5
Towards Research Which is Policy-Relevant: Comments on a Method for Exploring the Complexity of Agro-Environmental Issues

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Abstract

Our understanding of agro-environmental processes has emerged alongside a growing acceptance that 'real world' issues are complex and do not readily lend themselves to analysis or representation by single disciplines. This has in turn focused attention upon the value of thinking systemically and where possible holistically with an accompanying movement towards transdisciplinarity[16]. Drawing upon an example of investment in agricultural water infrastructure in the Argolid Valley, Greece, this paper suggests a conceptual framework for the interpretation and representation of agro-environmental issues. While this starting point may be articulated differently by the authors, each of whom have different disciplinary backrounds (sociology, engineering, education and training and technology studies), a general scepticism about planning for 'end states' is matched by the recognition that no single disciplinary perspective can provide an adequate insight into natural-human interactions. The need for an integrative method is highlighted which is about issues rather than disciplines, is consistent with the interpretation of systems as complex, and is sufficiently flexible to recognise the need to select the relevant skills for particular stages of research.

Introduction

By way of introduction to the core themes of this paper we would note some concerns about the increasing acceptability of linking disciplines. Firstly, interdisciplinarity can disappear into generality and thereby constrain development within single disciplines. Secondly, and central to this paper, is a concern that the introduction of more disciplines to the environmental melting pot is considered to be the best way to represent the complexity of issues. This is a premature assumption if those issues are inadequately defined and the information requirements inappropriately specified. There is a danger that agro-environmental research can become a catalogue of disciplines, information and techniques rather than *a guide to learning how to structure issues* (de Pablo et.al. (1994). It is this framework for structuring issues which should provide the basis for selecting the requisite contributions from different disciplines. In other words the agendas underpinning agro-

[16] Multidisciplinarity is interpreted as a number of independently performed studies with external co-ordination, generally through editorial linkage whereas transdisciplinarity research is the development of an overarching paradigm which addresses a specific issue(s) and encompasses a number of disciplines. Interdisciplinarity falls somewhere between these two approaches in that it provides internal and substantive linkages between the disciplines but is not subsumed under a supradisciplinary paradigm (Jeffrey, 1997).

environmental research, albeit in its interdisciplinary guise, need to be recognised as issues rather than scientific themes.

This approach, and the selectivity within it, must be accompanied by a degree of disciplinary humility, a requirement that is not always foremost in the academic tool box. Making sure that the nuts and bolts are roughly in the correct place is fundamental to representing the machine. By the same token, the absence of the odd nut or bolt will not necessarily be too detrimental to that representation. Herein lies an important point. What is being sought is a representation of the real world that is capable of generating questions about possible futures rather than providing solutions. Those questions need to be relevant and as such must be capable of supporting choices relating to the future - they must be decision relevant.

Agro-environmental studies must therefore reflect and make explicit the complexity of issues, including spatial (geography and organisation) and temporal (duration and tempo) scales, through the development of a conceptual framework which is not interdisciplinary so much as transdisciplinary. This is not intended either as a critique of the many attempts at integration or to question the fundamental contribution to be made by good teaching and science within single disciplines. Rather, it is an expression of the need to define issues more clearly through the exploration of social and natural interactions and an improved understanding about when, and to who, those relationships constitute a problem.

The paper will develop this argument in two parts. Firstly, the need to look at environmental issues as complex and emergent will be considered and a number of the concepts adopted in support of this approach will be introduced. Attempts to 'reduce' or simplify these systems, albeit within an interdisciplinary framework can be seen as premature in that they are often determined by the technical perspective of the analyst, teacher or student without an adequate description of their relevance or construction by different stakeholders (Linstone, 1981; Clark et.al. 1996). The second part of the paper will introduce the idea of a conceptual framework for the specification of agro-environmental issues (drawing upon modelling and soft complex systems thinking and the adoption of social enquiry elicitation techniques).

Complexity and Environmental Issues: a Problem of Definition?

The assumption that environmental studies need to be issue based immediately raises questions of "choice" by, or on behalf of, government, organisations, community groups or individuals. This choice inevitably relates to what is *perceived* to constitute an environmental issue and extends to the criteria used for its representation. This representation must also incorporate, though not be driven by, the impact and interpretation of science. Whilst the scientific community is a key player it is not an objective observer determining what are issues and how they can be dealt with. Environmental issues, therefore, emerge out of, and give rise to, decision-making in dynamic, uncertain and complex situations which are both poorly understood and inherently difficult to understand.

