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Inaugural address

Anne van der Veen

Professor of Governance and Spatial Integrated Assessment

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**INTERNATIONAL INSTITUTE FOR GEO-INFORMATION SCIENCE
AND EARTH OBSERVATION**

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It is a pleasure for me to deliver this inaugural address as it is a welcome opportunity to present my ideas on collaboration between the different departments within ITC. I will discuss my ideas on the art of integrated assessment embedded in the context of governance principles.

Governance

There has been a marked change within the discipline of public policy and public administration in the past 20 years. It has been a change from vertical steering principles towards a mix of horizontal and vertical organisation networks in the production of public goods. In the past, public policy was devoted mainly to the paradigm of:

- doing the right things, with a reference to legitimacy, and
- doing things right, which refers to efficiency.

Currently, however, governmental organisations are faced with multifaceted problems (employment, environment, agriculture, forestry, spatial planning, with all the accompanying societal clashes) that demand multi-instrumental steering mechanisms within a multi-stakeholder context. Moreover, this is combined with the problem of deciding what level of organisation should do the job. Should it be the municipality? the region? the province? the state? or the EU? Here, the production of public goods differs sharply from production within the market sector, where the decisions are relatively easy.

In this complicated arena, each country decides for itself how to organise its public goods production. It may be organised in a strictly centralised way, as in France, or in a federal way, as in Germany. There is no single optimal way of organisation. The structure of institutions is based on normative decisions in a particular cultural context. Likewise, the issue of what will be produced is a normative decision. Some countries, the USA for example, are organised around a highly competitive market formula, whereas in Europe we have opted for an economy characterised by equity principles and high levels of social security. Here, a community collectively decides on the content of its social structure and its institutions. Let us take as an example ITC advice on designing a new land administration system in Mongolia. Do we recommend a system based on Anglo-Saxon institutions, the cadastre, embedded in Roman law? Or do we recommend a system based on common good principles?

Several times in this lecture, we will come back to this issue. There is ambiguity when it comes to designing the rules of the game, or, in other words, there is no single optimal configuration (Scharpf, 1997; Bressers and Kuks, 2003).

The art of integrated assessment

Integrated assessment already has a longstanding tradition – within ITC as well. Since 1964, ITC has had a social science department with a special branch for integrated surveying, leading to a Master's degree in integrated surveying (de Haas and Rijnberg, 1973).

ITC realised quite early that the collection of satellite data should lead towards a kind of integration in decision support systems, because forest management, river basin management and land use change types of problems are by nature multifaceted. Note that in those days the word “governance” was not fashionable at all. It came as a remarkable discovery to learn, when I was talking to the rector of this Institute and to Erik de Man, that ITC already had a long track record in working with integrated analyses and integrated surveys, a track record dating back long before the term “integrated assessment” was coined. I am told that the ITC-UNESCO Centre for Integrated Surveying died out because researchers arrogantly thought that they were the only people with the right research design.

An important milestone in the development of the interdiscipline of integrated assessment in the rest of the world was the publication of an article on “wicked” and “tame” problems (Rittel and Webber, 1973). Conventional, let us say, engineering problems are tame, because they are easy to solve using mathematical analysis. Social problems are wicked, because they involve defining the problem, locating the problem in a hypercomplex social system, and finally proposing actions to fill the gap between what is and what ought to be. In rereading the last sentence, we realise ourselves that there is no single solution to any normative problem. Consequently, we are faced with multifaceted problems where the inhabitants of a region or a country have a say in designing their own future.

Integrated assessment is an approach to structuring the way we deal with multifaceted knowledge. Rotmans (1998) defines integrated assessment as “a structured process of dealing with complex issues, using knowledge from various scientific disciplines and/or stakeholders, such that integrated insights are made available to decision makers”.

In reconstructing the past, I think that there are at least two major strains in the literature that have formed integrated assessment:

- The first is the scene of global climate change models, starting from the level of large-scale models such as those of Forrester (1971) and the club of Rome (Meadows et al., 1972) and leading to the current IPCC models.
- Later, the micro level of environmental impact assessment (Toth and Hizsnyik, 1998) was added, leading to what is now called strategic environmental assessment.

