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Chapter 2: Changing Geographical Systems and Risk Processes: General Considerations

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"Risks are man-made hybrids. They include and combine politics, ethics, mathematics, mass media, technologies, cultural definition and perceptions; and, most important of all, you cannot separate these aspects and 'realities', if you want to understand the cultural and political dynamics of the world risk society" (Beck, 2000, page 221).

"It is perhaps obvious that high degrees of 'risk' are more irksome; most of us are reluctant to jeopardize our lives or the elemental requirements of life. But it is also evident that. … a life with uncertainty eliminated or perhaps even very greatly reduced would not appeal to us" (Knight, 1948, page 348).

1. Introduction

Considerations of the evolution of geographical systems and risk processes in the context of global changes and European integration are necessarily complex. Fist of all, there is the complexity of research questions arising from the heterogeneous character of elements of real geographical systems that are including both natural material (inorganic and biological elements) and societal phenomena and their mutual interactions. Considering the extremely heterogeneous character of geographical systems, researchers are confronted with societal processes which are constituted through the activity and subjectivity of actors advancing further societal development and associated with corresponding processes of cognition and human assessment. In consequence, there also is great variability and dynamics of societal development. It is important to recognise that this nature of the societal elements and processes in the evolution of geographical systems inevitably results in changes in crucial conditioning factors and implies shorter time spans in which established regularities in the evolution of complex geographical systems can be used and indicate in explanatory analyses possible causal factors (see further Hampl, 2000; Dostál and Hampl, 1995; 2007). Secondly, the complexity of the subject matter of studies of geographical systems also results from the multi-level character of geographical systems. The dimension of rank or geographical scale level is essential for any understanding of tendencies in the evolution of geographical systems. Accordingly, research questions are usually concerned with development tendencies of local and regional geographi-

cal systems in the national, European and global contexts. Thirdly, the complexity of considerations of evolutionary tendencies in real geographical systems also follows from the research orientation on diverse risk processes and uncertainties of assessments of development tendencies of geographical systems. This specific research direction needs to consider a wide range of research questions trying to highlight the ways in which different processes in natural environment and society can be understood as risk processes, often entangled, and in terms of uncertainties and hazards (Dostál, 2005). These three circumstances of the research considering the evolution of complex geographical systems make it necessary to follow research orientations that are using systemic approaches which can allow conceptualisations of feedback relationships between diverse heterogeneous processes in natural environment and society and between various scale levels of intertwined changes in natural environment and societal development (Dostál and Hampl, 1995).

The key research questions have to attempt to consider some main issues that beset studies of geographical systems and risk processes. There are the acknowledged complexities of geographical systems as intertwined societal and environmental systems and, consequently, there is given great emphasis to the necessity of methodological pluralism (see Dostál and Hampl, 2007). Another important point of departure is that an appropriate qualitative modelling of complex geographical systems based on systemic approaches can provides necessary foundations for development of quantitative models and approaches. It is also emphasised in this chapter that the multi-level character of feedback mechanisms in geographical systems significantly constrains possibilities to specify risks in exact ways. Further it is stressed that the dynamic development of the complex systems and associated uncertainties and risks are understandably an important problematic of current societal practice and political decision-making. Due to limited scientific knowledge and scientific foundations for solutions of current environmental and societal problems and risk situations, the approaches and procedures have often to be basically orientated on pragmatic ways of monitoring of development of individual cases of geographical systems and tackle specific phenomena and risk processes and narrowly defined issues. Whether one is considering hydro-geographical phenomena such as floods, changing water quality and erosion, or changing natural and cultural landscapes and land use patterns, or demographical and biosocial risks and risks of tendencies towards extreme regional socio-economic inequalities (see Dostál and Langhammer, 2007).

2. Uncertainty and risk in environmental and socio-geographical systems

According to Bernstein (1996, 3) the modern conceptualisation of risk has its origin in the Hidnu-Arabic numbering system which came to Europe seven to eight hundred years ago. At that time, farming, manufacturing and communication were simple. Disasters and breakdowns were frequent, but failures in one activity and locality or region had seldom direct impact on another. Today, the activities and tools we are using are characterised by high levels of complexity, breakdowns have often

far-reaching societal and geographical consequences, sometime even catastrophic impacts.

