

Spatial thinking Issues: Towards Rural Sociological Research Agenda in the Third Millennium

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Abstract—Does the spatial perspective provide a common thread for rural sociology? Have rural sociologists succeeded in bringing order to their data using spatial analysis models and techniques? A trial answer to such questions, as touchstones of theoretical and applied sociological studies in rural areas, is the point at issue in the present paper. Spatial analyses have changed the way rural sociologists approach scientific problems. Rural sociology is spatial by nature because much, if not most, of its research topics has a spatial “awareness.” However, such spatial awareness is not quite the same as spatial analysis because it is not typically associated with underlying theories and hypotheses about spatial patterns that are designed to be tested for their specific spatial content. This paper presents pressing issues for future research to reintroduce mainstream rural sociology to the concept of space.

Keywords—Maps, Rural Sociology, Space, Spatial variations

I. INTRODUCTION

INCREASED attention has been paid to location and spatial interactions in both empirical research and theoretical frameworks that rural sociologists produce and use [1]–[5]. Early literature alerting social scientists to the importance of space dates from, perhaps, the early 1960s, although the formal statistical literature dates at least from the 1930s [6]. Nonetheless, using maps to make inferences about collective social behavior can be traced back to at least 1920s when the rural sociologist, C. J. Galpin, used hand-drawn maps to plot the “ruts” in the dirt roads in rural Wisconsin, which helped demarcate the boundaries of small communities in proximity to regional population centers. Clearly, spatial thinking has a long history in rural sociology.

To clarify the nature of relationships between space and rural sociology, it is better to present the fields of study that occupy the interest of rural sociologists. References [7] and [8] review the substantive focus, theory, and methodological approaches of rural sociological research in its first fifty years. Both studies examine articles published in the journal *Rural Sociology* and use the same categories to classify research topics. The substantive categories delineated are social organization, social change, social psychology, population, social welfare and policy, methodology, and issues related to the profession. In the list of topics, little appears to differentiate the field from general sociology. However, distinctiveness remains in the application of these topics to the rural population, a segment the parent discipline neglected as it assumed that the urban-based mass society would wash over

all people. Concerning theoretical approaches addressed through the first fifty years (1936 – 1985), rural sociological research is generally more applied and less theoretical than general sociology [7], [9], [10]. Paradigmatic stances were social facts (i.e., deductive traditions ranging from functionalism to Marxism), social definition, and mixed paradigmatic perspective.

In terms of research methodology, early work tended to be descriptive and concerned on local populations to which rural sociologist had easy access [7], [9], [11]. As the field evolved, methodology became more rigorous and quantitative. The vast majority of articles published in *Rural Sociology* from 1936–1985 used primary data from surveys [11]. While individuals thus were mainly the unit of observation, there was continual interest in geographic space. About 30% of articles produced during 1936–1985 used ecological units as the unit of observation.

Reviews assessing rural sociological research in the contemporary period are found in [12]–[16]. These authors indicate a movement away from research on social psychology and social organization, toward social change and stratification (social welfare and policy), a pattern following general sociology.

In terms of theory, little suggests that previous patterns are altered; rural sociologists build from sociology using theories germane to substantive areas above [17]. Within certain substantive areas, rural sociologists have developed their own theoretical perspectives rather independently from sociology, with these sometimes-challenging conventional views of the parent discipline. Such independent theorizing is seen particularly within the sociology of agriculture [18].

Concerning research methods, Falk indicates that rural sociologists follow trends in sociology [17]. Because of the distinct subject matter addressed by rural sociologists as well as the need for data on specific populations, often means conventional secondary data have limited usefulness [19]. Therefore, rural sociologists have to rely perhaps more than other sociologists do on independent data collection. Lastly, rural sociologists are at the forefront of sociology in their use of spatial analytical methods and geographic information systems GIS [20].

According to the above-mentioned areas of interest and others, it seems logical for the spatial analysis to be at the heart of rural sociology since the latter does mainly go through the interpretation of human behavior and attitudes at a certain place of the earth. In other words, the neglect of spatial analysis is a peculiar deficiency in a discipline whose early and central projects have been as much about spatial variation as about temporal change. Rural sociology, from its outset,

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investigated and theorized differences between different types of places. Spatial variation and the meaning of place are central oppositional concepts like rural/urban, *gemeinschaft/gesellschaft*, developed/developing. Furthermore, actually all the fundamental concepts identifying social institutions have an important spatial component.