Two transdisciplinary points arise from this relating to the properties of process (e.g. spatial and temporal scale) in which the distinctions between cause and effect are not sharply drawn (e.g. between locality and structure). These points highlight the need to develop a conceptual framework which does not have a disciplinary basis but which allows us to move, and to teach how to move, more easily between real world systems and our representation of them (Checkland, 1992).

1. We are dealing with transboundary emergent systems which (re)configure at different spatial, temporal and organisational scales and do not lend themselves to end state 'technical' solutions (Sperling, 1984). What is considered to be an issue at one organisational (e.g. political) level may be manifestly different at another. For example, health concerns about nitrate at the local level may translate into water quality issues at area level and agro-environmental policy at the level of central and regional government.
2. Attempts to impose solutions without a comprehensive understanding of the range of local issues will result in unintended consequences (Lemon and Naeem, 1990). Central to this is the diversity of local agendas whereby issues are perceived differently, different issues are perceived as being significant, and to complicate matters still further these perceptions may change over time. Agendas are determined by the perception of how socio-economic, cultural and political processes emerge and interact with the natural world over different spatial-temporal scales.

While these points require considerable development they do represent the need to move away from clearly defined disciplinary or interdisciplinary parameters, and responsibilities. An integrative basis for environmental research which is grounded in a process view of the world and which draws upon specialist insights when required, implies an approach to environmental studies which relates process to behaviour (physical, natural and social transformation) via the perceived world. A similar problem concerns the different temporalities which need to be considered, particularly the time horizons that are appropriate for strategic policy. For example, the response to changes in water need, and use, may be relatively fast for marginal changes in quality and costs. More fundamental changes such as the introduction of new technologies and infrastructures may lead to structural changes regarding the source and level of demand over somewhat longer periods. Such spatial changes will also be influenced by changes in the physical, social, and economic environment alongside the evolution of innovative and spatially diverse infrastructures etc. The emergence of new inter-urban and regional spatial structures takes place over even longer time periods.

In a similar way the physical environment is not a passive entity but is driven by a complex set of factors which themselves have spatial and temporal properties. Dispersion and concentration of pollutants in air, water and soil, the rate of transformation of pollutants into other damaging phenomena all take place over different time scales. Changes in the levels of pollution and its immediate effect on a recipient human population are likely to be faster than the speed at which their effects reveal themselves in the ecological system. Additionally, delay is often apparent between stakeholder perception of an 'issue' and ecological distress. This proposition can be extended further to include the delay between that ecological distress and the 'issue' as it is interpreted by non-local institutions or agencies. This suggests that issues have their own emergent characteristics which are grounded in perception and decision making, bio-physical processes and institutional responses. The concepts introduced below are intended to provide a framework within which such propositions can be explored and translated into policy.

Some Useful Distinctions

A number of the terms and concepts adopted as relevant to this debate, and used in this text, need clarification. These are not intended to be cast in stone but are suggestions for a methodological route map. They are invariably derived from soft complex systems thinking and have been presented at greater length elsewhere (i.e. Winder & van der Leeuw, 1997).

Actors are the decision makers (individuals, groups, communities and organisations etc.) in complex situations.

Agencies are those organisations, whether governmental, non-governmental, voluntary, statutory etc. which have any function that influences actors as a consequence of any intended policy implementation at any level.

Policy relevant refers to investigations and research concerning a context and related issues about which policy may need to be formulated by a responsible agency on behalf of a wider group of organisations, communities or citizens.

Issue relevant refers to specific contexts in which there are symptoms which the embedded actors perceive as a "problem".

Decision relevant refers to contexts in which the actors have identified the nature of their problem and the choices and options either implicitly or explicitly and wish to further their understanding of the options and consequences.

Decision space refers to the range and nature of options considered by the actor(s) to be relevant and potentially achievable.

Option space refers to the number and nature of all the options notionally available to the actor. This will include outcomes of decisions which are not perceived by the actor or cannot be considered viable in terms of their ability to access them.

Policy formulating process refers to the qualitative, political, administrative and scientific interactions by which policy is derived.

Policy instruments refer to the various types of intervention (economic, infrastructure, educational etc.) which can be used to enact policy.

Policy delivery refers to the actions, mechanisms and management required for a policy to be enacted by agencies in order to impinge on the final recipients of policy.

Decision-making process refers to the sequence in which knowledge is used and the procedures by which decisions and subsequent acts and activities are derived and evaluated. Both this and the policy process may be implicit rather than explicit and under some circumstances the actors may not consider that they have made a policy or a decision.

