Re-formulating Community as a Complex Social System

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Abstract

Communities today are known to be complex (Fuller 1994; Smith 1998), subject to processes of local and global change. Past approaches to the study of community, although proven to be useful, are inadequate for understanding the processes of complexity. Complex systems thinking offers an alternative. The purpose of the paper is to explore the extent to which complex systems thinking contributes to an understanding of community. At present, however, there is no established theoretical link between community and complex systems upon which to pursue this line of inquiry. Interaction, however, emerges as a useful link. It is essential to a basic understanding of system as well as theories of complexity. Interaction also appears immediately and centrally in the common understanding of community. Further examination reveals that social interaction is viewed as the essence of community. This sets the basis for re-formulating community as a complex social system, offering a foundation upon which to pursue deeper levels of inquiry into the processes of complexity of community systems, as well as other aspects of complex systems thinking. This may also facilitate future research in traditional topics such as evolution, as well as in current topics such as social capital and social cohesion.

Glossary of terms

The following sets out how the term 'system' is used in different contexts in the paper.

System: defined as "a set of objects together with relationships between the objects and between their attributes" (Hall and Fagen 1980:75); an integrated whole whose essential properties arise from the relationships between its parts (Capra 1996:27); groups of interacting, interdependent parts linked together by exchanges of energy, matter, and information (Costanza et al. 1993). Further, a system exists within physical space-time (Miller 1978) either explicitly or implicitly (Bailey 1990).

System theory(ies): applies to systems in a very general sense, not to be associated with any period or type of systems approaches.

Systems thinking: defined as the understanding of a phenomenon within the context of a larger whole (Capra 1996:27); covers a range of systemic thinking, including general systems theory started in the 1930s and more fully developed by in the 1960s; also includes open systems theories, soft systems methodologies, and complex systems thinking. Note that Talcott Parsons' theories of social systems is commonly excluded from the field of systems thinking since it was developed in the 1930s and 1940s prior to the development of Bertalanffy's general systems theory (Lilienfeld 1978:196).

Open system theory: theories or concepts related to systemic thinking premised upon open systems; includes, for example, cybernetics and systems analysis; generally, constitutes much of systems thinking up to the 1980s; developed prior to the emergence of complexity theories. The main concepts of an open system are:

1. 'The characteristic state of the living organism is that of an open system.' It is open in the sense that it exchanges material with its environment; by this import and export of materials, there is change of components. Previous conceptions of the organism as maintaining a state of equilibrium must yield to the idea of the *steady state*.
2. The concept of the open system maintaining itself in a steady state represents a departure from the concepts of classic physics, which has dealt for the most part with closed systems….
3. The mathematics of the steady state may be developed based upon the nature of the chemical reactions going on within the system, some of which may be reversible…. (Lilienfeld, 1978:18)

Complex systems thinking: refers to theories and concepts associated with theories of complexity; also known as "dynamical systems theory," "the theory of complexity," "non-linear dynamics," "network dynamics"; self-organisation, autopoiesis, and dissipative structures, chaotic attractors, and fractals, are some of its key theories and concepts (Capra 1996).

1.0 Introduction

Communities today are known to be complex (Fuller 1994; Smith 1998), subject to processes of local and global change. Past approaches to the study of community, although proven to be useful, are inadequate for understanding the processes of complexity. The failure to account for disorder (Wilkinson 1970) and indeterminacy (Boudon 1994) exemplify such limitations. Alternatively, complex systems thinking can address this aspect of community directly. The advance of complex systems thinking in sociology over the past twenty years suggest that there is an opportunity to know more about communities. The purpose of the paper is to explore the extent to which complex systems thinking, as an alternative approach, contributes to an understanding of community. At present, however, there is no established base upon which to pursue this line of inquiry. As explored in the paper, interaction emerges as a theoretical link between complex systems thinking and community. Interaction is essential to a basic understanding of system and theories of complexity. It also appears immediately and centrally in the common understanding of community. Further examination of the meaning of community reveals that social interaction may be viewed as the essence of community. This sets the basis for re-formulating community as a complex social system. Although it may be too early to know the extent to which this useful, more importantly, it offers a foundation upon which to pursue deeper levels of inquiry into the processes of complexity of community systems, as well as other aspects of complex systems thinking. This may facilitate future research in traditional topics such as evolution, as well as in current topics such as social capital and social cohesion.

The paper is structured as follows. It begins with a review of approaches to community studies. Based primarily upon the work by Bernard (1973), the focus is upon approaches as defined by paradigms, including descriptions of each approach. The critique of these approaches sets up a review of complex systems thinking as an alternative paradigm to guide the study of community. A review of self-organisation and dissipative structures, two theories of complexity, provides a deeper understanding of complex systems thinking. Subsequently, community is re-formulated in the 'language' of complex systems thinking. This, then, provides the basis upon which to assess the usefulness of complex systems thinking for the study of community, and specifically as it pertains to sustainable rural communities.

2.0 The Study of Community: Paradigms and Frameworks

2.1 Is community relevant?

The lack of a clear understanding of what community means is problematic from a research perspective. As Hiskes (1982:21) stated, the problem with community is "not

because it defies all definitions given, but because it seems to collect them." In addition, past debate about the "demise" of community in conjunction with ambiguity of the term itself suggest that it is important to reflect upon the relevance of community as a prelude to the main argument of the paper. The range of debate among sociologists about the relevance of community is varied, and has been active for at least fifty years. Krannich and Greider (1990:61) suggested that by the mid-nineteenth century community was not relevant because "there were few if any remnants of the type of traditional social relations which when interwoven comprise community." This perspective signifies, in the words of Stein (1960), the "eclipse of community". Wilkinson (1979:8), on the other hand, suggested that community, as "an arena for immediate expression of the fundamental human disposition toward association," is an important factor in social well-being. In support of Wilkinson's view, references to community remain dominant in today's social policy. For example, there are the "community" capacity building programs of the Government of Canada's Rural Secretariat and of Human Resources Development Canada, as well as the "community" economic development programs of the Ontario Ministry of Agriculture, Food, and Rural Affairs. (Although none of these programs appear to offer a specific understanding or definition of community.[1]) In addition, a practical dimension of community exists.

> "People still live next door to others, they eat, sleep, love, hate, avoid, or seek one another in a given locale. Whether or not they have much to do with their neighbours, they use the same grocery store or supermarket, attend the same movie houses, and patronize the same beauty parlours or barber shops. Owners and renters, they depend on the same community services such as, humble as they may be, garbage collection, street cleaning, and police protection. However emancipated from spatial barriers and however independent of locale the elite may be, it is still on the community scene that for most human beings interaction takes place" (Bernard 1973:187).

This practical view of community looms in the hearts and minds of some rural residents. Documented in a study of rural communities, one resident who lived on a small farm, worked at a local hospital, and volunteered as a district leader of a youth organisation, proclaimed, "My grandmother told me that in twenty years, our communities won't exist" (Wall and Connell 2000). Municipal restructuring, changes in the delivery of government services, school closures, and funding cutbacks, she explained, were breaking parts of the "community wheel." As expressed in policy, theory, and rural residents, the concept of community appears to retain some relevance and, hence, provides reason for studying community as an analytical category for research.

[1] This is based on the author's review of each agency's website. In addition, the author had the opportunity to listen to a presentation by a senior, federal bureaucrat (October 2000) that included many references to community, e.g., community capacity. Following the presentation, the author asked the presenter if community was defined for these policies. The presenter replied that there was no definition.

2.1 Analytical Frameworks

A review of community studies reveals that researchers have used different approaches to sort out its varied meanings. For example, Stein (1960) composed the study of community as three broad fields of interest characterised by the disciplines of community researchers: anthropological, psychoanalytic, and sociological. Bell and Newby (1971) distinguish among different studies of community, e.g., the Chicago school, Yankee City, the southern Italian studies. Poplin (1972) classified theories of community as human ecology, constructed types (e.g., Toennies' *gemeinschaft* and *gesellschaft*; Redfield's folk-urban continuum), social system/functionalism, action and leadership, and change and problems. Hiskes (1982) identified four models of community, namely, organic, public interest, private interest, and respect. The listing of these frameworks illustrates some of the diversity within the field of community studies. To examine the approach to community studies in more detail, the author will draw upon Bernard's *The Sociology of Community*.

