Agricultural Extension and Rural Development: Breaking Out of Traditions

A second-order systems perspective

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David B. Russell and Raymond L. Ison

1.1 Introduction

This chapter argues for a contextual grounding for research and development (R&D) in rural communities. The history of science reveals many examples of how science has failed to recognise its context. So, what is context and how does one recognise it? It would be all too easy to answer these questions by simply adding social and political insights to the science equation. (What is necessary is that we look at the bigger picture!) Almost always, the bigger picture is nothing other than more of the same.

In this chapter we explore how our understanding of R&D is developed and how our understanding of 'change' is constructed. We are proposing what we believe to be a critical distinction based on the perceptions and actions of the researcher. In **first-order R&D**, which remains most common, the researcher remains *outside* the system being studied. The espoused stance by researchers is that of *objectivity* and while the system being studied is often spoken of in *open system* terms, intervention is performed as though it were a *closed system*. Perception and action by researchers and those who manage and maintain the R&D system are based on a belief in a *real world*; a world of discrete entities that have meaning in and of themselves.

In contrast to this tradition we stress the need for a **second-order R&D** in which the espoused role and action of the researcher is very much part of the interactions being studied. How the researcher perceives the situation is critical to the system being studied. *Responsibility* replaces objectivity as an ethic and perception and action are based on one's experiential world rather than on a belief in a single reality 'real' world. There are of course implications in any move towards a second-order R&D, not least of which are the forms of behaviour and organisation that might be required by, and for, a future cadre of 'researchers'. This is taken up specifically in Chapter 9, but much of the rest of the book is concerned with doing or moving towards second-order R&D.

1.1.1 *The global R&D system*

In his study of how scientists and engineers go about their work, Bruno Latour (1987) demonstrates with some simple statistics that those who call themselves scientists and engineers make up only a small proportion of the people interested in the generation of 'new knowledge' within the 'R&D

system'. It would seem that the number of scientists and engineers rarely exceeds 0.6% of the workforce, yet the practices which they largely initiate, give rise to technologies, metaphors, 'facts', and forms of organisation that affect profoundly the actions we take on a daily basis. In the US this was backed by an investment in 1988 of $139 billion in R&D (UNESCO, 1993) in a total worldwide investment exceeding $229 billion (Howells, 1990). The OECD maintains a database with 'rules of thumb', for nations to pursue as a guide to how much of their GNP should be invested in R&D. The R&D network is a powerful club.

Global R&D is growing (Howells, 1990). Most is conducted in the OECD countries, which is also where most of the 'researchers' are located (only 12.6% were in the developing world in 1973). As Janice Jiggins points out (Jiggins, 1993) an 'increasing number of countries in . . . Africa, but also in Latin America, are facing the collapse of public sector research and extension.' Increasingly there is no effective institutional capacity for R&D in many of these countries.

Within the domain of natural resource R&D, in which we might include rural R&D, the World Bank, FAO, IFAD and the CGIAR[3] network have been the most active funders and supporters of R&D. Janice Jiggins (1993) reviewed the extent of funding committments by these agencies to R&D projects in which there has been an 'extension' or 'technology transfer element' (Table 1.1). She points out that in the R&D sector associated with rangelands and extensive livestock, only local and at most short-lived gains have been generated and that many of the R&D projects have had unintended negative consequences.

Ian Scoones (1995, p. 3) claims that the 'last 30 years have seen the unremitting failure of livestock development projects across Africa. Millions of dollars have been spent with few obvious returns and not a little damage.' He notes that many donors and international agencies have abandoned the dry zone in their development efforts. He strikes a positive note, however, asking whether we should 'reconsider, and analyze in detail why the failure has been so consistent and what lessons can be learned from the convergence of recent ecological thinking, social science critiques and pastoralists' own practices?'

1.1.2 *Historical context*

As we arrive at the end of this twentieth century, it is useful to conceive of ourselves as living in the final days of near absolute faith in 'first-order' R&D.

3 / FAO, Food and Agriculture Organization of the United Nations; IFAD, International Fund for Agriculture and Development; CGIAR, Consultative Group for International Agricultural Research.

Table 1.1
A summary of rural 'extension' related R&D expenditure by major funders

Agency	Period	Number of projects	Amount (US$)
World Bank	1965–89	500	2 billion
World Bank	1988–89	221 (extension related)	793 million
FAO	1985	977	57.4 million
IFAD	1978–88	191	320 million

The ethos and achievements of this period are characterised by disciplinary knowledge, a 'fix' mentality and the belief that the generation of 'new knowledge' is a good thing in itself. In rural-oriented R&D much attention has focused on exposing breakdown and attempting to fix it. Often the cry has been: More resources need to be deployed into researching the needs of rural industries! The development of this approach has had its own phases, all of which exemplify the fix mentality:

(i) The 'problem' is seen as a mismatch between what is scientifically known and technically feasible, and what is current practice. The new technology is designed by research scientists and is then transferred to the end-users who put it into action to address the problem.
(ii) Built into the belief of a technological solution is a conception of the benefits that could be derived from better farming systems or, in the case of rangelands, a return to the 'natural ecosystem' state, without consideration of who participates in defining 'better' nor how what is perceived as 'natural', by some, has come to be constructed.
(iii) Social and political insights are specifically added to the R&D equation. (The declared purpose of the former International Livestock Centre for Africa [ILCA] would be an example of this multi-disciplinary approach to the development of models for range management.)