Drawing upon these distinctions, it is useful to consider decision making as a complex issue which involves a number of attributes of the elements (decision space) relevant to the actor(s) involved. Thus a decision takes place in an attribute space specific to the actor. Where there are very similar decision issues and very similar decision spaces then the relevant attributes of one actor and another in the same cultural context will be similar and the probabilities of individual outcomes can be aggregated. More commonly, each person will operate in an attribute space which has common attributes with some people or organisations, but others which differ. What is considered a decision to an outsider may not be considered as a "decision event" by the actor(s) involved. (The notion of "a decision" may itself be a scientific or cultural construct). Similarly, the attribute space of a policy recipient may be very different to that of the policy which attempts to obtain change in the recipients behaviour. Decisions and their pertinent attribute spaces are not just hierarchically juxtaposed but are also nested in the sense that on some occasions decisions by, say individuals, form the apex of a hierarchy while in other situations they are the object of decisions. Decisions at any level interact not only with a given issue but with other issues at different levels of phenomena to form complex and unpredictable *pathways of change*.

Pathways of Change

Research in support of policy should therefore be grounded in the identification of salient issues at the local level. This does not assume homogeneous responses, indeed it recognises that the complicated picture that may emerge is invariably the subject of political arbitration or prioritisation. Similarly, the local need not only represent the smallest unit but also the representative voice of stakeholders at their constituent levels e.g. the village council or agricultural co-operative. Representatives of these groups may have very different perspectives and some individuals are likely to operate in multiple capacities which on occasions appear contradictory. By exploring these perspectives an improved, but often less clear, picture can be obtained about how issues are defined, the processes that are seen to impact upon them, and those that are affected by them. These perceived 'pathways' of change do not necessarily coincide with the political or academic agendas relating to pre-defined issues and as such can provide useful insights into the unanticipated consequences of planned change.

Figure 1 presents an example of restricted perspectives on responses to the degradation and depletion of irrigation water in the Argolid Valley, Greece (Winder and van der Leeuw, 1997). While the transformations envisaged within these 'closed system' approaches vary considerably, they can only be usefully evaluated in the context of how they are likely to impact upon the wider system and how those impacts are going to be interpreted by the local population.

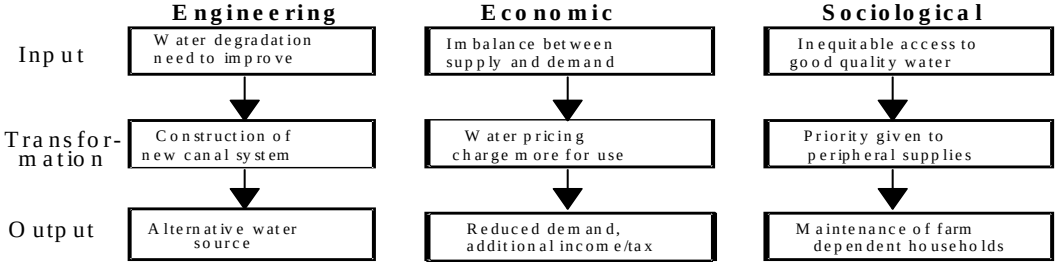

Figure 1. Technical (closed system) perspectives on the issue of degraded water

The engineering approach, which was adopted for the building of a canal, set in motion processes which ran counter to the original intention of the project (Figure 2). The building of the canal did provide irrigation water to large parts of the central Argolid Valley which had been particularly vulnerable to salination resulting from sea water intrusion. It followed a course through the central plain which meant that those who farmed the areas on the periphery did not have access to the transported water. They were also subject to less salination but had suffered resource depletion, much of which was accredited to the activities of the predominantly monocultural farming activity in the centre. Furthermore, the peripheral farmers felt that they were 'authentic', full time farmers whereas those in the centre were often perceived to be 'inauthentic', farming crops with low labour requirements because they had primary occupations and used their earnings from farming as a substantial income supplement. This situation was perceived to be caused, or certainly compounded, by the European Union's price support for citrus crops which are both labour extensive with heavy water demands.