Bernard's work is appropriate for two reasons. First, her overall objective is similar to the purpose herein, that is, Bernard questioned the usefulness of "normal-science research" for the study of community. While she focussed upon a critique of past approaches, she left the search for an alternative open. In this way, the line of inquiry adopted in the paper picks up where Bernard left off. The second reason for following Bernard's lead is that she constructed her inquiry within the context of paradigms. Citing Kuhn, she presented paradigms as "universally recognised scientific achievements that for a time provide model problems and solutions to a community of practitioners" (Bernard 1973:6). In framing approaches to community studies as paradigms, Bernard emphasised the set of beliefs embraced by each, as will be reviewed below. However, to avoid overuse of the term paradigm, and to provide greater clarity, the term 'analytical frameworks' is used to refer to Bernard's "classic community paradigms", while maintaining Bernard's use of the term "overarching paradigm." The intent of this change is to retain a meaning of paradigm more consistent with a broader worldview than implied by Bernard.

The following is a descriptive account of Bernard's paradigms and analytical frameworks. The objective is to demonstrate how one author deconstructs the study of community and subsequently critiques the various approaches. Bernard suggested that two "overarching paradigms" guided four analytical frameworks ("classic community paradigms") of community study. Although not specifically community paradigms, the two overarching paradigms of capitalism and structure-functionalism "constituted the encompassing matrix within which community research took place" (Bernard 1973:15). Within the capitalist paradigm, human relations were subject to the rational, achievement-oriented, and acquisitive interests of human beings. In addition, research within the capitalism paradigm promoted human beings as "full of initiative and out to win, socialized by their religion into an ethos of work, exalting competition, using profit

as information for decision making, viewing the new industrial order as a great beneficent natural force" (18). Bernard suggested that this had two significant repercussions for the study of community. First, the market became the foundation for decision making. Second, "the psychological and sociological commitments of the market" (16) were often used to characterise normative aspects of community, particularly as it pertains to the rural-urban dichotomy.

The second overarching paradigm that influenced community studies is structure-functionalism. This may be briefly described as concerning itself more with the institutions and the overall system to which the structures belong (22). As such, this guided one to look either for the functions performed by a given structure or for the way the functions of a system were structured. "A conventional approach to the study of community would analyse the formal institutions – family, school, church, industry, and government – that performed the functions required for its on-going life and show how they intermeshed with one another in a coherent whole" (23). Bernard equates the structure-functional paradigm with social-systems analysis or, more generally, as a systems approach. (This includes Talcott Parsons' theories of social systems, but lies outside of systems thinking, which covers a range of systemic thinking, including open systems theories, soft systems methodologies, and complex systems thinking.)

The four 'classic' analytical frameworks of community study are ecological, class, power structure, and rural-urban. It is evident in each of the following descriptions, as Bernard argued, how the overarching paradigms shaped the various frameworks, with some drawing more heavily upon one or the other overarching paradigm.

Ecological: "The ecological model … incorporated different land uses and asked what would be their effect on the nature of the community and the relations among its inhabitants. The 'hidden hand' in both cases was competition in a market with a minimum amount of regulations in which knowledgeable individuals, with profit as feedback information, made rational decisions. But the ecological model could also be viewed as an offshoot of the structure-functional or social-systems paradigm as applied to one particular aspect of the community—its spatial parameters. For functions were implicit on the concept of land use, and the interconnectedness of subsystems was intrinsic to it" (33).

Class: The ranked-status aspect of class, i.e., characterised in terms of upper, middle, and lower rank, was incorporated into community frameworks. This being different from 'functional' class based on the division of labour, which was implicit in the paradigm of capitalism (51). Bernard emphasises the visibility of ranked-status in local communities, e.g., others can see the family living in the large house on the hill. "Social class is therefore more meaningful, more personal, and more immediate at the local level" (53).

Power Structure: Power in communities takes on many forms, both personal power premised upon the ecological notion of interdependence, and impersonal power, premised upon functional dominance. The latter formed two research traditions, one concentrating

on the economic function and the other on the political function as seats of power. The power structure framework was also guided by an elitist orientation; emphasising class; and a pluralist orientation emphasising groups (71-89).
Rural and urban communities: This framework viewed "community itself as an independent rather than a dependent variable, shaped by far-flung impersonal forces – urbanisation, bureaucratisation, and industrialisation – and at the mercy perhaps of outside forces and power complexes" (89). This approach is best characterised by Ferdinand Toennies' *gemeinschaft* and *gesellschaft*. "Neither term referred to community in the settlement sense, nor did agrarianism and urbanism, their transmogrified form. But in actual practice, the rural community came to represent one and the city the other; one good and the other bad; one having a benign effect on its members, the other a sinister one" (91). In one form or another, the rural-urban, or community-city, framework "has been stated in different forms by different observers, but essentially they have all referred to the changes that took place in the nature of human relationships when preindustrial, isolate, 'closed,' 'folk' communities became urbanised or 'open' by becoming integrated into a wider industrial system. … When it became operationalised for research purposes, it took the form of the study of rural and urban communities" (92).

The benefit of presenting Bernard's work is to provide an organised, comprehensive account of community studies from different perspectives. By arranging them within the context of paradigms and frameworks, she has provided a basis that may be critiqued and, subsequently, against which complex systems thinking may be considered an alternative.

2.2 The paradigms and frameworks critiqued

Bernard critiqued each of the paradigms and frameworks and concluded that, while encompassing most of what is known about the sociology of community, they are in a state of crisis. She argued that each of the approaches to the study of community was hindered by "an enormous preoccupation with change."

> The growth of cities and the ecological processes themselves all implied changes: the social mobility of the Yankee City model implied changes that would result in the assimilation of ethnic groups; the power [frameworks] … had implied, if they had not explicitly stated, changes in the wielders of power if not in the structure of power itself, although Dahl's model had also shown changes over time even here; the *gemeinschaft -gesellschaft* [framework]… was, in effect, itself a [framework]… of change in the form of urbanisation and industrialisation (Bernard 1973:119)[2].

Most critically, the limitations of the community frameworks are embedded in the dominant ideologies within which they were developed. It has been the advance of the understanding of community, of social systems, and of the nature of social problems, that

[2] The link between theories of community and theories of social change become intertwined. This is re-visited later in the paper.

undermines previous efforts. With regard to capitalism, the subsequent rise of the welfare state undermined much of its primary assumptions about the ability to rely upon market forces as the basis for decision making. Also, conflict came to displace the virtues of competition. Structure-functionalism faced a different ideological crisis, eventually submitting to the frequent criticism about its conservative approach and penchant for promoting the status quo. As the overarching paradigms began to show their limitations, ever more anomalies began to appear in each of the 'classic' community frameworks.

Generally, Bernard's criticism of past approaches to the study of community is consistent with other authors who attribute these limitations to the dominance of "normal science research" in community studies as well as such pervasive concepts as modernisation. For example, according to Wilkinson (1970:151), "A theory of order is hamstrung from the outset by the fact that disorder, not order, is the dominant feature of many, and perhaps most, human events." Similarly, Boudon (1984) stated: "non-determined processes are just as interesting from the point of view of knowledge as rigorously determined ones" (156-7); and, "When we say that [an event] is due to chance, are we not really saying that it has *no* cause, or at least none that we know? In fact, not only does it certainly *exist*, but it is important to *recognise* that [the event] exists if we wish to account for an enormous number of phenomena" (173). These limitations, in general, reflect a scientific paradigm based on the Cartesian belief in the certainty of scientific knowledge.