'Second-order' R&D challenges the first-order tradition, a tradition in which most of us are deeply immersed because of our cultural background and specifically because of our scientific training. We have labelled this tradition 'first-order' because of its emphasis on particular styles of consciously rationalised thought and action. Explicitly, it is a tradition based on a belief in an increasingly knowable world: a world which is capable of being understood without the need to take into account our actions as participants in creating that very world that we experience. There is a basic assumption that a fixed reality is 'out there' and that by applying rational understanding, we will increasingly gain accurate knowledge of its elements and the laws of

its functioning. In addition, most often there is no distinction made between the possible understandings of material and biological phenomena (observable to the senses) and phenomena that are the products of the intellect (thoughts, beliefs, memories and the like).

We do not privilege first-order thinking with the widely held belief that it is the sole basis for being 'rational'. In questioning this there is no intention of fostering irrationality or fuzzy thinking, rather, along with Winograd and Flores (1987) our commitment is to developing a new ground of rationality – one that is as rigorous as the first-order tradition in its aspirations but that does not share the presuppositions underlying it.

At its simplest, the first-order view accepts the existence of an objective reality, made up of things bearing properties and entering into relations. We are actors in/on our 'environment'. Such has been the success and prestige of modern science that many accept it as the best framework available for understanding how we think and are intelligent.

1.1.3 *The origins of second-order R&D*

Developing out of this traditionally accepted paradigm is a much newer tradition that avoids being either objective or subjective. This tradition brings together understandings derived from the study of interpretation, the philosophical examination of the foundations of experience and action, and the 'new' *biology*, which provides an intellectual framework in which phenomena of interpretation arise as a necessary consequence of the structure of biological beings (see Chapter 2). All three intellectual streams have in common the questioning of our ability to objectify knowledge and thus see objects and events as being independent of the very act of observation. This new tradition avoids being either 'objective' (independent of the individual) or 'subjective' (particular to the individual). Our aim is not to replace scientific method but rather to show how our theoretical background might guide the design of research and development in the practical setting of the rangelands. By 'unpackaging' the presuppositions of the first-order interpretation of science, we become aware of its non-rational implications. This is especially the case in those most common of situations when there is no clear 'problem' to be solved, but a sense of irresolution that opens opportunities for action.

The region described as 'rangelands' provides some dramatic examples of first-order R&D and its unintended consequences.

1.2 Conceptual models of rangeland development

Examining the current practice of range management in any particular geographical context allows us to formulate the 'model of understanding'

that informs those particular practices. The very strong emphasis on the production of beef, on commercial ranching, on the specialised stratification of the production process in breeding, on markets, and on processing facilities are characteristic of say North America and Australia. These characteristics are 'a reflection of an ideal of what pastoral development is about' (Sanford, 1983, p. 6) and have exercised a strong influence in much of the developing world. When we 'unpackage' the history of these developments we find that the American and Australian models originated 'in particular historical settings where the interests of the previous inhabitants of pastoral areas were not taken into account, where the (indigenous) species of domestic livestock of pastoral areas were not taken into account, where the species of domestic livestock on which pastoral development focused did not previously exist on a significant scale if at all, where the general economy as a whole was characterized by labour shortage rather than by surplus, and where a large and wealthy non-pastoral sector could be called on from time to time to provide the resources with which to rebuild a pastoral sector suffering from collapse' (*ibid*).

1.2.1 *The first-order tradition*

The first-order tradition is characterised by concerned intervention, the definition of clear goals, the 'naming' of the problem, and the proposal of a rational 'solution'. However, every model of understanding grows out of a *tradition* – a network of prejudices (literally understood as a pre-understanding) that provide possible answers and strategies for action. A 'tradition' here is taken to mean a pervasive, fundamental phenomenon that might be called a 'way of being.' A tradition is an intellectual background within which we interpret and act. In using the word 'tradition' we are emphasising the historicity of our way of thinking – the fact that we always exist within a pre-understanding determined by the history of our interactions with others who share the tradition (in Chapter 2 this definition will be expanded to incorporate what Maturana (1988) has termed our history of 'structural coupling').

An example is provided by exploring Le Houerou's (1989) work on the grazing land ecosystems of the African Sahel. It is possible to identify a number of themes that go to make up his 'way of thinking' and his way of constructing his working reality (his epistemology). First, there is a deeply felt concern for the ecology of the region. Second, there is a plea for the detailed and careful description of 'the philosophy and development objectives . . . and the strategy and means to attain the selected goals' (p. 239). Third, there is a clear statement of the core 'problem': 'adapting stocking rates to the sustained long-term productivity of the grazing ecosystem'

(*ibid*). And finally, there is the proposed 'solution': 'responsible management . . . (which) involves fundamental land reform in terms of land tenure and ownership and water usufruct' (*ibid*). In order to appreciate this important contribution to the understanding of the Sahel we benefit greatly by looking at the tradition out of which it flows.