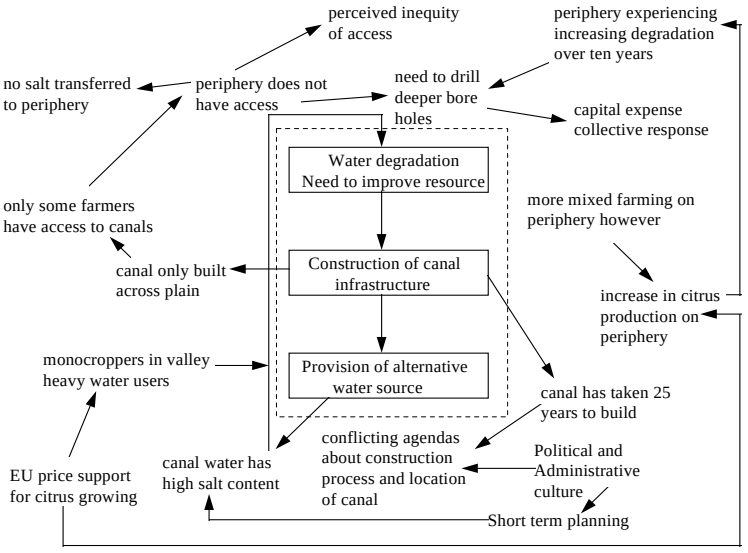

Figure 2. Open systems interpretation of new canal infrastructure

This brief sketch is introduced to highlight the limitations of adopting any isolated perspective. In so doing it makes clear that the objectives of a scheme may well be met i.e. through the transfer of better quality irrigation water and the possibility of improved aquifer stocks in the short term. However, when the quality of those stocks make them accessible again, through the (re)opening of boreholes, it is likely that they will be adopted in preference to water from the canal. This is because little cost is incurred in the central areas where the water is close to the surface and at present the water provided by the infrastructure is charged for. The degradation spiral again becomes a real possibility. Similarly, the existence of price support for water heavy crops has reinforced the need for additional technology. However, there is currently a move away from this support. Of equal importance has been the perceived inequity articulated by those on the periphery of the valley who felt, during the period of low rainfall prior to 1995, that they were not only seeing their natural resources decline, in large part due to activities beyond their control, but that they are were also losing out on the opportunity of relatively 'easy money'. With the current change in emphasis away from price support these farmers are now more confident of their ability to compete in a free market situation.

By appreciating the system of interest in this way it becomes clear that the noise which emerges is not extraneous but is the basis of the uncertainty that has to be managed. This is a fundamental condition of policy relevant research and central to it is the variation with which processes of environmental change are perceived and the spatial-temporal scales over which they occur.

It has been argued that individuals often assimilate process in a more complicated manner than can be understood simply by focusing upon the changes in attributes defined by technical agendas (Bryant and Jary, 1991). It is of primary importance to establish whether those attributes, and the issues to which they refer, are of relevance to the stakeholders concerned; indeed as part of this process it may also be necessary to reappraise who those stakeholders are. What is required are a set of social enquiry procedures for establishing how change processes are perceived and how decisions might be influenced by that perception. It is this

which can provide the basis for local description (Murdoch, 1995) and expose attributes and relationships that may be overlooked by more structured participation exercises. By pursuing this description it is apparent that multiple possibilities for intervention develop and that the scope for future uncertainty is accepted rather than obscured by the procedures of technical simplification. It is only through an improved understanding of the context in which an environmental change is perceived that the issues relating to it, in terms of impact, can be anticipated. The systemic picture which emerges from this (i.e. agencies and interactions) forms the basis for specifying an issue, the information requirements associated with that specification and thereby an improved basis for anticipating possible futures.

Perhaps the best way to establish how these perceptions vary is to ask the individuals or groups concerned and to read and analyse what they write. The ability to elicit information about perception in a structured manner is one that is not always considered relevant outside of the social sciences and market research. Indeed, when such an approach is adopted it invariably reinforces the perspective of the investigator rather than establishing that of the respondent. The ability to explore an issue without directing the respondent along a predetermined path is fundamental to describing the attributes and processes which constitute the system of interest around that issue. Obviously, some selectivity has to be exercised about the actors to be considered. However, it must be emphasised that the objective of these procedures is to establish the range of attributes and processes rather than their relative weightings. The weight that is attached to different aspects of the system is subject to an evaluation for which further information is required. In addition, the techniques for acquiring and interpreting this information may require specialist input from within the social science disciplines.

Whilst the ability to move towards this 'systemic' overview is also a move towards the specification of issues by concerned agents, human-natural systems can evolve rapidly and the best we can achieve is a limited engagement with complex change. Advances in computing power have made the handling of complicated data sets representing non-linear interactions feasible (Allen et.al., 1995). We are not suggesting that the ability to undertake a range of modelling approaches should be a requirement of agro-environmental education and research, but that an appreciation of their potential for diagnosis is.

In summary, it has been indicated that the use of modelling procedures, including cognitive models, must be part of an iterative process. The information requirements should be determined through the specification of issue(s) by stakeholders, including the scientific community. The generated futures should be part of a discourse with those stakeholders and as such contribute to the (re)specification of those issues. Education for environmental research, therefore, must be directed at the provision of skills to initiate, and engage in, that discourse and not exclusively towards the identification of 'solutions'.