> The belief that in every complex system the behaviour of the whole can be understood entirely from the properties of its parts is central to the Cartesian paradigm [and structure-functionalism]. This was Descartes's celebrated method of analytic thinking, which has been an essential characteristic of modern scientific thought. In the analytic, or reductionist, approach, the parts themselves cannot be analysed any further, except by reducing them to still smaller parts. Indeed, Western science has been progressing in that way, and at each step there has been a level of fundamental constituents that could not be analysed any further (Capra 1996:29).

Lilienfeld (1978:199-200) echoes these thoughts. He argued that the domination of equilibrium, consensus, or functional theory gave rise to earlier criticisms of methods as being either mechanical or organismic in nature. Further, he stated that these models are inappropriate for the study of culture and society. The outcome is that such conventional, linear models and metaphors provide a limited picture of reality (Price 1997). The rural-urban continuum, the premise of modernisation and urbanisation theories, may be included in this context. Turner (1997:xiii), while claiming that the 'hidden agenda' of science and philosophy has been to eliminate the conceptual problems of change, stated that the traditional hard science method, "which has proved enormously useful and will continue to do so, is now shown to have limits; the new science shows us what they are and how other methods can take up where the traditional ones leave off." Therefore, the

paper now turns to complex systems thinking in response to the above concerns and as an alternative for the study of community.

3.0 *Complex systems thinking*

Complex systems thinking refers to theories and concepts associated with theories of complexity; also known as "dynamical systems theory," "the theory of complexity," "non-linear dynamics," "network dynamics"; self-organisation, autopoiesis, and dissipative structures, chaotic attractors, and fractals, are some of its key theories and concepts (Capra 1996). Complex systems thinking is subsumed by the more general term *systems thinking*, which also includes open systems theories, soft systems methodologies, and complex systems thinking.

3.1 The Paradigm of Complex System Thinking

Complex systems thinking is presented as an alternative paradigm to those presented by Bernard, suggesting that this 'new language' for understanding the connectedness, relationships, and context of complex, highly integrative systems (Capra 1996) may also influence the study of community. Complex systems thinking may be characterised, generally, using four components: unpredictability, the nature of change, wholeness, and adaptation (Turner 1997). The first key characteristic is that complex systems, by their nature, are 'inherently unpredictable.' In contrast, the possibility of predicting an event relies on two assumptions: "that the chain of causes is recoverable and that the universe is fundamentally deterministic in its nature" (Turner 1997:xiii). Hence, the first fundamental outcome of adopting a complex systems thinking approach is that efforts directed at prediction may be replaced by efforts directed at understanding such events in different ways. According to Turner, "'unpredictable' does not necessarily mean 'unintelligible,' or inaccessible to knowledge and understanding" (xiv).

Turner's second key characteristic of complex systems thinking is its relevance for understanding change. What has previously been accounted for as a 'margin of error,' is now revealed as feedback associated with nonlinearity. This provides an alternative view of the 'forces' attributed to social change such as modernisation and urbanisation. Price (1997:13), for example, places evolution within the context of systemic global properties: "Theorists of complexity assert that local rules produce global properties, that systems move in the direction of increased variation and complexity, and there is an 'edge of chaos' that strikes a balance between stagnation and anarchy." The underlying logic is that societies reach critical stages, i.e., bifurcation points, at which new paths open up for them leading to new levels of complexity.

Complex systems thinking also changes the way the whole system is viewed, and specifically how macro-micro relations are viewed. Conventionally, a system is defined

as an integrated whole whose essential properties arise from the relationships between its parts (Capra 1996:27). However, this kind of holism, when viewed as a reduction to the whole, is just as problematic as the reductionism complexity theorists oppose. "Holism typically overlooks the interactions and the organisation, whereas complexity pays attention to them" (Price 1997:10). In this, the third characteristic of the complex systems thinking paradigm is that society is contextualised in its own local-global relations. By emphasising the relationships that exist within the system, rather than the existence of the system as a whole, complex systems thinking downplays, to some extent, the inherent difficulty of delineating system boundaries.

The concept of adaptation, another key characteristic of complex systems thinking, derives from these local-global relations. The system adapts to perturbations arising from its environment, i.e., its 'higher' layers, which gives rise to another perspective of stability. "A complex adaptive system is a system in which interactions give rise dynamically to emergent phenomena that are resilient in the face of perturbations" (Smith 1997:55). In this context, it is the system's ability to adapt that gives rise to stability. And the context, or environment, sets out the constraints that influence what properties of the system may emerge.

This description of complex systems thinking is sufficient to distinguish it from Bernard's paradigms of community study. In comparison, complex systems thinking complements Bernard's overarching paradigms while encompassing the four analytical frameworks. As such, complex systems thinking should be considered more than just an alternative to current frameworks; it represents a possibly new way to understand and to research community. Although an alternative to existing paradigms, complex systems thinking may be viewed as grounded within the scientific tradition (Price 1997). In recognising the need to modify reductionism, complex systems thinking responds to the limitations presented above. Premised upon nonlinearity, it reconstructs rather than deconstructs the classical scientific model.

A brief account of the principal theories of complexity lends insight to how a nonlinear approach can be pursued, and, subsequently, how such an approach may be applied to the study of community. Interaction, as will be seen, is a critical concept of complex systems thinking. Beginning with a basic definition of system as groups of *interacting*, interdependent parts (Costanza et al. 1993), the concept appears consistently throughout complex systems thinking and is the key for many disciplines that have embraced complexity (Smith 1997). Subsequently, it will be shown how interaction provides the theoretical link between complex systems theory and community.

3.2 Theories of Complexity

Emergence, a strong, intuitive construct central to complex systems thinking, is presented here to introduce two theories of complexity, namely, self-organisation and dissipative

structures. Emergence describes the phenomenon of seeing spontaneous order *emerge* from disorder (as opposed to 'planned' change). More specifically, emergence refers to the process in which patterns of global-level structures arise from interactive, local-level processes (Mihata 1997).

> What defines such an emergent property is that it cannot be understood merely as an aggregative product of the entities or parts of the system but arises through their organisation. Interaction often yields … forms that cannot be understood through simple linear decompositions of its systems into its interacting parts. The problem of studying these complex interactions has become the focus of research on complex systems—systems in which interactions among parts are marked by nonlinear dynamics (Smith 1997:55).

This description of emergence encapsulates the intuitive characteristics of complex systems thinking described above. Moving forward, it gives context to theories of self-organisation and dissipative structures. Self-organisation is a theory pertaining to the characteristic ability of the whole system to respond to disorder. Dissipative structures, a more detailed aspect of self-organisation, is a theory of how the system manages the balance of order and disorder, that is, it is a theory of system self-regulation. As such, emergence, self-organisation, and dissipative structures are inter-related and may be used to describe different aspects of structure, process, and pattern within complex systems.

3.3 Self-organisation

Self-organisation is a fundamental characteristic of complex systems. The 'self' part means that this ability stems from within the system, rather than from external imposition. The 'organisation' part speaks to the organising of behaviours and structures, which relate to pattern. In complex systems thinking, pattern of organisation is a configuration of relationships characteristic of a particular system and systemic properties are properties of a pattern (Capra 1996). It is the spontaneous emergence of pattern that is known as self-organisation.

Several important characteristics define self-organisation (Capra 1996). First, modes of behaviour, in addition to structures, may be created through the process. Second, self-organising systems operate far from equilibrium, that is, in conditions produced by continual disturbances from without or self-amplifying (via positive feedback loops) from within the system. This condition provides a constant flow of energy necessary for self-organisation to take place. Third, as per the definition of complex systems, all models include nonlinear interconnectedness of components resulting in feedback loops. Thus, self-organisation contrasts with a more conventional, mechanistic understanding of systemic change. The latter relies upon external conditions to explain the parameters of change among system components. Identifying emergent, or *global*, properties of self-organising systems marks a shift from an interest in quantity to quality, from detail to patterns. By looking at patterns of interaction, one is more interested in system behaviour than with time-specific values of variables. The

phenomenon giving rise to pattern is called a strange attractor, which is produced by the repetitive iteration of very simple rules that govern interaction (Eve et al. 1999). Most importantly, "strange attractors are not detached from the system, but very precisely *in* and defined by the process that it shapes and governs" (Eve et al. 1999:xxiii).