The first-order tradition can be depicted as a series of steps:

1. Characterise the situation in terms of identifiable objects with well-defined properties.
2. Find general rules that apply to situations in terms of those objects and properties.
3. Apply the rules logically to the situation of concern, drawing conclusions about what should be done. (From Winograd and Flores, 1987, p. 15.)

These steps are applied in a social context that encourages 'concerned' intervention, the definition of clear goals, the naming of the 'problem', and the proposal of a rational 'solution.' What is not encouraged is a debate about how the objects and properties were arrived at and how we come to know general rules, not to mention the issue of whose 'concern' is being attended to. Le Houerou's work raises all these first-order issues. It also represents an invitation to address the second-order issues which arise as we explore the intellectual context in which the first-order issues are embedded.

It is important to stress at this point that this exploration of the dominant tradition is designed to improve the application of good science and not to replace it. What is being proposed as this chapter unfolds is a contextual science for rural R&D that will evidence greater coherence with the expressed needs of the day-to-day lives of the people involved.

An inevitable experience of being embedded in any tradition is that we are not aware of the prejudices (pre-understandings) that shape our thinking and our action. This background of pre-understanding invisibly shapes what we choose to do and how we choose to do it. There is no neutral viewpoint from which we can see our beliefs as things, since we always operate within the framework they provide. This 'closed system', as it were, does not negate the importance of trying to gain greater understanding of our own assumptions so that we can expand our horizon. But it does preclude the possibility that such understanding will ever be objective or complete.

1.2.2 *When traditions of understanding collide*

A wonderful illustration of radically different 'frameworks of understanding' has been provided by Louise Fortmann's (1989) case study of fifty years of rangeland use in Botswana. Official policy consistently defined the major

problem of the pastoral regions as overstocking leading to certain ecological disaster. The problem was clear, as was the technical solution (destocking). Local experience, on the other hand, defined the problem as too little land. The local solution was also very different: renting, or simply using an enormous concession of land previously given to a European mining company. The local experience was that the local range could and did carry an increased cattle population and that besides localised problems, the dire official predictions did not eventuate. While there is general agreement that the quality of the environment (as indicated by the quality of the grazing, the number of trees and the extent of erosion) is deteriorating, there was, for over fifty years, clearly no agreement on causes or solutions. Of particular significance for our argument is the story consistently told by both 'world views' and spanning such a long period; a story that shows how different and how unconnected traditions of understanding can be. What is more this is not an isolated example. Leach and Mearns (1996) review other examples from Africa of conventional wisdom which, on further study, may be deeply misleading. They point out that it is often in the interests of certain people and organisations to continue such myths. These examples are not confined to Africa or less developed countries (Pearson and Ison 1997; Chapters 3 and 4).

Stephen Sanford (1983) addressed this central issue of traditions of understanding in considerable detail when he talked of the 'Mainstream view' and what it entailed. This tradition was promoted by 'concerned' professionals (academics and officials in national and international organisations) and related to the belief that the world's rangelands were suffering severe and rapid desertification. As with any example of a first-order tradition, the problem is clearly defined, the solution is a technological one, and the 'barriers' to adopting the solution are placed fairly and squarely with the pastoral community: 'traditional economic and social systems, including systems of land tenure and the social institutions which accompany them' (*ibid*, p. 12). Along with Fortmann, he contrasts this 'Mainstream' view with the day-to-day experience of the pastoralists and the value, gained of generations of practical usage, of traditional systems. The lack of participation by pastoralists in the design and implementation of rangelands projects in the developing world has been a consistent criticism made in many published reviews of project effectiveness (Little, 1982; Ndagala, 1985; Gilles, 1985; Hunter, 1990; Scoones, 1995). Growing awareness of this situation has led some to adopt a new optimism (see Scoones, 1995) but it is still too early to tell if this optimism is warranted.

Range science with its twin goals of the protection of the environment through the concept of sustainable yield and the improvement of the pro-

ductivity of ranges, had its origin in North America and its rapid adoption in Australia. Since range science and range management developed in North America, its approach was necessarily adapted to the social and ecological milieu of North American rangelands. A central feature of this history is that range management has evolved to meet the needs of a system based either on privately owned land or, as is largely the case in Australia, on land owned by the state and leased to individual livestock producers on a long-term basis, so that it is managed much as private property would be. So pervasive is this history, which constitutes this particular 'tradition of understanding', that it is difficult for those involved in it to see range management in any way other than their own way. This becomes very obvious when the privatisation of rangelands is considered to be a precondition for the protection of natural resources (Baden and Stroup,1977; Hopcraft, 1981). It is additionally apparent when the techniques of range management that have been developed in the West are applied, and have consistently failed in the less developed world (Gilles,1985; Lane and Moorehead, 1994; Lane, 1998).[4] The thought that they could possibly be effective in the first place is indicative of the continued blindness to seeing that such knowledge is socially constructed and is thus only applicable to its place of origin.