The macro models in particular generated a huge amount of literature. In the Netherlands, Hordijk (1991) was one of the first to embed environmental problems in an integrated assessment framework. Two years later, Dowlatabadi and Morgan (1993) published an article in the journal *Science* on the integrated assessment of climate change.

Integrated assessment raises a few thorny issues:

- the combination of scientific knowledge from various disciplines into models
- the explicit treatment of time and spatial scales: from pixels to oceans and continents
- the formulation and design of scenarios as a normative exercise
- the handling of uncertainty, showing our limited knowledge and all types of variability.

I am not able to discuss all the elements of integrated assessment within half an hour, so I have chosen to concentrate on the science philosophy problem of combining scientific knowledge and on the issue of governance. Later, I will give some examples of detailed problems and solutions in the collaboration between scientific disciplines.

Science philosophy, consilience and integrated assessment

What's so new about integrated assessment? The new element is the collaboration between natural and social sciences.

Let us first discuss how we can deal with integration between scientific disciplines. I will use some material from a provocative book on science by Edgar O. Wilson (1998), who introduces the term "consilience". The notion of consilience was taken from

Whewell (1840), as explained by Thagard (1988). Consilience is a measure of how much a theory explains. A theory is said to be consilient if it explains at least two classes of facts. Wilson translates consilience as a jumping together of knowledge by the linking of facts and fact-based theory across disciplines to create a common ground for explanation. According to Wilson (p. 7), "the only way to either establish or to refute consilience is by methods developed in the natural sciences [...] It is a metaphysical world view, and a minority one at that, shared only by a few scientists and philosophers. It cannot be proved with logic from first principles or grounded in any definitive set of empirical tests [...] Its surest test will be its effectiveness in the social sciences and humanities."

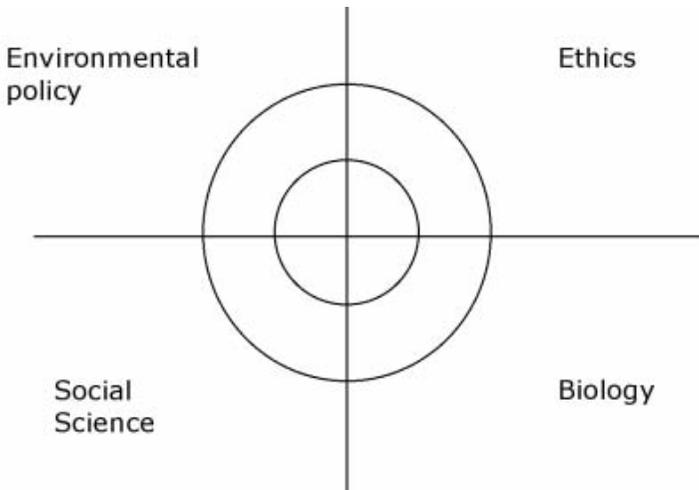


Figure 1 Consilience across scientific disciplines

Figure 1 gives an illustration of Wilson's ideas (p. 8), and to quote: "As we cross the circles toward the point at which the quadrants meet, we find ourselves in an increasingly unstable and disorienting region. The ring closest to the intersection, where most real-world problems exist, is the one in which fundamental analysis is most needed. Few concepts and words serve to guide us [...] Only in imagination can we travel clockwise from the recognition of environmental problems and the need for soundly based policy; to the selection of solutions based on moral reasoning; to the biological foundations of that reasoning; to a grasp of social institutions as the product of biology, environment, and history."

Will it ever be possible for specialists to reach agreement on a common body of abstract principles and evidentiary proof? According to Wilson (p. 9), “the momentum is overwhelming; disciplinary boundaries within natural sciences are disappearing, to be replaced by shifting hybrid domains in which consilience is implicit [...] Given that human actions comprise events of physical causation, why should the social sciences and humanities be resistant to consilience with the natural sciences?”

Wilson is a biologist and it is therefore natural that he sees a major role for biology: “all human actions comprise physical causation”. It is not something I can discuss quietly at home. However, Wilson is looking for a few general principles that cover the natural world and a few that fit the behaviour of human beings.

Wilson is right in pointing out that, especially within the natural sciences, enormous progress has been made in tearing down the walls between disciplines. But things may be different when it comes to the walls between natural and social sciences. To judge whether it is possible to tear these walls down, let us turn to science philosophy.