3.4 Dissipative structures

The theory of dissipative structures is the most influential, detailed description of self-organising systems (Capra 1996). A dissipative structure is not just an outcome of a process, it is both process and structure; it is an evolving, interactive process that is temporarily manifested in globally stable structures. This notion of structure is fundamentally different from any conventional sense of the term, which may be seen as static and (literally) concrete. Dissipative *structure*, on the other hand, only exists in the context of flows that occur in system states far from equilibrium. Prigogine coined the term "dissipative structures" to describe the co-existence of continual flow and structural stability.

> According to Prigogine's theory, dissipative structures not only maintain themselves in a stable state far from equilibrium, but may even evolve. When the flow of energy and matter through them increases, they may go through new instabilities and transform themselves into new structures of increased complexity.
>
> Prigogine's detailed analysis of this striking phenomenon showed that while dissipative structures receive their energy from outside, the instabilities and jumps to new forms of organization are the result of fluctuations amplified by positive feedback loops. Thus amplifying "runaway" feedback, which had always been regarded as destructive in cybernetics, appears as a source of new order and complexity in the theory of dissipative structures (Capra 1996:89).

Dissipative structures are the 'structural' qualities of the system. But these 'structures' are openly functional structures through which energy, matter and information continually flow. In this, the term dissipative structure addresses the paradoxical co-existence of change and stability: "The pattern of organization is always embodied in the organism's structure, and the link between pattern and structure lies in the process of continual embodiment" (Capra 1996:160). Hence, dissipative structures function as a *self-regulating* mechanism managing the balance between order and disorder. This self-regulation is what gives rise to self-organisation. According to Kay (1999:3), "systems tend to get better and better at 'grabbing' resources and utilising them to build more structure, thus enhancing their dissipating capability." In this, the capacity and survivability of the community derives from its ability to make "ever more effective use of the resources" to build more structure.

In summary, the theories of self-organisation and dissipative structures both shape and govern complex *social* systems. Complexity, therefore, is both a theory of change (process) and a theory of structure; the two are inseparable. The whole 'structure'

derives from the interaction of simple rules, i.e., it emerges from the process in which patterns of global-level structures arise from interactive, local-level processes (Mihata 1997). In this, pattern of interaction is not a thing, but a property, simultaneously process and structure; it is precisely *in* and defined by the complexity of the system. With this understanding of complex systems thinking, the paper now examines how these concepts might relate to community. In so doing the author attempts to bridge theories of community and complex systems thinking, building upon previous efforts in community studies.

4.0 Community and Complex Systems Thinking

Social interaction is a significant aspect of the commonly held view of community. As early as 1915 the processes of social interaction were purported to be an essential focus of community studies (Kaufman 1955:cf10). Of greater significance within the field of community studies, one may look to Hillery's classic review of various definitions. He identified three common attributes of community, namely, locality, common ties, and social interaction (Dasgupta 1996). However, in attempting to sort out the relative merit of each attribute (of social interaction specifically), one may ask if Hillery's tri-part definition of community revealed the essence of community by searching for commonality among various definitions? Or, alternatively, was something different created as an outcome of the process?

There is reason to suggest that what Hillery derived as a common understanding of community was, in effect, a hybrid which obscures the relationship between social interaction and community. This is first revealed by distinguishing between two distinct, although related concepts associated with community study: "the community" and "community." As Bernard (1973) explained, the former is associated with settlement, which places emphasis upon *locale*; the latter, "community," retains both common ties and social interaction. In effect, this distinction begins to sort out various meanings of community that may be derived from Hillery's definition. Firstly, it helps to think of community as something other than a settlement; locality, however, is never dismissed entirely. Further, in setting aside the settlement aspect of community, it is not necessary to distinguish among types of community, e.g., rural versus urban. (Specific reflection upon sustainable rural communities will take place in the conclusion of the paper.) The next step in sorting out the meaning of community is to separate common ties from social interaction. This is to be premised upon the work of the interactional theorists, most notably within community studies by Wilkinson (1990) and Warren (1978). The following sections present this line of thinking for the purpose of isolating the relationship between social interaction and community. Subsequently, community will be conceived as a system of social interaction.

4.1 Social system theory

A general understanding of social systems thinking begins by examining a basic definition of system. According to Hall and Fagen (1980:75), a system is "a set of objects together with relationships between the objects and between their attributes." In this definition 'objects' are the parts or components of the system; 'attributes' are properties of objects; and, 'relationships' are those that tie the system together, that make the notion of 'system' useful. Of the 94 definitions of community Hillery analysed, 'community as system' appeared in only one, although it is likely that the concept was implicit in other definitions.

An early adopter of the use of 'system' to denote society and social processes was the biochemist Lawrence Henderson (Lilienfeld 1978; Capra 1996). For Lawrence, all factors in a social system are interactive and mutually dependent (Lilienfeld 1978:13-4). According to Buckley (1967), three types of social system models have been identified: mechanistic, organic, and process. The premise of the mechanistic model is a system of elements in mutual interrelations, "which may be in a state of 'equilibrium,' such that changes in the elements are counterbalanced by changes tending to restore it" (9). The organic model, derived from biology, is characterised by a '"mutual dependence of parts' which makes society like an organism" (12). The Parsonian model, which Buckley characterised as a mix of mechanistic and organic, is presented as a conventional view of social systems. As per Bernard's frameworks, she associates Parson's systems-based approach with the ecological analytical framework and, more generally, within the paradigm of structure-functionalism. The following draws from Talcott Parsons' *The Social System* (1951) to present the main points of his theory.

The Parsonian model underlies many approaches to the study of community, either directly or indirectly. Parsons defines a social system as processes of *interaction* between actors; the structure of the social system is a network of relations between the actors involved in the interactive process (25). The first necessary distinction to make about Parsons' theory is that the social system is but one of three aspects that complete a system of social action. The other two systems are the personality systems of the individual actors and the cultural system that is built into their action. Reducing the elementary component of the system to the actor and his situation, "it is the *participation* of an actor in a patterned interactive relationship which is for many purposes the most significant unit of the social system" (25). While there has been strong criticism of his work, e.g., it promotes the status quo and does not allow for change (Colomy 1992; Martindale 1965), Parson's "patterned interactive relationship," as an elementary component of his theory, provides a link to complex systems thinking.

In addition to the Parsonian model, it is worthwhile to review the essential characteristics of the process model of social systems as another link between theories of community and complex systems thinking. The process model may be traced back to

thinkers such as Park (Buckley 1967). Although not as well received as the other models, the process model bears similarities to principles of complex systems. Quoting Buckley:

> In essence, the process model typically views society as a complex, multifaceted, fluid interplay of widely varying degrees of intensities of association and dissociation. The "structure" is an abstract concept, not something distinct from the ongoing interactive process but rather a temporary, accommodative representation of it at any one time. These considerations lead to the fundamental insight that sociocultural systems are inherently structure-elaborating and changing; for some, the terms 'process' and 'change' were synonymous. … societies and groups continually shift their structures as adaptations to internal or external conditions. Process, then, focuses on the actions and interactions of the components of an ongoing system, such that carrying degrees of structuring arise, persist, dissolve, or change (1967:18).

It is worth noting that for Buckley 'modern' systems theory did not advance much beyond open systems theories. His views were, nevertheless, explicitly couched in complexity.