More systematic considerations of risk began in the renaissance era when constrains of the past in conceptualisations and consciousness of people were broken and long-held believes based on fixed tradition started to be replaced by challenges of future activities and more dynamic societal development. This era is characteristically also the period in which much of the world was to be discovered and gradual integration of the global system begun and was carried upon colonisation, trade and exploitation of resources in far continents (see also Taylor, 1996). It is therefore little surprising that the notion of risk "derives from the early Italian *risicare*, which means 'to dare'. In this sense risk is a choice rather a fate. The actions we dare to take, which depend on how free we are to make choices, are what the story of risk is all about. And that story helps define what it means to be a human being" (Bernstein, 1996, 8).

2.1 Difficult notions of risk and uncertainty

Burgman, (2005, 1) defines risk as "the chance, within a time-frame, of an adverse event with specific consequences" He gives a definition that is assuming possibilities of calculations of occurrence of adverse events. He is also viewing the notion of risk according to two dimensions of probability. It is usually understood as the statistical frequency (or relative frequency) with which a certain event is expected to take place. But, it can also be viewed as the degree of belief warranted by evidence. This second conception is thus concerned with situations in which a probability of an event is unknown or unknowable. This relates to the idea of "subjective probability" (Burgman, 2005, 7). It has the meaning of a lack of knowledge about a process or it specifies personal degrees of belief of various actors (whether scientists, political practitioners or other knowledgeable citizens). It is obvious that the concept of subjective probability seems to be most applicable when assessments of risks relate to the functioning of complex socio-geographical systems (see Dostál, 2005, 20–22). There is also language problem of words clustering around the notion of probability and risk. The spectrum is wide and ranges from such words as change, belief or tendency to possibility or plausibility and further to more exact words such as confidence, likelihood and risk. Language permits borderline case and it results in vagueness. Also due this linguistic variation, there is a tendency to assess risks in inconsistent ways. It is obvious that risk assessments depend on relevant settings. It is important to note already at this stage of our general discussion that these considerations clearly show that risk assessment is inherently also a subjective affair which is significantly influenced by its societal context. Moreover, these considerations also indicate that analyses of the character of risk must be situated in conceptualisations of frameworks of geographical systems which are basically approached in term of reference of socio-ecological systems. Accordingly, the preliminary conclusion to be drawn is that "(r)isk assessments are invariably subject to distorting influences, perhaps more so than other types of scientific analysis, because the public setting of many of the problems" (Burgman, 2005, 25).

It is also essential to understand that the associated notion of uncertainty refers to a situation in which the likelihood of an event occurring cannot be estimated. Blyth (2002, 30–34) has been referring to two conceptualisations of uncertainty considering interests, complexity and bounded rationality. First, there is the notion of uncertainty developed by North who is conceptualising uncertainty as resulting from "the complexity of the problems" (1990, 25). This approach is recognising that decision-makers are sure of their interests, but unsure of how to realise them. Knowing their interests, the decision-makers cannot calculate how to achieve their interests and through reducing the set of possible strategies the decision-makers attempt to shift uncertainty to risk by ideas of some "road maps" or "focal points". In other words, the decision-makers cannot be "maximisers", but only "satisfiers" (Simon, 1957). Second, there is the concept of uncertainty defined already in the 1920s by Knight (1948) who is not reducing the notion of uncertainty to the one of risk. He was arguing that "the term 'risk', as loosely used in every speech and in economic discussions, really covers two things, which, functionally at least, in their causal relations to the phenomena of economic organization, are categorically different". … The essential fact is that 'risk' means in some cases a quality susceptible to measurement, while at other times it is something distinctly not of this character; and there are far-reaching and crucial differences in the bearings of the phenomenon depending on which of the two is really present and operating. … It will appear that *measurable* uncertainty, or 'risk' proper, as we shall use the term, is so far different from an *unmeasurable* one that it is not in effect an uncertainty at all. We shall accordingly restrict the term 'uncertainty' to cases of non-quantitative type". Knight conceptually elucidated the crucial character of the difference "between measurable risk and unmeasurable uncertainty" because making decisions "men must *know what they are doing*, and not merely guess more or less accurately" (1948, 19–20). Importantly, in his conceptualisation it is recognised that any really uncertain situation to be assessed is in a high degree unique and the researchers and decision-makers cannot have any idea as an outcome of their analyses as to what possible results are likely, and thus what their interest in such a situation can be. In brief, if "there is no possibility of forming *in any way* groups of instances of sufficient homogeneity to make possible a quantitative determination of true probability" (page 231). Accordingly, for example "insurance deals with those which are 'fairly' classifiable or show a relative low *degree of uniqueness*, but the different branches of insurance show a wide range of variation in the accuracy of measurement of probability which they secure" (Knight (1948, 247; words in italics are in the original).