In a carefully constructed critique of the dominant paradigm of pastoral ecosystem dynamics, James Ellis and David Swift (1988) argued that the time was ripe to examine the paradigms which govern our thinking about African pastoral ecosystems. These authors readily acknowledge the 'social construction' of range science and specifically, the notion of an African pastoral ecosystem and what constitutes it. While their work is the result of a nine-year study in northern Kenya, the underlying principles of their research are equally applicable in any region of the world. The central idea that they hold up for critical scrutiny is the assumption that the African pastoral ecosystems are potentially stable (equilibrial) systems which become destabilised by overstocking and overgrazing (reflected in the work of Lamprey (1983) who argued that overstocking by pastoralists causes departures from natural ecosystem equilibrial conditions and range degradation). Their empirical results present the opposite view: pastoral systems that are non-equilibrial but persistent, with system dynamics affected more by abiotic than biotic

4 / It can be argued that much of this failure was due to bad technology and bad science, and no doubt some of it has been. Admission of this argument, however, means that advocates of traditional science need to be open to the same possibility (i.e. poor practice) when providing critiques of participatory research approaches. Our position is that because of the traditions of understanding in which we are (often unknowingly) immersed, the reasons for the many failures are more complex and profound than just good or bad science.

variables. Because 'Our view of the world, or our perceptions of any system, has a great deal of influence on how we go about dealing with that system' (p. 450), the conventional development practices are based on the assumption of equilibrial grazing systems and that destabilisation of these systems is due to overstocking and overgrazing by pastoralists. These practices have involved the establishment of group ranches, grazing block, or grazing associations which have not worked. Their conclusion is that conventional development practices are destabilising influences in ecosystems which are dominated by 'stochastic abiotic perturbations and which operate essentially as non-equilibrial ecosystems' (p. 458). This is a fascinating story as it so tellingly illustrates that we know the world only through our conceptual models of it, which themselves arise through our action-in-the-world.

Development interventions which arise, as they always must, from our model of the world, our tradition of understanding, and which do not flow from the traditional understanding of the pastoralist community, will always be 'development experiments' that will have unfortunate implications for the ecosystem and people on which they are performed. It was Martin Andrew's view, which he conveyed in his plenary paper for the Third International Rangelands Congress in New Delhi (1988), that many of the research and technical interventions that were reported during the course of the Congress were developed without understanding the behaviour and needs of the pastoral people. Sandford (1995) in his analysis of 'new directions' in pastoral development, based on the appreciation that they are non-equilibrial systems, confirms that many development schemes were misguided: 'the expensive and authoritarian ways of regulating livestock numbers, the dividing up of ranges into self-sufficent blocks and the creation of private ranches to bring these about proved to be inappropriate'. This raises the question of how much longer we need to be told that the 'mainstream view', 'the dominant paradigm', the 'top-down' approach, just does not work and is, in fact, detrimental to both the people and the ecosystem of which they are a part?

1.3 Technology 'transfer' or 'creation'

The first-order tradition in which we are immersed emphasises thought and its application (the generation of technology) as an independent activity. 'Knowledge' and 'applying knowledge' are the very language of R&D, a language that does not acknowledge its dependency on interpretation. The notion of 'information' as it is commonly used implies that an 'external world' is knowable in a way that is independent of the user of the language. In the first-order tradition, the information and the knowledge are 'out there' and one can collect more and more information about the external

world and the greater the 'knowledge base', the greater the chances of useful technology and better interventions. The current trend to make technology 'user-friendly' is indicative of the questioning of the naive equation that more information equates with better results. While this questioning might not lead to a questioning of the theoretical paradigm itself, it will lead to the increased development of a technology designed 'to facilitate a dialogue of evolving understanding among a knowledgeable community' (Winograd and Flores, 1987, p. 76).

In a review of rural extension carried out by the authors (Russell *et al.*, 1989, 1991), it was concluded that the existing model of extension did not work well at all. It constituted neither good practice nor good theory. Promotion of innovative technology to the rural community has been based predominantly on the linear extension 'equation':

Research → knowledge → transfer → adoption → diffusion

A study of the effectiveness of this model showed that research results were adopted by only a specific minority of farmers and that for the majority, it was not a viable strategy for agricultural improvement. Experience of the deficiencies of this model in actual practice has led to the emergence of a very different conceptual system based on the idealised 'farmer-led' model (Chambers *et al.*, 1989). Despite the very real differences, both models incorporate current ways of thinking about and doing 'extension'. We think that it is time to abandon the term extension altogether because of what it has come to mean in practice and the network of faulty assumptions which are at its core.

As with range management, the term 'extension' arises from a particular tradition – from the North American land grant university model meaning 'to extend knowledge from a centre of learning to those in need of this knowledge'. Extension in practice has remained captive of this initial western conception despite differences culturally apparent in, say, the German '*beratung*' (to counsel or deliberate) and the French move from '*vulgarisation*' (to render popular) to '*développment agricole*' (involving the whole farming community).