4.2 Community as a pattern of change

Earlier, as per Bernard's critique of the analytical frameworks used for the study of community, the interrelationship between community and change became evident. One important view of change, like that of community, is to discern between two aspects. This includes both 'changes' *within type* of social structures, which occurs when processes and products in a structure become different but the basic structural type does not change; and, 'changes' *of type*, often marked by the emergence of new structural types that handle some or all of the function once taken care of by the older type (Colomy 1992:50)[3]. Typologies of social systems, that is, change *of types*, are embedded in the rural-urban continuum, which is embedded in theories of social change. Modernisation, for example, illustrates this. It is described as a linear development perspective focussed on "formalisation of previously informal social control and social support structures, increased impersonality and anonymity, and the demise of *gemeinschaft*-like social relation" (Krannich and Greider 1990:64). Along this path, society passes through types of organisational forms (Krannich and Greider 1990) or, in other words, types of social interaction, one of which is community. Change and community, then, are linked through direction of change (e.g., market processes destroying community) and patterns of interaction (e.g., *gemeinschaft* and *gesellschaft*). Thus, community *as a pattern of interaction* is a concept that can be linked to complex systems thinking.

[3] Ponsioen describes it as the difference "between the study of 'moving' societies (the internal dynamics of society) and that of 'changing' societies (the transition from one type of society to another)" (Ponsioen 1969:17).

4.3 Community as different from a sense of community

The meaning of community, however, is overlaid with qualitative aspects, particularly when urban is contrasted with rural, as it is within typology-based frameworks. Roy Buck shares this view, as accounted by Bernard:

> Roy Buck was one of the few sociologists who rebuked his colleagues for looking at the rural community through inappropriate paradigms: 'Traditional scholarship,' he charged, 'has tended to look at the American community through stereotypes growing out of European thought.' He wanted to dispel 'the traditional image of rural life as being wholly rooted in a European peasantry and 'elysian bliss' or an erosion of this once-upon-a-lifetime mentality.' He tried to counteract the romantic idealisation of the countryside. He decried the family-farm ideology that pervaded so much thinking about rural communities (Bernard 1973:96).

Wilkinson adds, "We need to pare down the concept [of community] to its bare bones to see how much excess baggage can be shed without missing the essence of community and to get rid of the provocative ideological and normative undercurrents that give community a bad name" (1990:153). This line of thought, as will be explained below, strengthens both community as an analytical category as well as community's theoretical link with complex systems thinking.

The separation of community from the sense of community reveals the importance of social interaction as the essence of community. Building upon Schmalenbach's work, Wilkinson (1990) stated, "community arises without self-consciousness as people *interact*, and awareness of self, grounded in community and awareness of community, follows" (1990:153; emphasis added).

> Schmalenbach (1961) nails this down even better than Toennies does by proposing an addition to Toennies' classic typology. Between *gemeinschaft* (or community) and *gesellschaft* (or society), he says, an important category is missing. Community, as described by Toennies, is a natural and preconscious state, and society refers to rationally contrived and consciously perceived relations. What is missing, says Schmalenbach, is a category for shared responses to community (Wilkinson 1990:153-4).

Schmalenbach calls the part missing between community and society *communion*. "Community itself is there, as it were, before communion. It arises naturally in social interaction with or without being acknowledged or celebrated" (1990:153). This distinction underlies Wilkinson's view that there is no good reason to equate the sense of community with community itself.

Separating communion from community effectively strengthens the theoretical link between complex systems thinking and community by isolating social interaction from common ties (as per Hillery's definition). But what of locality? Community interaction, as an important type of social interaction, occurs where people live and conduct their daily activities, and this tends to be mainly on the local scene – even in a highly mobile society (Wilkinson 1996). This, as has been shown, is consistent with the argument supporting the relevance of community, namely, that "People still live next

door to others, they eat, sleep, love, hate, avoid, or seek one another in a given locale" (Bernard 1973:187). It is also consistent with a systems perspective of locality, which either implicitly or explicitly (Bailey 1990) includes physical space-time in the definition of system (see, for example, Miller 1978). Thus, community retains locality as an implicit feature, but not as the dominant feature as it is with the settlement-based view of "the community."

4.4 Community as an interactional system

With regard for community as social interaction, Wilkinson stated: "There is more to it than interaction, and not all interaction is community; but *interaction is the essential ingredient*. Any theory of community must first be a theory of social interaction…" (Wilkinson 1990:152; emphasis added). This derives from Warren (1978:408-22) who argued that the interactional approach, based on community as a dynamic process of social interaction, has much more to offer than does the older functional view of community as a "concrete collectivity" (i.e., the systems approach). Generally, Warren and Wilkinson's conceptions of community appear very similar to the process model described above. More specifically, they make a case to sort out several aspects of community. First, they distinguish between community and communion, that is, between community and a sense of community. Next, they identify the community system as only one system that contributes to the sense of community. And, along the same lines, this interactional view draws upon measures of community to assess the extent to which community embraces a total society. This latter point is necessary to overcome earlier conceptions of community as concrete totalities, stemming from a criticism of functional approaches to the study of community.

What Wilkinson achieved may seem simple and reductionist (which it is) but it also strengthens a systemic conception of community in a number of ways. Surprisingly, while his argument is well grounded as a challenge to Parsonian functional analysis, he effectively revitalised Parsons' definition of a social system: *a system of processes of interaction between actors* – not to mention the earlier conceptions of process models of social systems. First and foremost, the interactional approach is a processual, systems approach; the social act is an ongoing complex of acts and responses (Lilienfeld 1978:206). The interactional approach, having grown "out of a crisis in community theory in the wake of the passing of the long-dominant functional model" (Wilkinson 1990:154), also marked a shift away from a mechanistic worldview. By dismissing the functional model they were marking the shift from function to organisation, which represents "a shift from mechanistic to systemic thinking, because function is essentially a mechanistic concept" (Capra 1996:27). In this, the relationship between the parts and the whole has been reversed, and the whole cannot be understood by analysis. This critical view of community reflects Wilkinson's concern for "wholeness" and "a functionally integrated whole," as well as Warren's concern about the "concrete

collectivity." These criticisms, however, are not against a systemic view of community, as they are against the mechanistic, functional analysis of systems.[4]

Furthermore, Wilkinson and others use the term 'field' rather than system. Their concern is that "system" strictly defines a functionally integrated whole concerned with boundary maintenance and reinforcing social order (Wilkinson 1991). Such a view of system, however, runs counter to an understanding of a complex system. The definition of field, on the other hand, may be interchanged with many aspects of complex systems thinking. For example, field is variously described as "a process of interrelated actions through which residents express their common interest in the local society"; "theories [that] emphasise the dynamic, emergent aspects of community life"; "directed more to the dynamic processes that create and alter community structure"; and, "an unbounded whole with a constantly changing structure" (Wilkinson 1991 2; 33; 35). Several aspects of these descriptions relate to complex systems thinking. It appears, then, that the interactional view of community may also benefit from a re-formulation of community as a complex system.

This distinction between "system" and "field" may seem trivial to those who strongly associate systems theories with structure-functionalism. For the paper, however, the distinction is significant. Primarily, it is consistent with Bernard's critique of existing paradigms of community study and substantiates her question, "is normal-science research guided by the classic [community] paradigms adequate for the purpose, or are we in need of a scientific revolution in this area to supply us with more appropriate paradigms for the postcity world of today?" (Bernard 1973:179).

5.0 Complex systems thinking: To what extent is it useful for the study of community?

Thus far, a theoretical link between complex systems thinking and community has been established, premised upon interaction and supported by other aspects of community. This permits one to begin thinking about community through the 'lens' of complex systems thinking. As explained above, the complex systems thinking paradigm embraces unpredictability and a notion of change based upon the emergence of global properties arising spontaneously from the interaction of local-level rules, which, in turn, adjusts

[4] Interactional tend to equate the functional model (i.e., structural-functionalism) with, what they refer to as, a systems perspective. This appears not to disagree with the community as a system, as they disagree with the functional aspects associated with social system theorists of the time like Parsons. Bernard (1973) also associates systems theory with structural-functionalism, although far more directly: "The second all encompassing paradigm, not itself specifically a community paradigm but one which has guided thinking and research in the field of community, has variously taken the form of structure-functionalism or of social-systems analysis. Although it is possible to make conceptual distinctions between the two forms, they resemble one another more than they differ" (1973:22).

one's conception of evolution, adaptation, and stability. In effect, this approach enables one to re-formulate conceptions of community as a complex system of social interaction.