To this end, the objective in this paper is to spotlight outstanding examples of the use of spatial analysis in rural sociology. Case studies were selected to illustrate how spatial analysis fosters theoretical understanding and enhances empirical testing. Each case study reinforces the key foundational principle – that the analysis of social phenomena (the domains of rural sociology and all social sciences) in space and time enhances our understanding of social processes. By incorporating a focus on the practice of spatial analysis, the paper responds to the argument that the ability to control the timing and spacing of human activities is a key component of modernity [21] and reflects the distribution of power and the control of resources [22]. Building on that principle, this work offers a framework for the conceptual integration of literature that is intended to illustrate the practice and value of spatial thinking in the sociological studies of rural life. Nonetheless, it should be clear that the problem of space is neither its lack of relevance or interest for rural sociologists, nor its absence from classical theory or current exemplary research. The issue is, rather, to mainstream spatial concepts and approaches and to extend our boundaries to incorporate spatial processes as part of the fabric of social life and its construction.

II. GROWING AWARENESS OF SPATIAL DIMENSIONS AMONG RURAL SOCIOLOGISTS

Spatial thinking offers a unique logic for interpreting the social world, as well as an established set of models, and a rich set of tools for visualizing, analyzing, and integrating diverse sources of information [23]. The discipline of rural sociology brings many assets to this enterprise: a core subject area and an epistemology that recognize the importance of the context, space, and time; a tradition of multi- and interdisciplinary scholarship; and a firm grounding in practice that keeps it relevant to the issues of the day [22]. The purpose here is to draw on the growing recognition of spatial dimensions to build an argument for the importance of spatial implications in rural sociology. Current research organizes our presentation around theoretical and empirical issues, recognizing that these two sets of arguments are neither exhaustive nor mutually exclusive.

III. THEORETICAL ARGUMENTS FOR THE IMPORTANCE OF SPATIAL IMPLICATIONS IN RURAL SOCIOLOGY

Rural sociology's theoretical solution to conceptualizing space was reflected in two schools of thought about "rurality" that characterized much of the literature until the 1980s. One school tended to reify rurality, focusing on documentation of presumed inherent differences between urban and rural communities and the social life within them, in a reflection of

the human ecology tradition. The other school, grounded in Marxian political economy, tended to deny the need to take spatial settings into account and viewed "rurality" as incompatible with the analysis of class relations [24], [25].

In general, spatial analysis may play key roles in both inductive and deductive approaches to science. Inductively, maps and other visual displays of spatial data allows for intuitive spatial analysis that can reveal patterns and anomalies that, in turn, suggest processes that might account for them. Deductively, spatial analysis can be rarely if ever used to confirm theories, though it can be used certainly to deny false ones and to justify controlled experiments where these are possible. This is attributed to an important principle that a range of different processes can produce the same spatial pattern. In other words, there is no one-to-one correspondence between process through time and pattern in space. In essence, spatial analysis is perhaps the best seen as an exploratory technique, more suitable for the generation of hypotheses and insights than to strict confirmation of theory [26].

Another viewpoint emphasizing the theoretical importance of spatial implications is "generalization" which is considered a cornerstone of the scientific method. In this sense, place-based analysis relies on a simple expectation that any model or theory in the social sciences will fail to account perfectly for the phenomena that it describes, and that in such circumstances phenomena will almost certainly exhibit non-stationarity. If this is the case, then more will be learned by exploring patterns of non-stationarity than by averaging them within a universal model [27].

Space is also important in spatially explicit theory whose outcomes depend upon the location of the objects that are the focus of the theory because it accounts for the effects of separation and imperfect communication between parts of a social system [5], [28], [29]. Rural sociology as a discipline has long been interested in the area of spatial orientation [6], [30], [31]. It provides a unique window on social life whose importance appears to be increasingly recognized. Attention to spatial dimensions of social life is the central element linking rural sociology's diverse concerns. Rural sociologists study people, places, and economic sectors that characterize spatial settings. Thus, rural sociology addresses a multitude of domains, but in general, its purposes may boil down to the following:

- To perceive and understand the components of social phenomena especially in rural areas. In this sense, many studies report that the inclusion of spatial analysis regimes in rural sociological research has allowed creating variables that would otherwise be literally unimaginable to rural sociologists. For example, previous studies assume that fertility level in a village is a function of female illiteracy, the percentage of adult women who are currently married, and the total of population size. Recently, with support of spatial analyses, rural sociologists show increasing interest in the role of diffusion in determining variation and changes in fertility levels. Even when controlling for a variety of other variables, fertility levels in certain areas are sensitive to fertility levels in other areas, especially proximate ones [32], [33].