Integration in science philosophy

There is a huge literature on the difference between natural and social sciences. I am not the one to provide the definitive answer, but I can at least raise a few issues.

In general, we can state that science is about facts and about hypotheses in relation to existing theories. We constantly play with facts and hypotheses. What role can there be for integration? The answer (Rip, 1997) is that there are two ways of inserting integration:

- The first is to define a border concept where two or more disciplines can cooperate. This border concept regulates the input and output of knowledge between decomposed disciplinary models.
- Second, an overarching principle may fuse disciplines. In the medical sciences especially this has worked quite well: concepts such as “cell” and “molecule” have served as engines for cooperation.

In my view, resiliency is an overarching concept where integration between natural and social sciences can be reached, and as such may serve as a kind of measure of fitness. It is interesting to note that the Stockholm Resilience Centre has now been founded to promote cooperation between ecologists and economists. Here, resilience refers to

the capacity of a social-ecological system both to withstand perturbations from, for example, climate or economic shocks and to rebuild and renew itself afterwards. Loss of resilience can cause loss of valuable ecosystem services, and may even lead to rapid transitions or shifts to qualitatively different situations and configurations for people, ecosystems, knowledge systems, or even whole cultures.

How far can we go? Is the ultimate aim a unity of knowledge? For me, the answer is no, and the argument lies in the differences between natural and social sciences. We have already touched on the words “tame” and “wicked”. Indeed, social sciences do deal with wicked problems, where groups in society may have different opinions. According to Gordon (1993), the main differences between natural and social sciences are that:

- social phenomena are not as uniform as natural phenomena
- social scientists have difficulty in carrying out experiments
- value judgements in social sciences are more involved
- social phenomena reflect entities of the mind
- social scientists are less able to isolate particular causal factors from their general context
- social sciences relate to a social domain where individuals form their motives, tastes and beliefs also on the basis of the groups to which they belong.

All this implies that there is a fundamental ontological disparity between natural and social sciences. However, the fact that natural and social sciences differ in an ontological way does not imply that they differ in the way we perform science. Like natural sciences, the social sciences utilise coherent and logically valid theories and have to treat relevant empirical phenomena carefully and objectively (Gordon, 1993). In other words, post-modern science is too difficult for me!

But there again, social scientists are closer than natural scientists to wicked problems in society. How then can we deal with this fact? The consequence is that we have to work out more precisely how to handle public values, how to deal with uncertainty, and how to imagine the future (van Asselt and Rotmans, 2002).

The problem of uncertainty is one of those malicious issues in science. It implies that we have to deal with limited knowledge owing to conflicting evidence or the lack of observations, and with uncertainty owing to variability, for example, in behaviour or in values and norms (van der Sluijs, 1997).

The way we imagine the future, the way we build scenarios, is not a value-free exercise. It is where we decide how we view the operation of our society and how we build our institutions. For example, what type of governance is pursued? Is it an economy based on market principles without a proper layer for social security, or is it a European-style economy based on equity principles?

Let us take an example (Carmichael et al., 2004). The University of British Columbia has designed a model – the Quest model – to envision the future in Canada's Lower Fraser Basin. The model combines expert knowledge and stakeholders' visions on values and beliefs. Combining these two elements has produced a 40-year scenario for the basin (*Figure 2*). *Figure 3* shows the part of the model where stakeholders make individual choices based on their values and beliefs. With buttons for World View, Politics and Priorities, stakeholders determine their future.

The Quest model is a clear example of how objective facts and normative values are combined to integrate natural and social sciences. The values and beliefs of stakeholders provide a way of dealing with wicked problems, ultimately leading to a solution to shaping the governance of a coastal basin. Not an optimal solution – because there is no optimal solution – but a legitimate solution.