5.1 Re-formulating community as a complex system of social interaction

As emergence was used to introduce theories of complexity above, it is used here by adapting a passage from Mihata (1997)[5] to illustrate how community may be understood using complex systems thinking language.

> Consider, for example, that as fundamental as [community] is to social science, there is surprisingly little consensus on its definition and even less on how it works. Yet, from the perspective of emergence, the long-standing difficulty of defining, measuring, and linking [community] to behaviour should not be surprising. No emergent phenomenon can be defined along a single dimension or set of dimensions (e.g., [community] as beliefs or values); such an approximation sacrifices its emergent character. No emergent phenomenon can be 'measured' or otherwise operationalised at (reduced to) lower levels. Perhaps most critically, no emergent phenomenon is causally linked in any simple way to its individual parts—that is, after all, the nature of emergence.
>
> Instead, what we describe most often as [community] *is an emergent pattern existing on a separate level of organisation and abstraction from the individuals, organisations, beliefs, practices, or cultural objects that constitute it*. [Community] emerges from the simultaneous interaction of subunits creating meaning (individuals, organisations, etc.). At the same time, it also emerges in each individual, through socialization, experience, and interaction.
>
> Thus, [community] is emergent not only within each level of analysis but also across multiple levels. It is facile to look for a simple causal relationship between abstract emergent [community] and the empirical behaviour of individuals—and equally facile to deny the existence of [community], or other emergent phenomena [such as culture], on such grounds (Mihata 1997:36, emphasis added).

Adopting the language of complex systems thinking, community may be defined as an emergent system of social interaction characterised by a specific pattern. The pattern is an emergent global property of the system arising from the iteration of local rules.[6] With this alternative view of community in mind, the re-formulation of

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[5] This passage is a modified quote of Mihata (1997). In the original, Mihata discusses culture as emergent. Herein, references to culture were replaced with references to community. The interchangeability of community and culture, while supporting the thesis of the paper, also demonstrates the applicability of emergence to describe different social phenomena.

[6] To help visualise this, imagine, for example, a map upon which one could plot social interaction. A dot on this map would represent an interaction between two people. The colour of the dot would change according to specific local rules, such as, the dot would be red for any interaction between any two people; blue if the same two people had met recently; green if these two people had each interacted with the same person recently; yellow if they interacted with the same two people recently. The outcome would be a map of coloured dots depicting various patterns. By examining the map, it might reveal specific patterns, perhaps associated with urban, suburban, and rural areas, neighbourhoods and cities, towns and counties, and agricultural areas and single-industry, resource towns. It is likely that within this plot pockets of interactions would fluctuate, some appearing and disappearing, others continuously growing, perhaps into urban areas, and still others merging with other pockets. The hypothesis is that upon examination types of patterns would repeat themselves and specific patterns would be characterised as 'community.' Hence, the community system may be identified by its specific pattern of interaction.

community is furthered by use of an example. The following illustrates how complex systems thinking may be applied to Tweed, a typical rural town located in southeastern Ontario, a site in which the author has conducted research.[7] Applying complex systems thinking to Tweed offers an alternative view of a common situation and challenges common conceptions of how a rural community may be researched. Therefore, by asking such questions as how Tweed is organised and how it responds to shocks and stress, the researcher's efforts are directed at discovering the operative local rules. To understand the dynamics of these local rules, the researcher would apply theories of complexity, such as self-organisation and dissipative structures.

The question of self-organisation may be re-stated in two, simpler questions: What gives the pattern of Tweed's community system its shape? How is Tweed's pattern of interaction sustained? With regard to the first question, the research would begin by examining the phenomenon giving rise to pattern, namely, strange attractors. As stated previously, a strange attractor is *in* and defined by the process that it shapes and governs (Eve et al. 1999). Most likely, there are several strange attractors influencing the community system, with each one created from a distinct set of local rules. One of these strange attractors may be mix of rules governing social interaction, some of which may be identified using data collected by the author. For example:

- Observation: There is very strong participation in service clubs, but these clubs do not often interact with each other;
  Rule: Stay loyal to only one service club.
- Observation: There are five church denominations, with little interaction among church-based organisations;
  Rule: Stay loyal to only one church.
- Observation: There is little interaction among business owners (premised upon an inability to keep the local business association active);
  Rule: Maintain only weak ties among local business associates.
- Observation: A core group of volunteers are most active; each organisation has its own core group with some overlap among groups;
  Rule: Maintain strong ties within organisations.

Each of these rules and many more affect social interaction and, thus, shape the community system. To see the real pattern of interaction shaped by these rules, however, would require a great deal of data. Alternatively, these rules could be incorporated into a modeling program that would simulate interactions[8]. The output of the simulation would

[7] To emphasise, this example only illustrates how theories of complexity *might* by applied to a real situation; this does not represent the results of research completed for this purpose and, therefore, any conclusions and/or implications with regard to Tweed should be treated with caution.

[8] Often, what is being mapped is some measure of 'distance' of interaction. The local rules defined by Lee, Muncaster and Zinnes (Saperstein 1997), for example, were a set of nonlinear differential equations: the friend of my friend is my friend; the enemy of my friend is my enemy; the enemy of my enemy is my friend. These rules described the time evolution of the 'distances' among groups.

be graphic representations in which patterns could be observed. The example strange attractor above is not likely to be the only one shaping the system of social interaction. Rules do not exist in a vacuum as there are other strange attractors as well as other systems, e.g., political and economic, with which the community system interacts.

The quality of social interaction also contributes to the community system's ability to sustain itself. What opportunities exist in Tweed for social interaction? Do community events bring the same people together or different people? What is the nature and purpose of interaction? Does an organisation promote private or public interests? How frequently are interactions repeated? In Tweed, for example, there are about 40 voluntary groups covering a full range of interests, almost half of which are either service clubs or sports and recreation groups. There are also a range of annual community events, such as the Santa Claus parade and Canada Day, which are well attended by local residents. The Tweed Studio Tour and Flowerama, on the other hand, draw many people from outside of Tweed. Also, many Tweed residents commute outside of town for work, some traveling more than two hours and staying away during the week. The increasing number of residents shopping in Belleville takes more people out of town more often. Each of these factors affects the level and quality of social interaction, either strengthening or weakening the community system.

The theory of dissipative structures is a particular aspect of self-organisation. As such, social organisations play another critical role in sustaining the pattern of social interaction in Tweed. In a conventional sense, organisations may be viewed as the 'structure' of community, whereas in complex social systems, they are viewed as dissipative structures. That is, they are both process and structure: an evolving, interactive process that is temporarily manifested in globally stable structures that exist in the context of flows of communications. Tweed's ability to adapt depends upon its ability to manage these flows. When there is a shock to the system organisations (dissipative structures) respond. Generally, organisations dissipate resources, including people's time and skills, as well as money and information. The organisation is multi-functional because it is an element of different systems, e.g., social, economic, political. Within the community system, the organisation, by definition, dissipates social interaction. For example, when the community system is under stress it is being pushed further away from equilibrium towards a bifurcation point. The future state of the system is not known. In effect, this means that the local rules that give shape to the pattern of the system are under stress. In the Tweed example, the recent loss of local employment opportunities may be viewed as a threat to the town's ability to remain viable and sustain a sense of local identity. The building of the heritage may be viewed as the system's response to mobilise resources to counter the push away from equilibrium to maintain the system's present state. Through this process of mobilisation it dissipates the flow of communication that pushes the system away from its present state.

In Tweed presently, the changes to the municipal structure and the economic re-organisation (e.g., office closings, loss of retail development) both threaten community. In response, the Historical Society, for example, has mobilised a broad community effort to expand the heritage centre. This may be seen for its direct impact on social interaction, as well as for its contribution to sustaining Tweed's symbols of shared history. In complex systems thinking, the Tweed community is being degraded, by being pushed further away from equilibrium. By mobilising interaction within the community system, the community group is responding to this threat, that is, it is adapting to the environmental change in order to sustain the community system. Given this description of Tweed, the fragmentation of its community system into sub-systems may enable each sub-system to respond to particular issues, but the lack of a stronger community system may hinder its ability to respond to system-wide shocks.