- To define, analyze, and report the relationship between such components and each other. Underlying every theory is the issue of causality. What exactly does it mean to say that poverty "causes" crime, that cultural materialism "causes" moral decay, or that religiosity "causes" one's euthanasia attitudes? As an applied science, rural sociology used to determine the direction and nature of relationships between varied elements of social phenomena. In the past, this was based upon statistical methods other than spatial analysis. Some studies neglect the fact that for adequate guidance of concrete actions pertaining social issues, the answer must be sought within the confines of a particular society or culture for which these actions are intended. Many leading sociologists label such studies as methodologically lacking and regard their results as unreliable.

- To predict the form and pattern of relationships between the components of social phenomena, therefore, the social phenomena themselves in the future, for planning purposes. The ultimate goal for research is to test hypotheses, and fill gaps in the literature by creating knowledge. Spatial regimes often improve the ability of rural sociologists to create models that give more accurate and valid results. An example is estimating urban population growth by integrating land use and road data with population data through spatial algorithms in GIS [34], [35].

- To control, as much as possible, the social phenomena and orient them to the benefit of society, more specifically, to solve the problems that face the society. Such control may be achieved by controlling for the elements of human behavior like actions, re-actions, place, and time. It is more difficult to control for actions and re-actions than controlling for place and time. The ability to control the timing and spacing of human activities is a key component of modernity and reflects the distribution of power and the control of resources. In this sense, spatial analytical techniques are useful for identifying significant spatial patterns of social phenomena. They help also to identify spatial clusters of statistically significant high or low attribute values of a point at issue and tell researchers whether high values or low values tend to cluster in a study area. Thus, they are often used to identify whether hot spots or cold spots exist. Hence, such hot spots or cold spots could be subjects for further in-depth investigation in a way aims to control for the place of human activities. Several recent studies in rural sociology adopt this approach [36], [37], [38].

Accordingly, space looks important and can contribute substantially to accomplishing the above-mentioned objectives of rural sociology. For rural sociologists, it is of crucial importance to incorporate spatial analysis to understand the community for which they orient their research efforts that is, rural areas. In other words, overlooking spatial analysis is a peculiar deficiency in a discipline whose central projects have been as much about spatial variation as about temporal change.

IV. EMPIRICAL ARGUMENTS FOR THE IMPORTANCE OF SPATIAL IMPLICATIONS IN RURAL SOCIOLOGY

With this background on the incorporation of spatial issues and how this approach can inform the work of rural sociologists, the research paper turns to three areas of applied work. The work featured here illustrates the kind of work, which rural sociologists are developing. This work concerns fertility transitions, spatial inequality, and rural development [7], [15], [16], [39], [40]. In addition to their long history in rural sociology, these issues are of continued public policy concern.

A. Spatial Inequality

In general, spatial inequality refers to a condition in which different spatial or geographical units are at different levels on some variables of interest such as average income, illiteracy rates, and population density. In particular, rural inequality or unequal distribution in rural assets seems to be a term defined according to the particular aim of a research project. The definition is often derived from the measurement technique utilized. Additionally, the measurement of inequality differs obviously between studies with different research goals. However, spatial inequality emphasizes the structural-territorial bases of inequality, extending sociologist's inherent concern with stratification to the new frontier of geographic space. Research in this area examines how markers of stratification such as economic well-being, race/ class/ gender inequalities, and other social, health, and environmental indicators vary spatially. In turn, the concern is with how territory itself becomes a marker of stratification, as in the comparative socioeconomic position of rural and urban regions.

Walking through history, the term inequality is commented on by Kuznets, in his pioneering study on incomes in the United States [41]. Although it is not a new topic, there is ample evidence, involving both international comparisons and national studies, assures that inequality is a subject of great deal of attention in recent years (see, for example, [30], [42]-[44]). Given its unique features and importance, the World Institute for Development Economics Research of the United Nations University (UNU-WIDER) initiated a major project on spatial inequality in 2002. UNU-WIDER reports there is now a considerable academic and policy interest about inequality decomposition by population subgroups defined in terms of spatial location, nevertheless there still is a number of studies which report inequality decompositions using non-spatial elements (education, age, etc.). Spatial inequality is thus a dimension of overall inequality, but it adds significance when spatial and regional divisions align with political and ethnic tensions to undermine social and political stability.