1.3.1 *Information transfer*

The belief that knowledge could be 'transferable' has derived from the associated belief that 'communication' was the process of transmitting information. The media is convinced that we are now in the 'Information Age' so it is not surprising that the most widely used metaphor for the practice of extension is that of 'information transfer'. So embedded is this notion, so pervasive has been the obviousness of electronic communication,

that challenging the appropriateness of continuing to use only this metaphor, is to risk being considered absurd. Risky or not, it must be done! The effectiveness of current practice continues to be judged and to be judged negatively (see Russell *et al.*, 1989, for a review of the literature and Scoones and Thompson, 1994, for a summary of emerging responses to this critique). Not only has the simple notion that knowledge can be transferred from one person to another, as if it were a case of one computer 'talking' to another, been shown not to work in practice, but biologically (as will be shown below and in Chapter 2), it is clearly not possible.

Shannon and Weaver (1949) were the first to use the model of electronic information transfer to refer to human communication. Simply put, they proposed that ideas were coded into signals, the messages, (by the sender) and then transmitted to another person (the receiver), who then decoded the message back into the original ideas. The root metaphor has had numerous elaborations in its application, such as those variously described as evidencing the *conduit* metaphor (Reddy, 1979) or the *hypodermic* metaphor. In the first instance, ideas were seen as being packaged into words so as to gain access to the original ideas. The hypodermic understanding was obvious when there was an intention to persuade the other to follow a certain course of action. The effective communicator could 'get under the skin' of the other if he or she could present the information 'persuasively'. David Sless (1986) has analysed a number of recent communication models showing how the basic 'information transfer' metaphor still dominates the thinking of many communication theorists. The prevalence of this established way of understanding communication, despite all the evidence to the contrary (see Sless, 1986 and Krippendorff, 1993 for reviews of the literature), shows how difficult it is to unearth a deeply embedded metaphor when it has taken root in the society's unconscious. The process of constructing more fitting metaphors will initially be awkward and cumbersome because we will inevitably have a foot in the old camp of *fixed reality*, a condition of the knowledge transfer idea, and a foot in the camp of *multiple realities*, the prerequisite for any new constructions.

1.3.2 *The biological basis of knowing*

In the language of the communication engineers, information is taken to mean 'instructing with knowledge'. What holds for engineering, in which communication systems are designed and structured with the intention of transferring information, does not hold for biological systems and in this discussion, we specifically mean human 'systems'.

Humans are structure-specified systems and cannot be instructed with knowledge by another living system (see Maturana & Varela, 1980, 1988). It

is one's history of interactions and the closed self-generating structure of the human (autopoiesis) that determines what will happen and not the nature of the information. Often the observer acts *as if* there was a case of instruction by knowledge but this cannot be the case biologically.

The nervous system is a closed network of interacting neurons. The physiology of the nervous system, because it is a structure-determined system (systems in which all their changes are determined by their structure and in which all those changes are a result of their own dynamics or triggered by their interactions with their environment) cannot be usefully compared to a computer or 'information transfer' system. Biologically, there are no inputs to, or outputs from, the nervous system, nor does the nervous system 'process information'. There is no encoding or decoding in the nervous system nor does it 'receive' or 'process' messages or 'information' from the environment.

The implication that flows from the nervous system being a closed and structure-determined system is that there can be no instructive interactions between such systems and between any one system and its environment. What another human can do, and all that another can do, is trigger a response without any control over what that response might be. In no way can such a triggering determine the nature of the response. It is biologically impossible to instruct or determine an outcome with 'information'.

1.3.3 *Structural coupling and the metaphor of conversation*

As distinct from a real world 'out there', the real world can only ever be our world of experience . . . the world in which the individual acts and lives. An individual constructs the world in which he or she lives and we share the meaning of these constructions through communication. My real world is different from your real world and this must always be so.[5] The common ground which is the basis of our ability to communicate with one another, comes about through the use of the common process of perceiving and conceptualising. The process might be common but the end products are never the same. What we share is communication of the worlds we experience, we do not share a common experiential world.

Since it is communication (internal and external) that creates what we call reality, developing a 'shared meaning' (a notion created by the observer)

5 / An amusing illustration of how differently we can experience the world because of our acquired habits to do with how we make distinctions and punctuate our world, is the joke told by Paul Watzlawick: '. . . a man arrives in heaven and finds an old friend sitting there with a luscious young woman on his lap. ''Heaven indeed'', says the newcomer, ''is she your reward?'' ''No'', replies the old man sadly, ''I am her punishment!''' (*How Real Is Real*? (1977), p. 62).

is going to involve the participation in the task of all those who will be affected by any outcome. If we accept that living systems are structure-determined systems then communication is a structural coupling of two (or more) individuals in conversation. So to converse is to dance: to turn together in a way that acknowledges the presence of two parties (one of course could and does converse with oneself) and acknowledges the willingness to act together in some mutually acceptable way. The meaning that we are inferring is similar to that found in the original Latin words: *con* . . . meaning 'with', and *versare* . . . meaning 'to turn'. The actual dance, the experience of the conversation, is a unique creation and we have no certainty whatsoever as to what the outcome might be. It is neither a transfer nor a sharing of information. Useful knowledge, knowledge that will lead to satisfying action, is created by the joint action of both parties and encompasses both scientific and aesthetic judgements.