When the flow of information through organisations increases, organisations (dissipative structures) "may go through new instabilities and transform themselves into new structures of increased complexity [and formality]" (Capra 1996:89). Thus, we see various groups taking on more formal aspects of organisation. The Tweed Heritage Centre is physically expanding, for example, and the Historical Society itself must re-structure to respond to the greater demands for accountability. The Eastern Ontario Trails Association is another example. Once a voluntary group of like-minded people interested in local trails, it is now an incorporated charity with paid staff after receiving funds from external sources. Generally, policies, practices, and procedures, such as the town council minutes, associations with provincial and national voluntary groups, as well as the by-laws of each voluntary organisation, represent more formal aspects that are also part of sustaining the self-organising pattern of interaction. As a general theory, dissipative structures helps to explain various levels of formality as well as a functional aspect of community organisation.

Thus far the explanation of the community system has not addressed its environment and associated constraints. Neither the community system nor local rules exist in isolation; they are constrained by the given environment in which the system is embedded as well as the available resources (Kay 1999). It is the interplay of the system and its environment that influences which processes and structures may emerge. The offshoot of delineating a system's boundaries is that by doing so, one delineates between what is inside the system and what is outside the system. At issue is the ontology of systems, i.e., do they exist? To exist, one assumes that it may be defined, i.e., to delineate its boundaries. In many cases, however, this is not possible. Two points help to understand the delineation of the community system. First, the community system is part of the social system, which, like the economic system, is open. That is, the community system is open because it interacts with other systems. It is operationally closed, however; it does not exchange its basic elements with other systems. In the community system, the operational unit is communication. Being distinct from other systems, the

operational unit serves to delineate the system boundary. Other systems include the economic system, the political system, and the ecosystem, each with a distinct operational unit. The operative unit of the community system is communication (Luhmann 1990), whereas the operative unit of the economy is money (Staubmann 1997), and the operative unit of the ecosystem is matter and energy. Whether or not the community system may be specifically identified, or to the extent that it may be approximated, is part of the broader question of the usefulness of formulating community within complex systems thinking. Further, the second point is that the importance of knowing the system boundaries may not be critical for the study of community systems. The important aspect of community is the relationship of the elements of the system. This is premised upon social interaction that takes the form of communication. Thus, a researcher knows that the relationship exists and may use it as the unit of analysis, while minimising the need to explicitly identify the system boundary.

5.2 Communion as an emergent property of an autopoietic system

The above example illustrates how two theories of complexity apply to a real situation. This explains dynamics within community unlike other approaches, thus contributing to a re-formulation of community. This, however, begins by accepting indeterminism, adaptation, and other aspects of the complex systems thinking paradigm. As a preliminary step to applying complex systems thinking, the example demonstrated that complexity is more than a simple idea to be used as a metaphor. There are many other aspects of complex systems thinking that may be applied to the study of community. For example, Bailey's (1990) theory of social entropy as a continuous measure of the state of community order that may be useful for assessing the level of community organisation, e.g., the number and interaction of community groups. This may have implications for studies of social capital that focus upon mutual relations, interactions, trust, and networks. In effect, setting out a theoretical foundation upon which community can be re-formulated facilitates both a deeper and broader inquiry into community as a complex social system.

Autopoiesis is an important theory of complexity that may have a significant influence upon how community is understood. This theory, representing a deeper inquiry into complex systems thinking, posits that an autopoietic system has the ability to interact internally in such a way as to continuously re-create the whole, and of the whole to influence the interactions of the parts to that end (Capra 1996:95-99). In repeated situations, the autopoietic system strives to expend the least amount of effort and resources that will support both continuity of the self and growth through replication of the success pattern — that organisation of relationships that meets both internal and external requirements at a given moment. Luhmann's (1990) theory of society as an autopoietic system may have taken this thinking the furthest. Several aspects of his theory may be noted. First, Luhmann distinguishes social systems as non-living systems,

arguing that the operative unit in a social system is communication, whereas in a living system the operative unit is matter/energy. Communication, then, is comprised of utterance, information, and understanding. The form this takes is meaning, which he presents as the essential concept for understanding social systems. Second, although Luhmann does not discuss community per se, the basic concept of meaning may have significant implications for understanding of community. As an autopoietic system, community may be understood as individuals making meaning of the greater complexity of society – which is fundamentally different from viewing community as "a place to live and work." This meaning becomes self-referencing, thus giving shape to a sense of community. Further, community is only one of several influencing systems. Each system has its own boundaries and component parts, although these overlap and interact. A sense of community (i.e., communion) may be viewed, then, as an emergent property taking shape from and within the confluence of many systems.[9] This sense of community may also be described as what is *experienced* by residents when the many systems interact in the 'right' way.

Since communion is a global property, it has relations with each of the systems giving rise to it including the community system. It is the sense of community, the meaning-making, that provides a self-referential quality to the self-organisation of the community system. This, as explained above, is referred to as autopoiesis. Without getting into further details of the explanation[10], aspects of the community's capacity for self-reference are evident in Tweed. For example, a self-referential system fosters a shared sense of history. In Tweed this takes several forms, such as: *The Tweed News* (a local paper with local stories, local advertising, and regular features about Tweed's heritage); sharing stories during a meal at the much-frequented Gateway Restaurant, the annual hosting of the now 119-year old Tweed Fair; painting the fire hydrants along main street each year to reflect the town's character; and so on. Each of these examples illustrates how the community system reflects upon itself through communication.

Luhmann's work on autopoietic social systems is one example of current work in complex systems thinking that offers various levels of inquiry that may be used for the study of community. Some of this work, however, does not advance much beyond complex systems as a metaphor. Marion, for example, describes strange attractors in his discussion of formal organisation but lacks a sound analysis. Other theorists advance beyond descriptions into specific analyses of complexity. Bailey's (1990) social entropy theory, for example, contributes a continuous measure of state of order. Capra (1996) presents a very comprehensive and intriguing account of complex systems thinking as it explains the meaning of life. What the various authors reveal are the many paths of

[9] This approach to understanding communion may have interesting implications for Fuller's (1994) Arena Society, a theory about aspects of social complexity.

[10] A deeper examination of autopoiesis would require a thorough discussion of the theory of cognition, for it is the system's capacity for cognition that gives rise to self-referencing. In this, as Capra (1996) described, cognition and autopoiesis are two aspects of the same phenomenon

complex systems thinking. More critically, the paths do not all run parallel. As with any good theory, competing perspectives are emerging. Some of these arguments challenge fundamental aspects of sociology. For example, there is a debate as to whether social systems are or are not living systems. Luhmann's conception of social systems as autopoietic is very important in this regard; his challenge that communication rather than action is the operative unit of society is one such example. Similarly, his focus upon meaning rather than information as the basic concept also opens the door to a re-examination of classic theories of community such as Mead's conception of community as 'generalised other' (Luhmann 1990).

There are many other aspects of community and communion that may be explored within the complex systems thinking approach. For example, the study of networks, which arises logically from examining community as a pattern, i.e., network, of social interaction can be applied directly to the study of communion, as well as other areas, such as governance and social cohesion. The rich field of social network analysis offers many ways to understand the complexities of networks (Scott 1991). Also, in the 1960s, the modeling of systems through input, messages, learning, memory, goal selection, goal seeking, network configurations, network maintenance or integrity, internal modification and possibly breakdown represented an entirely new and coherent set of concepts (Ponsioen 1969). By the late 1970s this was still considered the most important of the systems approaches (Lilienfeld 1978). Environmental systems approaches, for example, offer an interdisciplinary focus to examine the interface of humans with nature, between social and economic theories and with physical and biological theories (Bennett 1978). Today, nonlinear dynamic modeling builds upon this approach. While this may not be appropriate for the direct study of social systems, the methods are likely applicable to the study of communications.