Reference [45] draws evidence on the extent and nature of asset (land, machinery, durables, etc) inequality in rural areas and its impact on demographic incentives and behavior of rural households. Their work reviews initially studies on the distribution of rural resources (farmland and other associated assets) among communities in rural South Africa to obtain an

understanding of the extent of inequalities in rural areas. The study concludes rural inequality is a function of land and capital, human capital, migration and non-farm income, and access to technology. The work treats “the access to technology” as a spatial factor affecting rural inequality. On the other hand, the study investigates the effect of rural inequality on fertility and migration, concluding that strong associations existed between rural inequality on one hand and each of fertility and migration on the other hand. A reduction in inequality would increase fertility and family size. Additionally, the higher inequality especially in land is the main reason for migration from rural areas.

In the context of spatial inequality, Shorrocks and Wan review the theory and application of decomposition techniques [46]. Their work establishes some new theoretical results with potentially wide applicability, and examines empirical evidence drawn from a large number of countries with disparate living standards. In essence, an attempt is made to apply the regression-based decomposition framework to the study of inequality accounting in rural China, using household level data. It is found that geography has been the dominating factor but is becoming less important in explaining total inequality.

Lobao and Saenz have contributed most to this area of intellectual inquiry [47]. They articulate and bring together contributions that display the importance of spatial inequality in rural sociology and conversely, the importance of rural sociology to understanding spatial inequality and diversity in all manifestations. Their study reports that in the past two decades especially, scholars of rural sociology have attempted to incorporate the study of space directly into stratification theory and attendant empirical topics. Attempts to spatialize the study of inequality represent both a project to revise stratification theory from within sociology and an effort to import other social science traditions, particularly from geography, into rural sociology.

Rural sociology contains a large body of research on stratification, as an expression of inequality, documented in different literatures. This research area seems a unique contribution to sociology for two reasons: until recently, sociologists studying stratification largely neglected “space,” and when space was brought in to study stratification, it was typically at the scale of city and neighborhood or conversely, at the cross national scale. Rural sociology’s middle, substantial scale of focus distinguishes it from other sociological fields. This research often employs counties, labor market areas, or regions as units of analysis either directly or as multilevel measures of context surrounding households and individuals [48].

At the broadest level, the crosscutting theme on spatial inequalities refers to research on the determinants and consequences of varying spatial distributions of populations across major axes of social differentiation, especially race, ethnicity, nativity, and social class. Therefore, it is recommended that future studies of inequalities must incorporate spatial sources and outcomes [22], [27]. Some suggested ways to bring spatial dimension to the study of

social inequality include: direct investigation of how spatial distinctions link to other differences and hierarchies, increased study of spatial inequality per se at varying spatial scales, greater scrutiny of peripheral, poor, remote, and exploited places at multiple scales, direct investigation of the spatial properties of constructs that are normally viewed as aspatial or transcending space, better measurement and collection of data for peripheral locations at marginal scales, specification of appropriate units and scales for analyzing specific social practice and forms, and movement beyond binary spatial distinctions into social and spatial continua with variable and permeable boundaries defined by careful delineation of their properties and their relations with other social forms.

B. Fertility Transitions

Investigating fertility transitions is of dominant importance for rural sociologists as well as for researchers in some other academic disciplines and to workers in a variety of applied fields. Classic demographic transition theory attributes fertility decline to changes in social life associated with industrialization and urbanization [49], [50]. Recently, growing body of evidence asserts that such theory was overly simplistic, too general, and incomplete [32], [51]-[53]. Reformulations began with Davis’s theory of demographic change and response [54] but have been driven especially by results of the European Fertility Project at Princeton [55], [56]. Diffusion played a critical role in the decline of fertility in Europe during the late nineteenth and early twentieth centuries [33]. First, the European transition was more concentrated in time and less concentrated in space than one would expect from a strictly structural explanation of fertility decline. Second, important structural factors, such as literacy and industrialization, were more weakly associated with the onset of fertility decline than one would have assumed. Third, fertility patterns appeared to follow important religious and linguistic contours within Europe.