This emphasis put on the uniqueness is also of decisive importance for an adequate understanding of the notions of uncertainty and risk in the geographical systems and thus not only in the systems of economic institutions and decision-making such as speculation on financial markets or investment decisions in times of major and highly unique economic crises. In the case of risk situations one can assign probabilities to possible outcomes founded on adequate empirical systemic analyses. Here, however, there must be reiterated a number limiting circumstances of adequate research of the evolution of geographical systems and risk processes (Dostál and Hampl, 2007, 30–31). In the first place, the varied activities and also the subjective character of be-

haviour of actors carrying on societal development processes are processes of cognition and assessment. Secondly, the multi-level structuration and stochastic character are typical features of the development of societal systems. These aspects of social behaviour and societal development give room for speculative and normatively biased assessments of realities of societies. Thirdly, usefulness of information and data on societal development is complicated. Because dynamic and variable societal development tendencies result in modifications of conditioning factors tend to lead toward shorter time spans in which identified regularities can be employed in subsequent scientific research and applied in practical decision-making. Fourthly, given these difficult circumstances of the cognition process there are also inclinations to distort research and its outcomes concerned with real societal and geographical systems by excessive ideological approaches which further complicate a systematic and cumulative process of knowledge acquirement. It is inevitable that at the field of studies of complex geographical systems and risk processes different ideological positions are constituted by perceptions and understandings and by wished changes of realities of intertwined societal and environmental systems. These concerns indicate the importance of a reliable basic research that can avoid inadequacies of ideologically biased research and its irresponsible applications (Dostál and Hampl, 2007, 34).

Finally, there is the above-emphasised issue of uniqueness which has a long history of controversy in human geography as well as in physical geography. It is concerned with the controversy between the research interests in generalising nomothetical studies seeking regularities and the research interests in idiographic studies emphasising uniqueness of studied areas (Hartshorne, 1959; Chorley and Haggett, 1967; Harvey, 1969; or Dostál ad Hampl, 1995; Hampl, 2000). For example Hartshorne stated the arguing that "we face, therefore, a dilemma: in order to study a sufficient number of areas similar, we must define the category so broadly as to include individual variations sufficiently great as to upset the validity of generalizations based on the assumption of identical character; if the types are defined sufficiently closely to avoid this danger, we may have but one specimen of each type" (1959, 151). There is no need to summarise here the controversy, but considering the Knightian type of uncertainties it is necessary to reiterate in this introductory chapter about our research on the geographical systems and risk processes a few key epistemological and methodological issues. First, there is a research continuum stretching from the research interests in (a) *unique* (i.e. exceptional) features of geographical systems that distinguish a single geographical system from other geographical systems towards the research interests in (b) *specific* features emphasising particular features distinguishing a geographical system from others of its kind, and further towards the research interests emphasising (c) *general* (i.e. typical or universal) features of the geographical system suggesting that general features are widely spread in the set of geographical systems concerned and studied. It is clear that the research interests focused on the unique character of geographical systems approach a studied geographical system as if it is the only one of its kind, but usually not separate from other kinds of geographical systems.

Second, it must be reiterated that the concepts of uncertainty and risk are obviously *future orientated* notions. The Knightian type of uncertainties assumes that