1.3.4 *A 'knowledge and information system' does not lead to action*

No one has done more towards achieving a robust development of a conceptual understanding of the research–technology transfer interface than Neils Röling. His major conceptual tool, the generation of an Agricultural Knowledge and Information System (AKIS), is the integrated group of people that encompasses scientists, subject-matter specialists, village-level extension workers, and pastoralists. The members of the group (the system) are together for 'the purpose of working synergically to support decision-making, problem solving and innovation' in any specific domain of agriculture (Röling, 1990, p. 1). He proposes the ideal that all major parties in the system engage in all its major functions: 'the generation, transformation, transmission, storage, retrieval, integration, diffusion and utilization of knowledge and information' (*ibid*). It is not surprising that, on the basis of what is actually happening on-the-ground, he concludes that there is still too much emphasis on 'downstream' functions, suggesting the use of a one-way model. Such is the pervasiveness of the dominant conceptual tradition that Röling admits that 'we have no words for the functions to be performed in shifting indigenous knowledge and farmer influence 'upstream' toward the science end of the science-practice continuum' (*ibid*, p. 36). Nothing is more certain than that we are entering unfamiliar intellectual territory as when we realise that we do not have the words to talk about our experience. And without the language, the ideal can not be transformed into purposeful action.

The experiences in agriculture and rural development have parallels in computing and artificial intelligence (AI) research (the metaphors and ac-

tions of scientists from the latter were quickly taken up in other disciplinary domains). As Terry Winograd (1997) points out 'the promises of massively increased productivity through knowledge engineering didn't come true' because 'the mainstream AI effort rested on a view of human intelligence and action that implicitly assumed that all of intelligence could be produced by mechanisms that were inherently like the conscious logical manipulation of facts represented in language'. The detailed arguments which refuted this position appear in the book by Winograd and Flores (1987).

1.4 What is second-order R&D?

The method of doing science espoused by Maturana (1988), which we follow for part of our research (Chapter 6), challenges the way of knowing and acting-in-the-world that: (i) sees an objective reality 'out there' (externally independent of the observer) and (ii) conceives humans as possessing an ability to increasingly know and understand such a reality. While we behave *as if* this way of knowing and acting was a possibility, biologically it is not (see Chapter 3).

Second-order R&D is built on our scientific understanding that human beings determine the world that they experience. The application of science demands that we reflect upon how we operate as perceiving and knowing 'observers' who *bring forth* their experiential worlds through the actual functioning of their nervous systems and the cognitive operation of making distinctions: You have to look in order to see![6]

The characteristics of second-order R&D can be summarised as:

- The doing (the praxis) is grounded in the extending of an *invitation* to, and the willing acceptance by, another to join in making a space for mutually satisfying action.
- The reality that is brought forth includes the researcher, to constitute a duality. It is not subjectivity – subjectivity belongs to objectivity (see Box 1.1).
- All participants share the responsibility associated with every outcome.
- It involves the study of relationships, particularly their nature and quality rather than enties or objects.
- As science, it is grounded in the explanation of what is experienced and, unlike philosophy, is not concerned with adherence to, or the explication of, principles. It has no imperative character.

6 / Here Einstein's famous remark to Heisenberg comes to mind: 'It is the theory that determines what we can observe'.

Box 1. 1 Duality and Dualism

It is now widely known that light can be treated as both a wave and a particle depending on the experiment we, as observers (or experimenters) have decided to use to observe its behaviour. This apparent paradox, i.e. wave-like behaviour and particle-like behaviour, was described for many years as the 'wave–particle dualism', which implied they were separate or opposite phenomena. The term used to describe antagonistic or negating opposites is *dualism*, e.g. mind/matter, objective/subjective. Two concepts form a dualism when they belong to the same logical level and are viewed as opposites. The logic behind this dialectic is negation. Reyes (1995) suggests that dualistic thinking is a product of the prevailing objectivist Cartesian world view with its orthodox logic under which we are still brought up. He also suggests that dualisms are responsible for ephemeral and endless debates, e.g. centralisation versus decentralisation. Dualistic or either/or thinking can often represent a trap in our thinking.

It was not until it was recognised that phenomena we observe in 'nature' are not independent of our observing that this paradox was resolved by appreciating that wave-like and particle-like behaviour were complementary behaviours that constitute a duality. Taken as a whole they do not negate each other but constitute a unity or whole. A commonly used example of a duality taken from ecology is the predator–prey relationship. Two concepts form a duality when they belong to two different logical levels and one emerges from the other. The logic behind this dialectic is self-reference. The following pairs are examples of dualities: environment/system; control/autonomy; constraint/freedom; 'what'/'how'). When recognised as complementary pairs the discussion is potentially more rewarding and exciting.