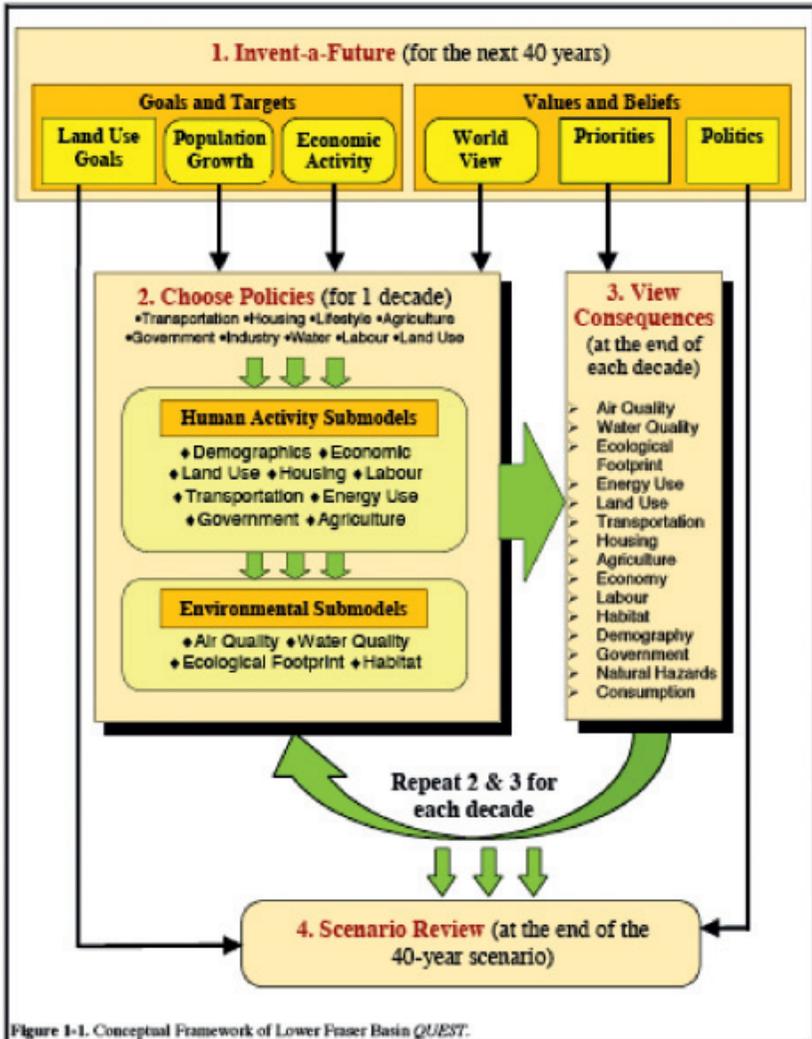


Figure 2 The Lower Fraser Basin Quest model structure (<http://www.envisiontools.com/lfbquest>)

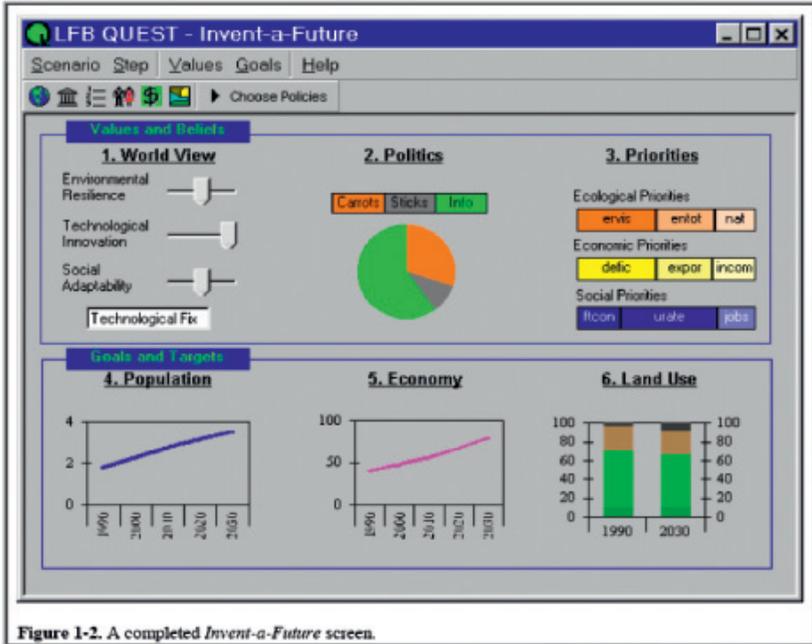


Figure 1-2. A completed *Invent-a-Future* screen.

Figure 3 The Lower Fraser Basin Quest model: stakeholder choices (<http://www.envisiontools.com/lfbquest>)

Unity of knowledge and consilience: a conclusion

Let me put forward an initial conclusion before I turn to some examples. Wilson (1998) reformulates the collaboration between scientific disciplines in terms of consilience. It is a challenge for me, doing integrated research, to search for overarching paradigms. Here, the concept of consilience may form the basis for validating such paradigms. However, I believe that natural sciences and social sciences differ so much in substance that unity of knowledge is a bridge too far.

