AGRICULTURAL KNOWLEDGE AND ENVIRONMENTAL REGULATION IN THE NETHERLANDS

A case study of the Crop Protection Plan

NIELS RÖLING

Introduction

Agricultural research, extension and education (REE) are commonly perceived to form a triad of key policy instruments which, together with vigorous investment in land development, explain the phenomenal growth of Dutch agricultural productivity since the Second World War. In addition, farmers, agribusiness and REE have traditionally been regarded as constituting a system of articulated actors, often with multiple and redundant roles, mutually adding value to each other's contribution, thus forming a synergistic whole, or 'knowledge system', of which sustained innovation - a necessary condition for staying in the market place - is the emergent property (e.g., Havelock 1986; Röling 1986; Röling and Engel 1991; Röling 1992b).

The growth in efficiency has had the effect of squeezing out about 2 per cent of farmers annually, a cost considered acceptable by the farmers' organizations, partly because the strong export position has created jobs in agriculture-related industries. Until the end of the 1970s the knowledge system operated in a conducive context. The rapidly increasing productivity and political acceptance of, if not pride in, the performance of agriculture, led to the availability of ample resources, supportive legislation and a great deal of political room for manoeuvre.

Whereas the loss of farm jobs and the squeezing of small farmers were considered acceptable costs (e.g., Somers 1991), the environmental consequences increasingly were not (Glasbergen 1992). It is not necessary here to describe the process by which environmental concerns increasingly affected the agricultural industry (see Frouws and van Tatenhoven this issue). At the end of the 1980s non-agricultural interests finally won the day and various far-reaching regulatory measures were introduced to limit inputs of chemicals and minerals, as well as further growth in farm production.

The question to which this article is addressed is how the agricultural

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knowledge system, set up to serve only productivity, adapts itself to support sustainability as well. This question is particularly interesting because it can be expected that more sustainable forms of production would rely on replacing inputs of chemicals and minerals with inputs of information, leading to even more knowledge-intensive forms of agriculture. It can also be expected that more sustainable forms of agriculture necessarily rely more on farmer expertise than on external expertise. Thirdly, the contradictions and inconsistencies, which the concern for sustainability introduces, are likely to have important consequences for the synergy of the knowledge system. In short, the recent move to more sustainable forms of agriculture in the Netherlands provides an interesting opportunity to study the adaptations of the knowledge system under the influence of environmental regulation.

The paper presents a case study of the impact of the Crop Protection Plan (Ministerie van LNV 1991) on the knowledge system serving market gardening in the Koekoekspolder, in the Province of Overijssel. The case study is based on a field training exercise in the summer of 1992, for which the author was one of the facilitators. The method employed was a contrived 'rapid rural appraisal'. That is, it followed an RRA approach, but cut corners in a number of ways: the case itself had been pre-selected to provide sufficient interesting insights in the brief period available, a great deal of prior information had been collected and visits to key actors in the knowledge system had been arranged beforehand. Sub-groups of trainees visited these actors and exchanged the insights gained in plenary sessions afterwards. To complete the exercise, the trainees presented their main conclusions in a session with some of the actors. The following actors were involved (between brackets the name by which the actor will be referred to in the rest of the article):

- vegetable producers (growers), of whom twelve were visited
- the privatized extension (DLV) team in Hoorn
- the socio-economic extension service (SEV)
- the water management board (Waterschap)
- the Agricultural Education and Training Centre (AETC)
- the Co-operative Vegetable Auction (Auction)
- the Research/Extension Liaison Bureau (IKC) in Ede
- the Regional Research Centre (ROC) and the experiment station for arable farming and open-air vegetable production (PAGV)
- the Provincial Directorate (Consulentschap) of the Ministry of Agriculture, Nature and Fisheries (the ministry) in Zwolle
- the provincial office of the apex of farmers’ organizations (Landbouwschap) in Zwolle
- the Lelyland Agricultural Co-operative (Co-operative) in Dronten. This co-operative was the only pesticide seller visited
the National Federation of Horticultural Study Groups (NTS) under whose auspices small, temporary, groups of growers (study groups) meet (usually twice a month throughout the season) to discuss a specific subject. The study groups are often convened by extension workers.