NB. The term 'dialectics' comes from the Greek *dialecktike (techne)*, the dialogical art, which in turn derives from *dialegesthai*, which means talking together, holding a dialogue. Etymologically, dialectics thus means the art of unfolding meaning of a word or idea through a conversation in which two or more persons argue pro and contra. Dialectical thinking is open and dynamic in contrast to formal-logical thinking, which proceeds in a linear and unreflective manner and is thus closed and static.

Source: Open University (1997). *Environmental Decision Making: A Systems Approach.* Adapted from: Reyes, A. (1995). A theoretical framework for the design of a social accounting system. PhD Thesis, University of Humberside, UK.

The need for explicit contextual grounding is at the heart of this conceptual development. This contextual grounding has to do with an increasing understanding of the social construction of the very concepts of the 'research–development relationship' and 'rangeland'. A contextual science is increasingly based on exposing the workings and limits to disciplinary understanding and on exposing a need for an ethic coherent with the capacity to respond to situations.

A problem with 'first-order' science is that it assumes that rangelands can be studied in isolated fragments and that an understanding of the whole can be gained by simply aggregating the detailed understandings. Second-order science (R&D) accepts that real systems (rangeland *per se*) are essentially unknowable and that all science can do is to generate models of reality. And models of 'rangeland' and models of 'research and development' are just that: models.

The essence of this new knowing is that all phenomena are *self-referential* (built mirror-like, by reference to themselves) and *dialectical* (the dynamic relationship between the selected elements brought into experience by the act of making a distinction – see Box 1.1). The notion of self-reference is in direct contrast to our traditional values of 'being objective' or holding a 'neutral position'. The intention behind these values is a very worthy one, it is just that it is scientifically impossible to maintain. Von Foerster (1971) summarises the historical shift as follows:

'Self-reference' in scientific discourse was always thought to be illegitimate, for it was generally believed that The Scientific Method rests on 'objective' statements that are supposedly observer-independent, as if it were impossible to cope scientifically with the referee in the reference, the observer in the description and the axioms in the explanation. This belief is unfounded, as has been shown by John von Neumann, Gotthard Gunther, Lars Lofrgen and many others who addressed themselves to the question as to the degree of complexity a descriptive system must have in order to function like the objects described, and who answered the question successfully

(pp. 239–240).

Much earlier, 1932, the physicist Planck put it his way: 'Science cannot solve the ultimate mystery of nature . . . because, in the last analysis, we ourselves are part of nature, and therefore, part of the mystery we are trying to solve'.

1.4.1 *Research as a dialectical relationship*

The name for certain sorts of relationships, of which self-reference is an example, is a 'dialectic' (see Box 1.1). Much of our traditional view constructs its knowledge on the basis of dualisms: science as distinct from art; pastoralists as distinct from rangeland; mind as distinct from matter; and so on. The process of a dialectic encourages us to continuously re-connect dismembered dualisms. The new epistemology, often called cybernetic epistemology (Keeney, 1983), or second-order cybernetics (Howe & von Foerster, 1974), uses a dialectic which continuously exposes both sides of our distinctions (e.g. rangeland and pastoralists) and keeps them connected in a recursive way: the rangeland creating the pastoralist and the pastoralist creating the rangeland. In a real sense, the pastoralist is the rangeland and not an actor in it as though the rangeland existed independently of the pastoralist. The practical implications of this epistemology are far reaching. No longer is the pastoralist the 'problem', or the degraded ecosystem the 'problem'. The pastoralist and the rangeland are now seen as a complementary pair: they are distinct but *related*. The dialectical process allows us to look at the quality of the relationship as a 'variable' in research. In second-

order science it is not objects that command attention but the relations between them.

What became increasingly clear to the students of 'systems' was their own role as observers. It was the observer, by means of making a distinction, who specified that a system was a unit distinct from its background. It was the observer who then attributed to both system and background their respective properties, properties which justify the act of seeing them as separate. This act of making a distinction is the most basic cognitive act; it is what is at the heart of any investigation of knowledge. So, what is seen to constitute a system is a decision made by an outsider who, for reasons of his or her own, wants to explore a set of relationships.

1.4.2 *How first-order and second-order R&D are related*

Second-order R&D in no way replaces the validity of first-order R&D. Rather, they are related in complementary fashion. In fact, second-order R&D is the context of the first-order. The relationship between the two is itself an example of a duality constituted through a dialectical process: there is 'science', and there are the 'processes leading up to' science. There are pragmatic strategies gleaned from first-order thinking which are contextualized by the systemic wisdom of second-order thinking. With second-order R&D we are moving towards setting a context for change which necessarily complements strategic and consciously pragmatic strategies of intervention (see Umpleby, 1994). It is the more encompassing, building upon the insights and strategies gleaned from the first-order models.

What is being proposed is not an interdisciplinary mingling of the 'two cultures', rather it is a new science. It is a contextual, systemic, and dialectical science.