Examples

To illustrate the difficulties and the challenges regarding integrated assessment, I would like to give some examples from my own work. It will become clear that life is hard and that there is a long way to go even to reach what has been called consilience.

Economics and ecology

Economists and ecologists have borrowed several concepts from one another. Economists have delivered input-output analysis to the life sciences (Leontief, 1970, 1986; Boomsma et al., 1991; van der Veen et al., 2006; van der Veen and Kalfagianni, 2006), while ecologists have inserted evolutionary principles into economic theory – this was indeed a revolution! It has meant a critical review of equilibrium models that were supposed to be at the cutting edge of economics. In evolutionary economic models, chance and selection are the key issues. Moreover, path dependency and increasing returns to scale determine the outcome of economic processes (Lambooy and Boschma, 2001; Dopfer, 2005). It is not the equilibrium outcome that is important, but the analysis of the process after a disturbance. However, the frightening consequence of an evolutionary theory applied to economic phenomena is that it is an almost impossible task for (regional) governments (Lambooy and Boschma, 2001) to design instruments that enable public policy to react in a proactive way to sudden perturbations. There is no blueprint for the future structure of a regional economy that will deliver low unemployment. This is a particular problem for governments that aim at economic growth of the Silicon Valley type (e.g. around regional universities). One of the major research issues in regional economics is to explain the growth pattern of agglomerations. The particular problem is how to model the chance that new firms will develop and, on top of that, the consequent agglomeration forces that will lead to sustained growth. We will come back to this issue when we turn to agent-based computational models.

Payment for environmental services

In my previous inaugural address in 1995, from the perspective of integration between economics and ecology I paid ample attention to contingent valuation, a technique that Peter Geurts and I apply to detect what individuals are willing to pay for preserving environmental quality. Our conclusion was that, under rather strict conditions, individuals are able to process the complicated information that is offered (Bateman and Willis, 2001; Polomé et al., 2006; Vatn, 2004). I now want to follow up on this piece of research with what is called payment for environmental services. This new idea stems from a concept discussed in de Groot et al. (2002), where the interrelations between economic and ecological processes are analysed from the functions that nature delivers to the economy. These functions can be translated into public services that require a price. The idea is that, if the functions are not available in the future, society anyhow has to pay for new technology that produces the same service. For

instance, if clean water can be maintained by demanding that farmers refrain from certain activities, their lost income should be compensated. ITC forms a perfect base for doing this type of integrated research – research such as that which Robert Becht and I proposed for Naivasha in Kenya. *Figure 4* highlights the logic behind this new idea.

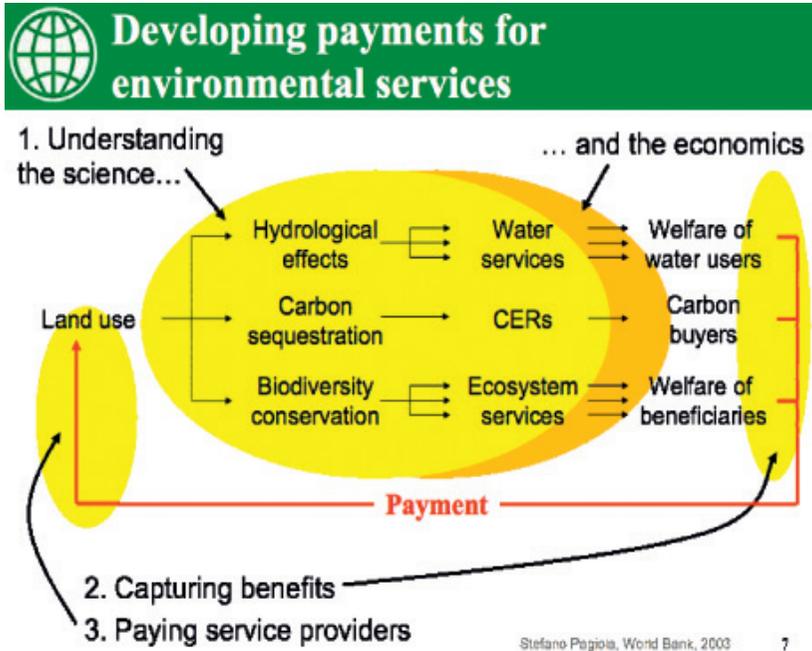


Figure 4 Payment for environmental services (Pagiola, 2003)