Despite the increasing centrality of the concept of diffusion in the study of fertility transitions, the picture appears to be more complex in several ways [57]. It seems likely that the fertility transition is best understood as a blend of structural factors exemplified by the supply – demand framework [58], diffusion factors [59], [60], and the local context in which reproductive decisions are actually made [61]. In essence, it is argued that fertility especially in rural areas may be influenced by both spatial factors (including the diffusion of innovations) and by essentially non-spatial factors (such as the availability of education for women and the percentage of women who are currently married) [32]. Weeks’s study was guided by a model incorporating assumptions that;

- (a) The social environment influences the social and human capital variables that more directly influence the demand for children,
- (b) The reproductive behavior of some people within a village will influence the behavior of others, even net of the human capital opportunities that objectively exist in the village,
- (c) These influences operate on reproductive levels through

the mechanisms of the proximate determinants of fertility, such as age at marriage and the use of contraceptives within marriage, to determine fertility at the local level, but

(d) Changes in reproductive behavior at the local level may be influenced by changes in, and reciprocally influence changes in, other neighboring regions, resulting in spatial patterns of fertility transition,

(e) The consequences of such patterns ultimately determine the overall societal level of reproduction, thus creating the wider phenomenon of a fertility transition.

However, building on the above-mentioned empirical studies and others, there is a clearly established spatial component to fertility levels and fertility change in rural areas. In other words, an understanding of the dynamics of the fertility transition in rural areas is enhanced by a spatial perspective in two ways beside the theoretical perspective that the spatial analysis helps quantify the roles that human capital and diffusion factors may be playing in the fertility transition in rural areas. First, from a research perspective, the spatial analysis helps identify places where things are clearly different and where additional research ought to be focused. Second, from a policy perspective, the spatial analysis helps planners and providers to know where programs of reproductive health are likely to have the greatest impact on fertility change.

C. Rural Development

Rural sociologists contribute significantly to rural development from the standpoint of research, policy, and practice [12], [16]. Reference [62] reviews the research on economic development in small communities. Past narratives have included 'community development', 'the green revolution' and 'integrated rural development'. Current narratives include 'a new, doubly-green revolution', 'sustainable agriculture', and 'rural livelihoods.'

Turning to the viewpoint of policy and practice, it is enough to say that many international institutions such as FAO, UNDP, Organisation for Economic Co-operation and Development (OECD), the World Bank, Islamic Development Bank (IsDB) and the Asian Development Bank (ADB) have adopted the United Nations Millennium Declaration of halving poverty worldwide by 2015. As most poverty in the world (75%) is rural, therefore, reaching the international development targets means giving high priority to rural development practices.

Regarding the spatial component of rural development, however, some commentators have pointed to a tendency in academic discourse and policy prescriptions to treat rural communities as homogeneous in nature, ignoring the diversity, for example, in physical environment, socioeconomic potentials which are evident in many rural areas [31]. Considering the spatial dimension- the point at issue in this paper, it is not enough to note that poor rural people live in different kinds of rural areas: the constraints and opportunities are markedly different and require different strategies. Key factors are (a) proximity and access to cities, (b) the amount and quality of natural resources, (c) density of settlement, and

(d) vulnerability to natural catastrophes. To simplify the complex spatial picture, it may be helpful to distinguish between peri-urban zones, the 'standard' countryside, and remote rural areas [63].

Additionally, reference [64] delineates that almost all information to support rural development has a strong spatial context, particularly since it deals with the natural resource base over extensive areas. Therefore, it makes sense that spatial analysis plays an important role in rural development, throughout the continuum of planning, governance, and management. Practically every aspect of planning, governance and management for rural development where geographical space is an important consideration would have use of spatial thinking. This facilitates inter-disciplinary interpretation of information for a more holistic understanding of the problems and needs, and better insight into the opportunities and key interventions in governance for improvement of the rural sector.