The Crop Protection Plan

Increasing awareness of the implications of pesticide usage in the Netherlands led to a political consensus that Dutch agriculture was on a totally unsustainable course. Average rates were 10 kg of active pesticide ingredients per ha per annum, with 200 kg in strawberry production and 77 kg in arable farming (of which 85 per cent for nematicides in potato production). As a result, the Crop Protection Plan was developed by an inter-ministerial working party and introduced in the middle of 1990 as a policy intention to reduce the use of pesticides by 35 per cent in 1995 and 50 per cent by the year 2000. After an initial period during which various interest groups could contest it, the Plan became a government decision in 1991. A report on the status of its implementation is presented to Parliament every two years, with 1995 and 2000 as important benchmarks. Some room for manoeuvring to adapt target dates or reduction targets still exists. But the very fact that an inter-ministerial committee could formulate such restrictive regulations is indicative of the erosion of the ‘green front’ (see Frouws and van Tatenhoven this issue).

Initially, compliance with the Plan is largely voluntarily. However, if targets are not reached by the dates specified, increased compulsion is expected (based on use registration). Subsidies to ease farm transition have been ruled out because of their inequitable impact. Thus the cost of adapting production to the Plan must be borne by the growers. On-farm research on some farm types has suggested that the required reductions can be reached without necessarily threatening farm survival.

For each crop sector, the Plan spells out detailed targets for air, soil/groundwater and surface water emissions. In addition to emission, it aims at reduction of dependency and use. To achieve these aims, the Plan announces various measures, such as the vigourous encouragement of integrated farming systems, the availability of nematicides on prescription only, the curtailment of herbicide use, the introduction of pesticide use registration, special certificates of competence for application, criteria for equipment, a destination levy on pesticides, and stricter requirements for pesticide admission. The plan also provided for twelve extra staffing posts for crop protection extension at the IKC, and finance for extension materials, a special training programme and additional research.
The Plan does not provide guidelines on how to comply with it, it only specifies that a certain amount of reduction must be achieved in the coming years. Developing the methods is left to the creative ability of the industry: the growers, research institutions, commercial companies, and a specially appointed task force at the IKC. The introduction of the Plan has had a galvanizing effect on farmers, experiment stations, cooperatives and others to search for alternatives.

Market gardening in the Koekoekspolder

The Koekoekspolder covers about 600 ha, parcelled out in narrow strips, intersected with drainage ditches and devoted to animal husbandry and market gardening. The soil is well suited for the latter pursuit. Water is permanently available. The main outlet for the produce, the Auction, is located in the municipality to which the Koekoekspolder belongs. In 1989, the Auction had a turnover of some US$ 54 million. The authorities consider the development of horticulture in the Polder unsatisfactory. Growers are said to be extremely conservative. The gardens are small, cultivation under glass is limited and meadows with sheep and cattle intersperse the market gardens. A municipal campaign to attract growers from the Westland to 'modernize' the Polder has so far not been very successful.

The growers are a diverse lot. Some concentrate nearly exclusively on year-round hydroponic production of chicory shoots from roots bought from arable farmers. Others focus on open-air vegetables in summer and combine them with chicory or greenhouse production to maintain continuous employment. The main crops are lettuces of various kinds, leeks, celery, spinach, endives, carrots and french beans. In all, the ninety-five market gardeners in the polder engage in the following pursuits (see Table 1).

The farming system is complex and demands considerable skill in 'reinventing' ideas brought from outside. One grower visited only had 1.86 ha. In addition to himself and his married son, he employed one full-

Table 1: Types of horticulture in the Koekoekspolder

<table>
<thead>
<tr>
<th>Type of production</th>
<th>area (ha)</th>
<th>number of growers</th>
</tr>
</thead>
<tbody>
<tr>
<td>open-air vegetables</td>
<td>62</td>
<td>65</td>
</tr>
<tr>
<td>greenhouse vegetables</td>
<td>20</td>
<td>56</td>
</tr>
<tr>
<td>chicory</td>
<td>145</td>
<td>27</td>
</tr>
<tr>
<td>greenhouse flowers</td>
<td>5</td>
<td>11</td>
</tr>
<tr>
<td>open-air flower bulbs</td>
<td>5</td>
<td>9</td>
</tr>
<tr>
<td>orchards</td>
<td>3</td>
<td>2</td>
</tr>
<tr>
<td>others</td>
<td>2</td>
<td>5</td>
</tr>
</tbody>
</table>
time labourer and two seasonal labourers in summer. His wife helps twenty hours a week, especially in winter with the chicory. This very high labour input on minimal land requires careful planning of land use. Lettuce is grown three to four times on the same land during the growing season, establishing 0.1 ha every week, for a total production of 2 ha of lettuce a year. To maintain healthy crops, a careful rotation is required. Thus leeks follow lettuce to reduce soil-borne pathogens. The combination of crops and their rotation has been developed over a period of years. It is difficult to change such a system abruptly.