to a very high degree regularities are unknown; regularities which must be applied in necessary estimations of future outcomes of processes in the system studied. The concept of risk is also distinguished from the one of uncertainty, because risk involves decision-making resulting in a *voluntary* taking of doubtful of adverse chances. Further, risk differs from hazard which is implying danger from something *beyond the control* of decision-maker. Therefore, risk situations refer in the studies of geographical systems to high possibilities of loss or harm that are to a certain degree known to decision-makers concerned. In short, the conceptualisation of risk situation assumes research interests that can produce relevant information about general or at least specific features of geographical systems. Third, the research orientated on studies of complex real geographical systems and risk processes must be obviously concerned with the intertwined nature of the societal and environmental systems and confront the complicating facts that repetitions of their features and processes are limited (see also Dostál and Hampl, 2007). In consequence, the production of *useful* knowledge about regularities that are needed for *estimations of future developments and risk processes* is significantly constrained. Accordingly, the research methodologies concerned with systematic studies of risk processes in real geographical systems must often be orientated necessarily on *monitoring of individual cases of systems* (see also Bennett and Chorley, 1978). The monitoring-based research considering individual cases of geographical systems can deliver useful outcomes that make it possible in the specific context of the system concerned to assess future states of quality and forms of feedback mechanisms between the societal and environmental components of the geographical system though extrapolations through quantitative modelling. Examples of the monitoring and modelling of individual geographical systems were presented earlier (see Dostál and Langhammer, 2007) and highlighted some of the ways in which different processes in nature and society can be understood as risk processes or in terms of unexpected hazards and uncertainties. The key lesson to be drawn from all these considerations of the difficult notions of risk and uncertainty is that highly unique situations which are often identified in complex analyses of the real geographical systems are beset by uncertainties which cannot be reduced to risk situations defined in unequivocal terms of causes and effects which would make effective decision-making and applications in other instances an unproblematic affair.

2.2 Further considerations on geographical systems: social systems and ecosystems intertwined

Among early and interesting considerations of the extremely heterogeneous character of geographical systems are conceptual studies of the character of intertwined social systems and ecosystems and the key role of the societal context carried out by Duncan (1959; 1961). He claimed that "if one holds with Durkheim that the basic categories of science, as well as the interpretative schemes of everyday life, arise from the nature and experiences of human collective existence, it cannot be long before we are forced to conjure with some version of the ecosystem" (1961, 149). He sketched a preliminary human-ecological frame of reference in terms of four referential concepts:

(i) population, (ii) environment, (iii) technology, and (iv) organisation and explained that "the unit of ecological analysis is a human population, more or less circumscribed territorially" (1959, 681). Further he rightly argued that "the problem of adjusting to an environment is both facilitated and complicated by man's possession of a culture" and suggested to follow functional and analytical approaches which were involving "a concern not with culture as an undifferentiated totality but with aspects of culture as they play into the process of adaptation". His sketch defined the referential term 'technology' in a broad way and as an important explanatory factor changing the socio-ecological systems. He referred to "a set of techniques employed by a population to gain sustenance from its environment and to facilitate the organization of sustenance producing activity" (1959, 682). Moreover, Duncan was timely warning that "the trend of social evolution is toward the elaboration of organisation at the intercommunity or supralocal level to such an extent that it becomes necessary, for some purposes, to take account of a fabric of interdependence with planetar scope – the 'world community', for want of a better term. Intermediate levels of organisation must, of course, be recognized; the most prominent heuristic concept at present is the 'region'" (page 684). The early recognition of interrelations of the referential concepts and the whole fabric of interdependences ranging from the local and regional levels to the world system level is also important in more recent considerations about changing real socio-ecological systems, in brief about the evolving geographical or environmental systems.

Also Bennett and Chorley (1978) were referring in a challenging way to research problems of interfacing of the systems and were drawing the conclusion that "the structure of both types of systems, particularly in terms of the disposition of their gains, delays and storages, provides an overall unification of systems operation which makes any simple division into the stable negative-feedback physico-ecological systems and the unstable positive-feedback socioeconomic ones very difficult to sustain (1978, 468). They further pointed out to that "there are many difficulties facing those who have interests both in the natural environment and in the man-made environment together with the problems of their interfacing. One of the currently most intractable is that, having been imbued with the ecosystem, with the emphasis on balance, equilibrium, cycling and stability, scholars are increasingly faced with the methodological necessity of also accommodating active control involving the impelling of systems on time trajectories through sequences of state, each different, probably non-recoverable and presumably ever more adapted to evolving needs of man in society. … In short, scientists are being faced with the basic problem of modelling systems which are stable in the short term under negative feedback mechanisms, yet capable of long-term changes under the positive feedback evolutionary mechanisms involved in economic and social tendencies" (page 471). They also claimed that "whichever model of systems interaction one chooses is partly dependent upon one's view of man-environment relationships… or on the scale of operation of the system … the larger the total environmental system concerned, both in time and space, the greater the tendency there is to model it in a symbiotic, rather than in intervention, form" (page 480). Research and also practical application interests in symbiotic control made clear "that many of the most pressing problems of physico-ecological and