The spatial dimension of rural development has a unique role in geographical targeting. It is very well known that one challenge faced in rural development is proper targeting of limited resources for better equity, particularly given the pro-poor focus of several development assistance programs. Reference [65] reports that pro-poor development programs need better geographical targeting because the poor tend to be concentrated in areas commonly characterized by harsh living conditions. Reference [2] states that the identification of geographical hot spots is particularly relevant for rural development programs for determining:

- Where rural populations are most disadvantaged and vulnerable, to design strategic and emergency response;
- Where particular problems exist in relation to agricultural (including crop, livestock and agro-forestry) production, to identify research and development and extension priorities;
- Which areas are poorly serviced, to improve infrastructure, marketing, health, education and other services;
- Where and to what extent natural resources are being overly exploited and degraded, to undertake prompt measures to minimize if not reverse the degradation?

If the above propositions have been taken as issues for consideration, it may be asserted that the reluctance of some rural sociologists to engage the spatial component with development dynamics is surprising especially when considering that 80% of data used by managers and decision makers are related geographically [66].

V. REASONS BEHIND THE MOUNTING IMPORTANCE OF SPATIAL ANALYSIS

The origins of spatial analysis in rural sociology date back at least to the community boundary studies of Galpin in the 1920s. This work facilitated the development of the Chicago school of urban ecology. In the 1990s, the spatial orientation has grown as a proportion of the total scientific activity in rural sociology as in the social sciences in general (for more details see: [4], [6], [27], [32], [67]).

Building on the revision of in-hand literature, it is argued that the recent dissemination of a spatial analytical perspective

in the rural sociology and the entire social sciences (outside of the discipline of geography) is often attributed to the followings:

- Rural sociology is always interdisciplinary-oriented. This may stem from its subject material, which being varied and attending to ecological aspects of social life, connect it to other disciplines, including the biological sciences. Addressing applied social issues also calls for interdisciplinary approaches. In this sense, for example, rural sociologists have long addressed conceptual, substantive, and methodological issues in studying space and their substantial scale of focus may have no counterpart elsewhere in sociology. At the same time, some sociologists have called for more theoretical development and integration of spatial thinking into mainstream sociology [68]. As sociology becomes more spatialized, the incorporation of space into rural sociological research is bound to increase. Interest in space also is connecting rural sociology to disciplines such as geography and regional science. Researchers from these disciplines increasingly attend each other's meetings and participate in broad initiatives to integrate the social sciences spatially.

- The rapid spread and the confluence of powerful geographic information systems (GIS) technology to the desktop. This has led to the use of GIS for data organization and visualization as well as encouraging an inductive approach to exploring data for meaningful patterns and structures (exploratory spatial data analysis). In essence, since their inception, geographic information systems have been promoted as vehicles for conducting spatial analysis, that is, for supporting scientists trying to extract meaning and insight from geographic data. More precisely, societal applications are enhanced when geographic information systems link local knowledge in the form of digital maps stored in databases with general principles in the form of algorithms, models, and methods of analysis [69];

- With advances in the design and improvement in the representational and geo-computational capabilities of spatial statistics, the operationalization of time-geographic constructs has recently become more feasible [3], [70]. More specifically, recent software developments are bringing important new capabilities in empirical modeling and estimating, leading to new insights about the role of space in human action and interaction, the main domains of rural sociology and the social sciences as a whole;

- Spatial analysis has mainly benefited from the proliferation of digital data that have come into existence in recent years. The availability of a vast array of geographically referenced socio-economic databases, especially in the developed nations, has significantly improved the ability of rural sociologists to think spatially. As a result, there is a reawakening of interest in models of human behavior that place individuals in the environmental context of space and time; and

- As a crucial aspect, has been the need to operationalize new theoretical constructs that explicitly incorporate space in the analysis of human behavior. A new generation of applications has emerged with branches in many fields of

social sciences. Many researchers, planners, and software vendors are making significant new claims for the feasibility and value of applying spatial research to societal problems, main area of interest in rural sociology (Brail and Klosterman 2001).

VI. CHALLENGES BEHIND NON-APPLICATION OF SPATIAL ANALYSIS IN RURAL SOCIOLOGY

Recent developments in the mainstream social sciences in general and in rural sociology in particular raise a number of challenges for the next generation of "spatial analysis." Central to these challenges are:

- An important issue, frequently overlooked in the enthusiasm for spatial analysis techniques in some rural sociological research topics, is their voracious appetite for detailed data. Although much detailed geo-referenced digital data are now routinely available, they are sometimes not suitable for use in models built at the micro-scale of individuals, households, buildings and tracts. Instead, data are available in aggregated and anonymized geographical forms especially in developing countries [71]. Creating models at micro-levels of individuals, households, buildings and tracts is a substantive focus for many rural sociologists for long time;