Growers face a demanding market. Both in the Netherlands and in Germany, to which most Dutch vegetables are exported, consumers demand products without a blemish, but also without chemical residues. With arable farmers increasingly turning to large-scale vegetable growing, the small-scale open-air vegetable producers can only survive by producing first class fine vegetables. It takes a few years for a grower to learn how to produce grade 1 leeks, for example. Now the Crop Protection Plan has introduced additional criteria, the general feeling is that if they succeed, growers will have gained an important advantage over their competitors.

Introducing the other actors

The market gardeners claim to rely mainly on three sources of information: agricultural journals, study groups and informal contacts with other growers (e.g., during daily visits to the Auction). Many of the articles written in the journals are contributed by specialists from extension and research. In the Koekoekspolder, an active study group exists with respect to chicory production. A member of DLV is usually present at its meetings, during which the growers visit one of the members' enterprises and openly discuss technical and financial aspects. This exchange is considered particularly useful. Besides the chicory group, an Iceberg lettuce group is also active, but membership is not as widespread. Surprisingly, there is no study group which deals with the adaptation of complex market gardening systems to the Crop Protection Plan.

In addition to the three preferred by the market gardeners, a host of other information sources exist. All growers showed us large amounts of printed materials, such as catalogues from seed companies, brochures, pamphlets, and folders from pesticide and fertilizer companies, and leaflets from the Auction and the farmers' organizations.

Various extension services exist. The three farmers' organizations each have their socio-economic extension workers (SEV) who assist members with questions of succession, inheritance, forms of incorporation, insurance, farm liquidation, and so on. But they also mobilize, organize and train members to consider the implications of manure
laws, the Crop Protection Plan and other challenges. The SEV is subsidized 50 per cent by government with EC support. Organization members pay the other half. This gives a sense of ‘ownership’. Most market gardeners in the Koekoekspolder belong to the non-denominational Overijssel Society for Agriculture.

The DLV is the former government extension service which became a private foundation in January 1993. Government financial support will gradually diminish to 50 per cent. DLV is run by an executive board appointed half by the Landbouwschap, and half by the ministry, with a chairman who is appointed by the ministry on the recommendation of the Landbouwschap. DLV is in favour of reducing its individual advisory work and increasing its focus on the study groups, but whether and how fees will be raised is uncertain. At the moment, the service to study groups is still free.

DLV is in a complex position (Tacken 1991a). On the one hand, it is a private agency charged with serving farmers’ interests, especially in technical, economic and management issues. Its statutory independence from government is important now the erstwhile automatic commonality of interest between the ministry and the agricultural industry has been broken, and government is imposing severe restrictions on agriculture in the public interest. On the other hand, DLV is still largely paid for, and controlled by the ministry, and, therefore it is often charged with tasks government considers important.

Despite the official perception that DLV is an important source of information, the market gardeners in the Koekoekspolder invariably claimed that DLV visited them at most once a year. This fits with the fact that the DLV centre is more than an hour away, and that market gardening in the Koekoekspolder is a relatively small and specialized industry. The DLV Centre has eleven horticultural specialists, four for chicory. DLV estimates that 30 per cent of the time of its horticultural specialists is spent on direct contact with the 3,200 growers it serves, i.e., one full-time equivalent for roughly 860 growers.

DLV is provided with research-based information by the IKC, the ROC, the PAGV, and the various disciplinary research institutes. DLV’s position with respect to these information providers has not crystallized. For example, the ROC and the PAGV are financed 50 per cent from levies on farmers’ produce. Farmers complain that they will have to pay DLV for knowledge they paid to develop in the first place. Such complaints highlight DLV’s hybrid status.

The ministry’s Consulentschap provides policy information to various publics and advises the central government in The Hague. It does not work for individual farmers, but addresses groups, writes brochures for, and liaises with, provincial and municipal councils, contributes to radio and other mass media presentations, advises boards of farmers’ orga-
nizations, etc. Though the Consulentschap is supposed to support the public interest, in practice "its heart is with the farmers", as one official put it. Thus it represents agricultural interests on such platforms such as the Provincial Council, where complex decisions (regional planning, zoning) are made on the basis of accommodation between various interests.

