmqvist et al. 2003, Scheffer et al. 2009). When the “of what to what” is clear, this is referred to as specified resilience. In contrast, general resilience refers to broader system-level attributes such the ability to build and increase the capacity for learning and adaptation (Walker et al. 2009, Folke et al. 2010). The resilience lens is useful for making suggestions about broad categories of investment such as in the capacity to learn, adapt, and transform without being too specific about what this actually means in practice, i.e., how much it costs, who pays, who benefits, etc. Thus, although resilience thinking provides heuristics for living in a complex world, its system-level nature limits its utility in concrete decision analysis, at least in its current state of development.

### **Boto et al. (2013)**

The concept of resilience is rooted in material sciences and ecology, but has also been applied in various social disciplines and psychology. In concrete terms, it is the ability of critical physical infrastructure to absorb shocks. From a psychological point of view, it is the process of adaptation and of developing a set of skills, capacities, behaviours and actions necessary when dealing with adversity...

- The Asian Development Bank and the International Food Policy Research Institute (IFPRI) define resilience as the ‘magnitude of disturbance that a system can withstand without crossing a threshold into a new structure or dynamic. In human systems, resilience refers to the ability of communities to withstand recover from stress, such as environmental change or social, economic or political upheaval, while for natural systems, it is a measure of how much disturbance (storms, fire and pollutants) an ecosystem can handle without shifting into a qualitatively different state.’
- For DFID, resilience is “The ability of countries and communities to manage change, by maintaining or transforming living standards in the face of shocks or stresses –such as earthquakes, drought, or violent conflict without compromising their long-term prospects”
- The Intergovernmental Panel on Climate Change defines resilience as “The ability of a social or ecological system to absorb disturbances while retaining the same basic structure and ways of functioning, the capacity for self-organization, and the capacity to adapt to stress and change” (IPCC, 2007)
- The Resilience Alliance defines resilience as ““The capacity of a system to absorb disturbance and reorganize while undergoing change”
- For the United Nations International Strategy for Disaster Reduction, resilience is “The ability of a system, community or society exposed to hazards to resist, absorb, accommodate to, and recover from the effects of a hazard in a timely and efficient manner, including through the preservation and restoration of its essential basic structures and functions.
- The World Bank defines resilience as “The ability to withstand, recover from, and reorganize in response to crises so that all members of society may develop or maintain the ability to thrive”
- The World Economic Forum defines resilience as (i) the adaptability to changing contexts, (ii) the capability to withstand sudden shocks, and (iii) the ability to recover to a desired equilibrium, either to the previous one or a new one, while preserving the continuity of its operations.

In spite of the variations of the definition, all share four common elements: i) Context... ‘resilience of what?’ ... ii) Disturbance... Shocks... Stresses... iii) Capacity to deal with disturbance: The ability of the

system or process to deal with the shock or stress is based on the levels of exposure, the levels of sensitivity and adaptive capacities... iv) Reaction to disturbance... bounce back better... 'bounce back' to a normal, preexisting condition, or to 'recover, but worse than before'

### **Béné et al. (2013)**

Resilience is not just about the ability to maintain or return to a previous state; it is about adapting and learning to live with changes and uncertainty. There are three types of capacity that are important in helping people do this: (i) absorptive capacity, that is, the ability to cope with, and absorb the effects of shocks and stresses – for instance when a household temporarily reduces its expenses following a drop in its income; (ii) adaptive capacity, that is, the ability of individuals or societies to adjust and adapt to shocks and stresses, but keep the overall system functioning in broadly the same way – for instance when a household decides to diversify its crops in order to respond to changing weather conditions; (iii) transformative capacity, that is, the ability to change the system fundamentally when the way it works is no longer viable – for example, when a farmer decides to stop farming, and migrates to a city to become a taxi driver.

### **Moberg and Simonsen (2013)**

Resilience is the capacity of a system, be it an individual, a forest, a city or an economy, to deal with change and continue to develop. It is about the capacity to use shocks and disturbances like a financial crisis or climate change to spur renewal and innovative thinking. Resilience thinking embraces learning, diversity and above all the belief that humans and nature are strongly coupled to the point that they should be conceived of as one social-ecological system.

### **Barthel and Isendahl (2013)**

Ecological resilience was originally conceived in forest ecology (Holling, 1973), linked to the interrelated behavior of sets of species over time in spatially defined areas (Folke, 2006). Social–ecological resilience is defined as the capacity to absorb shocks, utilize them, re-organize, and continue to develop without losing fundamental functions. Diversity has been put forward as an overriding principle of social–ecological resilience. The evolutionary logic is that “diversity of species within the same functional group, superficially described as a redundancy, add resilience to that specific ecosystem function (e.g. pollination), because each species responds differently to a given disturbance” (Folke et al., 1996), as memories of past experiences are captured in the genetic pool of each species. Since it informs future responses and renewal in relation to disturbances by drawing on different forms of memories, the capture and use of experiences – sometimes called learning – is another key principle of resilience. Analyzing features that brings “captured experiences” into periods of crises is one way to unpack temporal sources of resilience. One concept that deals with such temporal resilience dynamics is called social–ecological memory. Such memory also includes features of wider spatial importance for renewal after collapse.

### **Kindra (2013)**

There is no standard definition of the term... The UN International Strategy for Disaster Reduction defines the term as “the ability of a system, community or society exposed to hazards to resist, absorb, accommodate to and recover from the effects of a hazard in a timely and efficient manner.” The Intergovernmental Panel on Climate Change, meanwhile, describes resilience as “the amount of change a system can undergo without changing state”. The UK Department for International Development defines it as “the ability of countries, communities and households to manage change, by maintaining or

transforming living standards in the face of shocks or stresses... without compromising their long-term prospects.”

But according to UNDP, these and other definitions focus too narrowly on responding to shocks rather than preventing or preparing for them, and their stated goal is only to return beleaguered communities to their original state. UNDP therefore proposes to define resilience as a “transformative process of strengthening the capacity of people, communities and countries to anticipate, manage, recover and transform from shocks” – otherwise known as build back better.

Resilience “is more of a process than an outcome,” said Samuel Doe, UNDP’s focal point on resilience... Any community targeted by a programme with a resilience component is meant to end up with improved self-esteem, gender sensitivity, the ability to organize themselves, an effective early warning system, and other forms of self-sufficiency, he says.

### **Walker (2013)**

The definition of resilience: the capacity of a system to absorb disturbance, re-organize, and keep functioning in much the same way as before. But there are limits, or thresholds, to a system’s resilience, beyond which it assumes a different way of functioning – a different identity. Many coral reefs that were once home to a rich diversity of fish, for example, have become algal or turf ecosystems with very few fish.

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