1.4.3 *Objectivity is replaced by responsibility*

Because of the active focus on the social construction of knowledge, technology, and the very 'doings' of R&D, second-order/contextual science gives attention to people's participation in terms of *power* and *control*. There are the very concrete issues of development for whom? Who benefits, who loses, and who has increasing control of resources and decisions? This is not a simple matter of redefining the problem as this would imply staying with the old framework. What this contextual science looks like on-the-ground would be:

- Evidence of emancipation from powerful authority (including dependency on the disciplinary knowledge of 'science' . . . scientism!).

- Evidence of greater empowerment through collaboration.
- Collaboration based on mutually accepted difference (each person's reality is as valid as another's even though it might not be seen to be as desirable).
- Collaboration is based on shared enthusiasms-for-action.
- Recognition of a complementarity in personal skills or access to resources.

1.5 Precursors of the second-order approach

As academics we both were initially attracted to an experiential and student-centred approach to agricultural education in the early 1980s (see Ison, 1990). This approach stressed the importance of structuring the educational programme around the student's learning needs and the practical problems currently facing the agricultural industry, rather than a prescriptive curriculum based on building blocks of accepted knowledge. The attraction of this educational philosophy and practice resulted from our personal experiences as students with the educational system and from our close working relationships with the rural community. There was a strong sense that learning did not work along the lines espoused by the professional educators. Likewise, there was the belief that knowledge did not flow from the experts to the practitioners.

Coupled with this historical experience were the recent findings from neurophysiological studies shedding new light on the processes of perception and cognition. Then came the complementary models of human communication which presented *meaning* as a relational phenomenon. Meaning is brought about in the interaction and is not present in the head of either the 'sender' or the 'receiver'. This constructivist's view of knowledge formation, information, and learning, began to provide the theoretical underpinnings for a research project involving both authors and aimed at the identification of agronomic problems *in context*, that is, not detached from the more complex social and community issues in which they were embedded. The research developed out of the tradition of rapid rural appraisal (RRA) that had been successfully applied in less developed countries (Khon Kaen, 1987).

This first exploration of RRA in Australia (Ampt and Ison, 1989) took place in central western New South Wales (Forbes shire). One of the key outcomes of this study was the impetus to start work on an alternative model for participatory agricultural research and development in Australia. Following on from this exploratory research, the authors were commissioned by the then Australian Wool Corporation to undertake a critical

review of rural extension encompassing both its theory and practice (Russell *et al.*, 1989).

Probably the most significant finding that flowed from the RRA study and the subsequent Critical Review was that all participating farmers and graziers, who were representative of the diverse range in a large agricultural district, were *enthusiastic* about what they liked doing. If they wanted to do something they became well-informed about the relevant issues and did the task competently. They did not have to be educated or persuaded by any outside source when it was their learning need that they were responding to. This is taken up again in Chapter 6.

The elements of our second-order R&D were beginning to fall into place. Next came a collaborative research project by one of the authors, between farmers and the extension services in the Swiss Emmental (Scheuermeier and Ison, 1991). This research evolved from the 'farmer first' tradition in which rapid rural appraisal had frequently been employed using multidisciplinary teams and local people in the 'identification' of problems for research and development. This research, however, moved beyond much of the RRA experience at that time to encompass aspects of the emerging theoretical position described in this chapter. It also attempted to move beyond multidisciplinary to genuine interdisciplinary collaboration by attempting to explore each other's perceptions of what we experienced and how we interpreted these. Through the process of collaboration, and the acceptance of the worldviews of those involved, issues were brought into being, and formulated. In the Swiss research, understandings, derived through the process of semi-structured interviewing, of farmers' histories and present circumstances were used as a basis for them to identify potential actions which might sustain their involvement in farming. Later, in a community setting, farmers were able to join with others in the community who shared common enthusiasms for future action.

Issues identified for future action included: (i) new products; (ii) wood chipping from forest by-products for domestic energy; (iii) machinery and labour sharing; (iv) farm–household diversification; and (v) further information and training. The community forum also provided an opportunity for women to come together and participate for the first time. This resulted in the formation of a women's support group and the public articulation by the group's spokeswoman of the incredible pressure they were under and the need for men to change their ways of working.

These experiences and our emerging conception of second-order R&D led to our involvement with pastoralists, conscious that so often the interventions resulting from first-order R&D have led to the 'administration of carrot and stick incentives . . . (and a failure to) begin to develop systemic

frameworks for thinking about things' (Fisher, 1990). As will be illustrated in subsequent chapters, the contextual approach aims at increasing the capacity of pastoralists to respond and offers a clear alternative to the carrot and stick approaches to effecting human action.

1.6 Concluding comments

As we outlined in the introduction to this section, it was possible to recognise three streams of inquiry which we found necessary to pursue at the start of our research. This chapter has referred to all three but has had as one focus a review of the intellectual traditions which have given rise to our very conception of rangelands, rangeland management and rangeland science. A second tradition, which gives rise to the meaning we give to human communication, and from this to information, knowledge and understanding, is also explored. For many readers this may be the most challenging set of ideas because it runs counter to the current common and everyday understandings and to the language that is used. For this reason, and because its relevance is universal, we feel it is important to explain this tradition in more detail in the next chapter.

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