The fact that the Consulentschap continues to represent agriculture causes considerable friction within the ministry between the Directorate General for Agriculture and Food and the DG for Rural Areas and Quality Care responsible for environment and crop protection. This friction leads to a complex situation because an integrated viewpoint is essential for the continued survival of the ministry and to prevent its two directorates general being absorbed into the Ministry of Economic Affairs and the Ministry for Public Housing, Spatial Planning and the Environment respectively. These complex politics explain why the Consulentschap is not housed in the same building as the Agricultural Inspection Service. The latter is responsible for controlling the implementation of the increasing number of laws which restrict the farmers' freedom and has recently been considerably expanded. Consulentschap and Inspection Service, though part of the same ministry, represent totally different approaches to inducing change in agriculture: information based on trust and regulation based on police power.

Schooling and training are provided by the training centre 'Groene Welle'. It not only provides full-time day education, but also offers a programme of courses for farmers, their wives and others engaged in 'green space'. In accordance with the Crop Protection Plan, the 'Groene Welle' started offering courses leading to certification in professional application techniques for pesticides. One of these is suitable for growers. Mailings were sent to 500 growers, but only five participated in the course.

Other sources of information include the Auction which provides information on what the markets require and on criteria for quality, sorting and packaging. The Auction has a special fieldworker for this and makes extensive use of pamphlets. The Central Bureau of Associated Vegetable Auctions, partly financed by a levy on marketed products, is responsible for market research and the collective marketing development (quality control, advertising, uniform packaging and quality standards). The Co-operative also has an important information function. Its six fieldworkers give information about the Plan, organizing meetings, study evenings, crop protection days and so on, but they largely work with arable farmers.

The rapidly dwindling number of farmers and the rapid decrease of government support lead to increasing competition between the various information services. Thus DLV competes with private consultants and
AETCs (who will give short courses?). Now that the farmers' organizations are responsible for managing both DLV and the SEV, with government paying 50 per cent of both, the possibilities of an eventual merger of DLV (700 staff) and SEV (250) are obvious to everyone.

The information suppliers discussed above, as well as others who are in direct contact with growers, such as banks, accountancy firms, and contract workers, form the target groups of the IKC, in this case the IKC-AT in Ede, responsible for arable farming and horticulture. The mandate of the IKC is to act as a conduit between research and those in direct contact with growers. It does not deal with farmers or growers directly.

The final actor we must introduce is the Landbouwschap. A typical grower in the Koekoekspolder is a member of his local farmers' organization. These local and regional organizations (Catholic, Protestant and non-denominational) belong to powerful national 'Central Agriculture Organizations' (CLOs) which jointly have an apex organization: the Landbouwschap. Its main job is to represent the interests of farmers and farm workers wherever decisions are being made which could affect them. Hence the Landbouwschap has a cadre of specialized officials who keep abreast of developments and act on behalf of the agricultural industry. Farmers were not involved during the formulation of the Crop Protection Plan. When it was launched, it led to strong reactions. The Landbouwschap played an important role in this fight. Its main theme was not to cancel the Plan, but to gain time and to make the general public and the authorities aware of the complexities involved in implementing it.

Organizations, such as the Co-operative, the Landbouwschap and the Auction, have a strong sense of common interest with primary producers. The survival of the former depends on the viability of the latter. This is a strong co-ordinating force which explains part of the clout which the agricultural industry can muster against such onslaughts as the Plan. This influence is far beyond the political power of the 120,000 primary producers, of whom about one-third is on its way out. As can be expected, members of organizations in the ambience of government (DLV and IKC) did not demonstrate this strong sense of dependence.

The eyes of the beholder

Before turning to the actors' reactions to the Plan, it is important to consider the 'eyes' with which we looked. These eyes were shaped by a number of studies and experiences. One important learning experience is the innovative Integrated Pest Management in Rice programme in Indonesia (Röling and van de Fliert 1993; van de Fliert 1993). Another is the Land Care movement in Australia (Chamala and Curtiss 1990,
Woodhill et al. 1992; Campbell 1991) with which the author became acquainted during a recent sabbatical. A third is an exploratory study of experiments with more sustainable forms of agriculture in the Netherlands (Somers and Röling 1993). Finally, the author has made a theoretical attempt to use these experiences to explore the dimensions of a shift in policy models from transfer of technology to facilitation (Röling 1992c).