Discussion and Conclusions

Two sets of skills therefore underpin issue specification and as such should be incorporated into the diagnostic element of agro-environmental research. The first is based in the modelling of soft complex systems (Clark et.al., 1995) and the second in social enquiry (Lemon et.al., 1994).Figure 2 has been used to represent how an irrigation canal which was built in response to an engineering perspective cannot be disconnected from the range of impacts that resulted, and for which no response was, or could be, anticipated. Soft complex

systems thinking is an attempt to provide an antidote to this reductionist paradigm by studying the whole picture, inevitably at a reduced level of definition. The term soft is used to represent systems that have a human component and as such are complex (as opposed to complicated) and unpredictable. Such an approach can be interpreted as a set of conceptual devices that help us represent this complexity through the agencies of change (all humans are agents but not all agents are human), their interactions and the scales at which those interactions take place.

Any representative framework must convey natural-human interactions as complex and dynamic and as such should be able to deal with concepts such as process, agency and scale in a way that is meaningful. The focus for policy relevant research on environmental issues is therefore directed towards issue or problem specification. As noted above this translates into a number of procedures which require an appreciation of soft complex systems thinking, social enquiry and conceptual and computer based models. In terms of method this implies that:

- the 'system of interest' which defines an issue should be articulated by the population(s) concerned (issue specification).
- the mapping of this system should identify the range of information, and techniques required, to move towards problem diagnosis (issue representation and information specification).
- the future options that emerge from that diagnosis need to be generated and explored (scenario generation and issue (re)specification).

In terms of interdisciplinarity it is essential to consider the nature of the contribution that formal research disciplines can make. Each discipline or system of thought that is relevant to a particular class of decision issues has its own internal debates and enquiries which facilitate its evolution while providing knowledge about a certain class of phenomena and issues. However, embedded in that knowledge is some component which could be useful in a policy context. The difficulty is that the relevant knowledge seldom addresses directly the policy issues from a decision making point of view. It is articulated in an intellectual attribute space appropriate to that discipline and invariably one that is not relevant to policy formulation and decision making processes, or to the recipients of those processes. Experience of interdisciplinary research shows that not only does it result in conflict (resulting from attempts to redefine the issue to one which is tractable within one discipline as opposed to another) but that we are left with a number of qualitatively different reports and insights. While it is apparent that no single one of them is sufficient, we must ask ourselves what transdisciplinary mechanisms can be developed to combine them in such a way that we end up with more than the sum of their particular data sets?

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References

Allen, P. Black, I. Lemon, M. and Seaton, R. (1995) "Agricultural production and water quality in the Argolid Valley, Greece: A policy relevant study in integrated method", Final Report to the European Union (EV5V-0021).

Bryant, C.G.A..and Jary, D. (1991) Inroduction: Coming to terms with Anthony Giddens.' in Bryant, C.G.A. & Jary, D. 'Giddens Theory of Structuration: A Critical Appreciation.' Routledge. London

Checkland, P. (1992) "Systems and Scholarship: The Need to do Better", Journal of the Operational Research, 43, pp.1023-1030.

Clark, N. Perez-Trejo, F. and Allen, P. (1995) "Evolutionary Dynamics and Sustainable Development", Edward Elgar, Aldershot.

de Pablo, C. Agar, P. Barturen, R. Nicolas, J. and Pineda, F. (1994) "Design of an information system for environmental planning and management (SIPA)", Journal of Environmental Management, 40, pp.231-243.

Jeffrey, P. (1997) A study of cross-disciplinary interaction, in Winder, N and van der Leeuw, S (eds.) Environmental Perception and Policy Making - Final Report to the European Commission on contract EV5V-CT94-0846.

Lemon, M. and Naeem, A. (1990) "The response to non-urban change", in Vyakarnam, S. ed. "When the harvest is in", (Intermediate Technology Publications, London.

Lemon, M. Seaton, R. and Park, J. (1994) "Social enquiry and the measurement of natural phenomena: The degradation of irrigation water in the Argolid Plain, Greece", Int. J. Sust Dev. World Ecol, 1, pp.206-220.

Linstone, H. (1981) "The multiple perspectives concept: With applications to technology assessment and other decision areas", Technological Forecasting and Social Change, 20, pp.275-325.

Sperling, D. (1984) "Assessment of technological choices using a pathways methodology", Trans Res, 18A, pp.343-353.

Winder, N and van der Leeuw, S (eds.) (1997) Environmental Perception and Policy Making: Cultural and Natural Heritage and the preservation of degradation-sensitive environments in Southern Europe, - Final Report to the European Commission on contract EV5V-CT94-0846Winder and van der Leuuw.