- Spatial analysis is just not easy to carry out for some social scientists out of geography [72]. In addition, yet there are enormous issues of scale, both temporal and spatial, and data compatibility and accuracy which must be overcome;

- Some spatially explicit data used by rural sociologists are still difficult to obtain, more especially in less-developed nations. Developing regions of the world frequently have poorly developed spatial data sets, and even if they have reasonable maps, those maps are not very likely to be available in a digital format;

- Spatial sociological theory may be subjected to mounting theoretical and empirical attacks because of its initial ambiguities and later reliance on methodological individualism, which may lead to micro-social fine-tuning that neglects macro-social prospects. This may make some specialists of rural sociology remain unconvinced of the value of spatial analysis in the systems they study [6];

- Some software to support such analysis have not been easily available especially for researchers in developing countries; and

- The recency of many of the more useful spatial statistical approaches has not allowed spatial analysis to play a big role in the development and testing of sociological theory.

Nonetheless, spatial data of interest to rural sociologists are proliferating, as are opportunities for spatial analysis.

VII. RECOMMENDATIONS FOR MORE INCORPORATION OF SPATIAL ANALYSIS INTO RURAL SOCIOLOGY

For some researchers, it is not at all clear that a technology designed to process geographic information is of significant value to the social sciences (outside geography), or it has potential as research infrastructure. Indeed, it seems illogical to make broad generalizations regarding rural sociological

research without considering geographic variations. However, building on the interest in, and the potential for more adoption of a spatial perspective in rural sociology mentioned in the previous sections, this paper exemplifies a potential for new developments of spatial thinking in the discipline of rural sociology in the following domains:

- *Disseminating the operational concepts of "space" among rural sociologists:*

It is certainly time, if not past time, to examine in some depth both existing and potential relationships between "spatial analysis" as a methodological module for rural sociology and the complex technology that has become labeled "geographic information systems." It is clear that future developments in both areas are going to require higher levels of integration than what is now seen if both are to advance significantly.

However, much more focus is suggested on the theoretical constructs that explicitly incorporate space in the analysis of human behavior. Spatial thinking needs to go beyond dealing with physical geographical locations to include location in "social" space (social distance, economic distance). This will require further consideration and development of distance metrics for "social" space, for space-time dynamics and notions of "topology" in space-time (the counterpart of the "weights" matrix in spatial autocorrelation analysis).

- *Empirical considerations:*

The spatial analysis needs to be extended to the analysis of socio-economic space-time data. Empirical validation of the new "spatial" concepts and models requires an explicit spatial sociological methodology that tackles issues of spatial dependence and spatial heterogeneity, as well as their extensions in the space-time domain. As researchers, some rural sociologists may still need more training to ask depth empirical questions about the world they study, systematically collect, and analyze spatially the data necessary to answer those questions. In this process, this category of rural sociologists especially from the third world, like all good researchers, may rely heavily on spatially processed research already completed by colleagues in rural sociology and other fields of social science.

- *User friendly tools:*

In spite of rapidly emerging tools that enabled the spatial approach for social science in the past decades, higher powered, accessible, extendable, and user-friendly tools are required. User-friendliness of tools ensures they are easy to learn, use, understand, or deal with. The next generation tools may allow data to be explored simultaneously from several different perspectives or at several levels of spatial aggregation to get on with many applications of rural sociological studies from individual and household to regional and national levels. Moreover, software for advanced spatial sociological techniques should be developed to deal with non-parametric data in addition to panel data and categorical variables.

- *Training programs in spatial analysis geared for rural sociologists especially in developing countries:*

Good research is a matter of method, not magic. Methods of spatial analysis can be learned, and learning them is a particularly important part of the field of rural sociology. In order to really bring spatial analysis into the classroom, and therefore, into the greater scientific and professional community of rural sociologists, we must have better trained analysts and better tools to work with. The immediate challenge is to include the researchers from developing countries who have so far been excluded from the benefits of GIS and spatial technology. Additionally, a comprehensive handbook of spatial analysis methods, techniques, and tools, adapted for use in GIS and spatial analysis in rural sociology, is needed.

It is to be noted that this paper's vision for the new scientific insight through the incorporation of spatial thinking into rural sociology does not constitute a research program per se. Instead the program is a collection of initiatives to support research across the discipline.

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