Economics and psychology

One of the most promising fields of research within the social sciences is the combination of economics and psychology. The Nobel prize winners Tversky and Kahneman (1981) had already come to the conclusion in 1981 that the analytical scheme of economists was not free from errors. If respondents are confronted with another framing of the same problem, preferences may reverse. Because of this anomaly, McFadden (1999) raises the question of how far economists have to go in order to deal with this problem. His conclusion is that only a search for deeply rooted beliefs and attitudes, away from full information and so-called rationality, will rebuild economics. In fact, this is a plea for a general social theory: a Holy Grail.

Wilson, in his book on consilience, is very radical in his judgement of social sciences. Being a biologist, he acknowledges that social sciences are hypercomplex but considers that the only way of dealing with the above-mentioned anomalies is to go back to the foundations of human nature and pay attention to its deep origins. Not surprisingly, he mentions a few evolutionary principles from socio-biology: kin selection, parental investment, status, territorial defence, and contractual agreement. It is interesting that the last now forms the basis for institutional economics.

A more fundamental criticism, and a huge challenge for social sciences, is the lack of micro-foundations for macro-social phenomena. This is where agent-based modelling comes in and where we make our final move in order to discuss research on land use change.

Economics and complexity

It was Schelling, another Nobel Prize winner in economics, who showed how complexity concepts from natural sciences could be inserted into economics (Schelling, 1978). Schelling proves that ghettos in the USA are formed even though individual agents are not aiming for such a macro goal. The only aim of his agents is to have neighbours of the same colour on the left and right. This is a typical consequence of complexity. Interactions between agents lead to structures on meso and macro levels that cannot be explained by micro processes (Colander, 2006).

In agent-based computational economics, this notion is used in order to restore the relation between microeconomics and macroeconomics. Currently, macroeconomics is based on a representative producer and consumer. In agent-based models, the heterogeneity of agents is acknowledged, as well as the complex interactions between agents (Tesfatsion and Judd, 2006). In a conventional Walras type of economy, prices act as an invisible hand in matching demand and supply. How this match develops – the actual process – is of no interest at all. In agent-based models, however, it is precisely the process that is of interest, as well as the consequent emergent structure.

Agent-based models

Agent-based models are a vehicle for reformulating the foundations of economics (Vriend, 1996). Growing artificial societies is a pastime for scientists of a computer-nerd character (Epstein and Axtell, 1996). The formal issue, however, is serious: interactions between agents give rise to non-linearity, which forces us to turn to

simulation models that generate solutions for our system (Gilbert and Troitzsch, 1999). Most of the time, economic models do not pay any attention to interactions between consumers and producers that lead to emergent behaviour on a higher scale level. In ABM (activity-based management) models, not only can the optimisation function be changed from utility maximisation and rationality to evolutionary game models, we can also put in how the interactions between agents are shaped. Moreover, we can insert beliefs and attitudes as constituting elements of actions (Conte and Castelfranchi, 1995).

Agent-based models and land use change

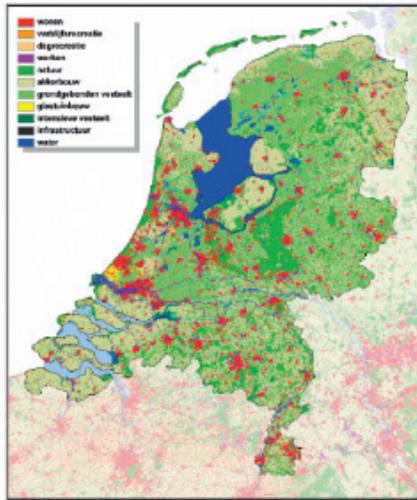
In land use, literature problems are even more formidable, because of the combination of behavioural models and spatial systems. Indeed, Castle and Crooks (2006) conclude that the combination of four (time and space) dimensions and a social model is impossible, because it is not yet possible to update GIS systems constantly. Consequently, a more modest approach is necessary. In my own research programme with PhD students, I try to combine ideas on agent interactions and land use change in highly abstract models (Grevers, 2007).