What emerges from these experiences is an expectation with the following contours. A shift to more sustainable forms of agriculture, such as required by the Plan, is not a question of the adoption of an innovation. It requires a slow learning process and a change in mentality. The shift forces a grower to go back to basics, in that a new criterion for production is introduced (sustainability in addition to productivity), which requires a new apparatus for making visible (feedback, indicators) where one is and what the consequences of one's actions are. Furthermore, reduced reliance of chemical inputs requires observation, coupled with considerable knowledge to interpret what one observes (e.g., life cycles of pests and pathogens). Making use of natural processes requires active eco-system management, which is more than producing a crop. Instead of applying rules (e.g., calendar-based preventive spraying), farmers must be able to apply general principles to their situation and make their own rules. Instead of a blanket extension recommendation for fertilizer dosage, for example, more sustainable agriculture requires that farmers measure available nutrients and apply general principles to make up their own recommendations.

Reduced reliance on external chemical inputs leads initially to feelings of uncertainty and risk. In short, if we accept the constructivist position that man is a sense-maker, shifting to sustainable agriculture seems to require a great deal of new sense-making activity (e.g., making things visible). The farmer must become an expert in his own fields instead of a 'user' of products of scientific research.

The concomitant experience with respect to introducing more sustainable agriculture leads to the expectation that extension shifts from a role of expert transferring technologies and rules, to a facilitator who works with farmers to learn, develop technology, and become expert. A special characteristic of the shift to more sustainable practices is the importance of groups. Growers seem to benefit a great deal from joint learning and discussion of the changes required. In some cases (e.g. catchment management for erosion control, the introduction of parasitoids on crop pests, the creation of habitats for natural enemies, etc.), groups are an essential ingredient of the more sustainable practice. In sociological terms: one must create agency at higher levels of aggregation in order to manage agro-ecosystems in a sustainable manner. This means that facilitators must not only be technically trained, but also have skills in group work and organization.
The impact of the Crop Protection Plan

The response of the growers to the Crop Protection Plan has been mixed. Most welcomed the Plan as necessary to change an unsustainable course. What is more, the legislation is seen to prevent 'free riders' (Messick and Brewer 1983) so that growers can afford more sustainable methods. On the other hand, they fear implementation before alternatives have been developed and worry that similar legislation has not been enacted in other countries. Compliance with the Plan has to 'come out of the market'. But its enforcement might demand farm adaptations which are incompatible with the market. These opinions are consistent with the results of a survey of three thousand farmers' reactions to the Crop Protection Plan (van der Ley and Proost 1992). Although some growers had adopted a 'wait-and-see' attitude, others had started anticipating Plan implementation by taking various measures to reduce pesticide use. These included:

- crop rotation (e.g., leeks after lettuce)
- early planting under nylon cloth (e.g., early cropping of lettuce which gives a better price while keeping aphids off)
- selection of resistant or tolerant cultivars (e.g., only growing closed 'butter lettuce' in the high summer season instead of Iceberg which is susceptible to aphid attack and requires more frequent spraying)
- careful scouting as a basis for spraying decisions instead of preventive spraying
- use of green manures (e.g., rye before potatoes),
- use of less toxic sprays (e.g., Pirimor, a selective insecticide against aphids)
- biological controls (e.g., use of catch crops in between the regular crops)
- making things visible to accurately determine requirements for intervention (e.g., careful analysis of nutrients in chicory roots as a basis for determining the fertilizer mix to be used in the hydroponic production)
- use of labour to replace herbicides (according to one grower, the seasonal workers he employed cost as much as the herbicides).

Such measures replace routine chemical inputs with time and situation-specific inputs of information (and labour). This raises the question how growers acquire the necessary information to implement the Plan. It is of interest to look at the 'products' offered by DLV for sustainable agriculture (Tacken 1991b). These include:
a check-up with respect to environmental indicators leading to a score which gives the farmer an idea where he stands
an environmental analysis indicating extent and place of pollution on the farm and technical or economic reasons for it
an environmental farm plan, which provides information about environmentally relevant aspects of the farm, solutions, technical and economic consequences and plan implementation.
'Optimest', a software program advising farmers about manure and fertilizer use
a manure disposal plan advising farmers what manure can be used on the farm and how to dispose of over-production
a mineral advisory plan, advising the farmer at an operational level about the consequences of dunging and fertilization for soil mineral deposits
a mineral bookkeeping administration, a complete package to keep track of the amounts of minerals bought, used, and lost.