Generally, the re-formulation of community using Tweed as an example demonstrates how the complex systems approach offers an alternative means to research social structure and process, placing emphasis on the quality of the pattern, rather than the details of the interactions or the system as a whole. Previous approaches, such as those directed by classic frameworks of power, class, ecology, and typologies, still have much to contribute. To summarise the argument put forth in this paper, theories of self-organisation, dissipative structures, and autopoiesis explain how community organises itself, the nature of this organising process, and how community is sustained. Many new questions about community may be asked and, more interestingly, many old questions may be re-asked through the complex systems thinking 'lens.' It is reasonable to suggest, therefore, that complex systems thinking contributes significantly to an understanding of community. It both provides an alternative starting point for the study of community and challenges basic assumptions about the nature of community.

6.0 To what end sustainable, rural, and community?

Community

Community has appeared throughout the paper as a central concept. Therefore, only a few additional comments are made here. Fundamentally, one of the most important contributions complex systems thinking may provide is to affirm community as a researchable analytical category, thereby revitalising its study. This would inform areas of study such as community capacity building, community economic development, and community development. Viewing community as an emergent system, as distinct from communion, is a first step along this path. At the outset, this overcomes what Bates and Bacon (1972) describe as the three fallacies of community theory: community as an emergent property is not geographically defined; sets communication as the operative unit rather than people; and accepts social interaction, positive and negative, as the essence of community rather than 'romantic' systems of co-operating individuals or groups. Perhaps the most useful aspect of the approach outlined in the paper is the way complex systems thinking is capable of theorising about community and communion as distinct analytic categories. As conveyed by the Tweed example, community may be studied as a complex system characterised by a specific pattern of social interaction. Communion, on the other hand, is an emergent property that would be studied in conjunction with an understanding of many systems, such as the economic, political, ecosystem, and community systems.

Rural

The distinction of rural has not been important to the examination of community thus far. The notion of rural appeared most often in the context of the rural-urban continuum, which is strongly associated with both typologies of community and within theories of social change. Complex systems theory, by bringing together pattern, process, and structure, also bring together theories of community with theories of social change. In so doing, the *linear* construct of the continuum is not applicable. Hence, many of the distinctions associated with 'rural' communities in the literature become unnecessary for complex social systems.

How, then, does rural relate to complex systems thinking? A difficulty of studying rural, as it is with community, is the normative qualities associated with the rural idyll. Therefore, one way of viewing rural within complex systems thinking may be to re-formulate it as a specific pattern of organisation. Whereas community is strictly defined as a specific pattern of social interaction within social systems, rural may be conceived as a particular pattern of interaction of social, economic, political, and environmental systems. The rural locality, then, is a significant influence upon the community system because it sets out the specific environmental constraints present.

This also includes a temporal dimension. History is an essential aspect of for making meaning of the context. Within community, it plays an important role in formulating a sense of identity. Rural, therefore, is the context of the community system and is very important to complex systems thinking.

Sustainability

There are two aspects to sustainability as it relates to complex social systems thinking. The first aspect, as illustrated by the Tweed example, is the sustainability of the community system itself. Herein, the application of complexity theories to study the dynamics of social interaction can be used to study how community is sustained. Much of this considers the capacity of the community system to adapt to shocks and stresses, that is, its ability to dissipate flows of communication. Viewing organisations as dissipative structures and examining the quality of interaction are keys to this conception of sustainability. The autopoietic relation between the community system and communion offers another important way to examine sustainability.

The other aspect of sustainability is the more conventional sense of sustainability as it relates to the natural environment, which has not been addressed within the paper. To address environmental sustainability one must study the natural system, as distinct from the social system. The strongest reason supporting this statement rests upon Luhmann's discourse on autopoietic social systems. He argues that the operative element of the social system is communication, not matter and energy. Hence, one must focus upon the living dimension, i.e., the flow of matter and energy, as it interacts with the social system. Fundamentally, the study of complex *social* systems only addresses the community-communion aspect of sustainability. To carry out the environmental aspect requires other approaches, such as ecosystem health. As with social systems, natural systems do not exist is isolation; that is, the economic, political, as well as the social system give context to the natural system, thereby setting out the constraints that give shape to the properties that may emerge within the natural system.

Collectively, 'sustainable rural communities' implies, to some extent (or, perhaps, as a function of the author's bias), planning and development. In this context, planning for sustainable rural communities raises important philosophical debates about determinism, control, agency, and evolution, which may be viewed as different perspectives of the same problem. Complex systems theorists do address these issues and, most interestingly, challenge conventional understandings of each of these terms. Generally, complex systems research seeks a greater understanding of the onset of change. This approach aims not at immediate solutions, rather, at anticipating the appropriate time to intervene (Price 1997). To this end, theories of complexity inform how this may be done.

7.0 Conclusion

The purpose of the paper is to examine the extent to which complex systems thinking contributes to an understanding of community. The argument put forth is that interaction provides a theoretical link between community and complexity. This position, however, is premised upon a number of other arguments. The first point is that the study of community remains relevant today as expressed through policy, theory, and rural residents. Past approaches to the study of community, however, have significant limitations associated primarily with the linear, deterministic assumptions. While these approaches have proved enormously useful, complex systems thinking responds to their limitations, thereby providing an important alternative for the study of community that addresses nonlinearity and indeterminism.

The key characteristics of complex systems thinking are presented in the form of unpredictability, the nature of change, wholeness, and adaptation. Collectively, these provide the basis for describing complex systems thinking as a paradigm that stands as a complement to existing paradigms used for the study of community. As such, the author argues that complex systems thinking should be considered more than just an alternative to current frameworks; it represents a possible new way to understand and to research community. Emergence, self-organisation, and dissipative structures describe different aspects of structure, process, and pattern within complex systems. In summary, the theories of self-organisation and dissipative structures both shape and govern complex social systems. The system's 'structure' derives from the interaction of simple rules, i.e., it emerges from the process in which patterns of global-level structures arise from interactive, local-level processes. It is at this point in the argument that interaction emerges as the critical link between complex systems thinking and the study of community.

The work by community theorists who have focussed upon interaction (Wilkinson, as the primary example) strengthens the theoretical link between complex systems thinking and community by isolating social interaction from the ideological and normative aspects of community, while retaining locality as an implicit feature. Thus, the theoretical link between complex systems thinking and community, premised upon interaction and supported by other aspects of community, provides the basis to re-formulate community as a complex system of social interaction. Applying these theories to a real village demonstrates how the complex systems approach offers an alternative means to research social dynamics, placing emphasis on the quality of the pattern, rather than the details of the interactions.

Granted, complex systems thinking is not all new. One can return to Spencer's idea that the development of society is a process of growth of increasing complexity, differentiation, and interdependence. Also, one can draw upon the 'process' model of social systems that has been around for almost a century. What is 'new,' is an

understanding of the nature of complexity, that is, an understanding of its dynamics and characteristics such as unpredictability, emergence, and adaptation. Its inherent logic is premised upon theories of thermodynamics, feedback loops, and nonlinearity. Most significantly, the rise of mathematical tools has helped scientists to see, literally, the details of complexity. This has created conditions enabling people to re-think assumptions about society and its systems. This does not mean that everything prior to complex systems thinking has to be discarded. To the contrary, there are obvious conditions under which more modern approaches to research may be used.

In conclusion, re-formulating community as a complex social system is significant for a number of reasons. As a paradigm, it provides an alternative starting point for the study of community and challenges basic assumptions about the nature of community. Importantly, by reconstructing the 'scientific' approach rather than deconstructing it, this approach encompasses existing analytical frameworks rather than dismissing them. By generating interest in both 'old' and 'new' ways of asking questions about community, complex systems thinking may help to revitalise the study of community. With a willing mind, complex systems thinking may help to sustain rural communities – and to re-build 'the spokes of the community wheel.'

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