In economics, land is one of the most complicated goods. It is treated as having no spatial characteristics at all. In standard regional economic literature, a neoclassical view is taken, where the consumption of land is traded against the costs of distance to the central business district (Alonso, 1960). This means space is handled as a one-dimensional feature that can be translated into costs. And that results in very simple maps where land use is concentrated in rings around the central business district (*Figure 5*; Wu and Plantinga, 2003).



Figure 5 Concentric rings around a central business district (Wu and Plantinga, 2003)

As soon as we try to introduce some reality into these maps, we have to turn to cellular automata or to other Markov types of allocation mechanisms as, for example, applied in the so-called Ruimtescanner in the Netherlands.



Figuur 1 – Nederland in 2000

Figure 6 Urbanisation (in red) in the Netherlands, 2000 (source RIVM)



Figuur 2 – Verwachte NL Nederland 2040

Figure 7 Urbanisation (in red) in the Netherlands, 2040 (source RIVM)

When comparing *Figures 6 and 7*, the increase in urbanisation looks rather scary. One criticism may be that the underlying behavioural content is rather low. However, if we try to insert more behaviour, we can start with only very simple assumptions because of the problems of handling the dimensions of time and space that I mentioned above (Parker, 2005). My PhD student Tanya Filatova does so using the agent-based model scheme shown in *Figure 8*.

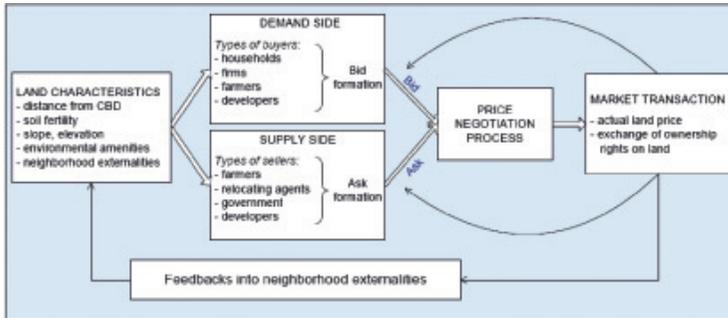


Figure 8 Price formation in the land market (Filatova and van der Veen, 2007)

This model applied to an artificial society results in the picture shown in *Figure 9*.

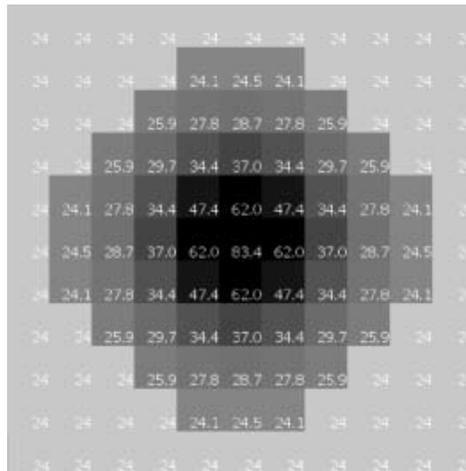


Figure 9 Emergent land use patterns in an agent-based computational economic model (Filatova and van der Veen, 2007)

This is still not a very exciting picture. However, the good news is that we refrained from the concept of an invisible hand (as used in standard economics) and instead applied a procurement process that restored the relation between microeconomics and macroeconomics. Second, where in standard economics space is translated into distance, a one-dimensional concept, in these ABM models space is the combination of a GIS and a behavioural model. Finally, we are able to depict emergent spatial change. I am convinced that in the future ABM will play a major role in explaining land markets. It is here that I will make major efforts, drawing on the field of spatial statistics within ITC.

Conclusion

Social problems are wicked and should be tamed with integrated knowledge. In this inaugural address, I have tried to clarify both the challenges and the pitfalls of consilience as a theoretical concept for integrated assessment. I have not committed myself to the unity of knowledge as a general principle, but have showed some examples of how values, beliefs and attitudes shape the decision framework that we have to apply in order to govern our society.

I thank the rector of ITC for giving me the opportunity to work on integrated surveying (as it was called in 1964). And I thank my family for the discussions we have had on water, on democracy, on energy and, last but not least, on the mind.

Ik heb gezegd.

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