This overview suggests that DLV focuses on making visible the farm situation and on providing concrete plans for what to do about it. The products do not comprise guidance to adapt farming systems, or training to enhance expertise, observation skills, decision-making and experimentation.

Let us now consider the role of the IKC. The Ministry established a special Crop Protection Core Group at the IKC-AT, which is responsible for developing the information which DLV and other 'intermediaries' use in dealing with growers. The strategic plan 'Towards Plant Protection with a Future' established twelve working groups consisting of members of the IKC, as well as of the DLV and other intermediary organizations (not farmers). They develop the extension campaign in detail, comprising a general part aiming at understanding and acceptance of the Plan and a thematic part focusing largely on technical subject matter. Each working group develops an extension plan comprising objectives, ways of reaching them and required 'extension products'. It also indicates with which intermediaries it will work. The following themes have been spelled out for the campaign:

- improving the expertise of intermediaries (all sectors)
- soil decontamination (focussing on nematicides in potato)
- hardware (use of spraying equipment, etc.)
- sector-specific (e.g., open-air vegetable production) reduction of insecticides and fungicides
- reduction of the use of herbicides in animal production and 'public green'.
For open-air vegetables, activities included:

- monthly lectures for the NTS about the general activities of the Core Group and the possibilities for reducing pesticide use
- publication of a brochure for DLV, NTS and private consultants about ‘Guided Control’ (see footnote 5)
- production of slides for extension workers to accompany the brochure, with special focus on the stages of development of organisms and pathogens
- various articles in the journals concerning the Plan, the consequences for market gardening and practical possibilities and measures
- study days for front-line extension workers
- guidance for NTS and DLV facilitators of plant protection registration groups.

The IKC developed its strategic response to the Plan without grower participation. Some growers we visited were experimenting with far more daring alternatives to conventional production than ‘guided control’. It is unclear how IKC came to decide on the information needs of growers under pressure of the Plan. There seems to be little recognition of the possibility that shifting to more sustainable forms of agriculture requires a learning process and that growers at different stages might require different information.

Long before the present environmental regulatory measures, the PAGV had started experimental work to develop an integrated arable farming system at Nagele. Its economic performance compared favourably with both conventional and bio-dynamic controls. The environmental crisis accelerated implementation of this farming system in that it became the model for the thirty-seven experimental arable farms in the national project to introduce more sustainable arable farming. The PAGV is heavily involved in this experimental project.

The Crop Protection Plan has also galvanized a great deal of experimental activity by other actors to find solutions to the ‘how’ question left unanswered by the Plan. The Landbouwschap is engaged in a number of research projects. What is even more interesting is that it carries out these projects with financial support from the provincial government, which it often opposes. It also receives technical support from the local secondary agricultural school. One of the projects comprises experimentation with ten farmers in the area of soil decontamination and focuses on the use of resistant potato varieties. Another project looks at mechanical weeding of maize as an alternative to Atrazine. A third project involves intensive experimentation with mineral bookkeeping in a study group. In all, it undertakes some ten projects and employs two people to manage them. The motivation for the Landbouwschap to en-
gage in research is that it does not believe that farmers' interests are served by always saying 'no'. It gives agriculture a bad name and an untenable position, especially where the environment is concerned. Hence the Landbouwschap has chosen an offensive approach, initiating the search for alternatives, in the hope of gaining bargaining points when that becomes really necessary.

The Co-operative works with a chemical company (Luxan) and the governmental R&D organization TNO to develop a chemical which can act as an attractant for nematodes, much like a pheromone for insects. It apparently entices nematodes to engage in self-destructive behaviour. The study should yield results in two years time, not just for potatoes but also for flower bulbs and vegetable production.

Another type of research engaged in by the Co-operative involves a new laboratory for analysing plant nutrients in soil, leaves and roots. One of the uses establishes precise norms for nitrogen fertilization based on leaf stem analysis. This has already resulted in norms for Bintje, the most popular potato cultivar, usually called 'poison spud'.

One can ask why the Co-operative, a large semi-commercial organization for which the supply of agro-chemicals is a major task, would take the initiative to develop alternatives for pesticides. The answer given was that the Co-operative, though "C stands as much for commercial as for co-operative", is still governed by a board in which farmers have an important voice. Given their long-term interest, the co-operative seeks to be ahead of the game. Sometimes this leads to meetings with farmers where the co-operative is perceived to be in the 'enemy camp'. But it must also be said that the leaf-stem analysis has developed into a popular service, which provides the Co-operative with a positive image.

Though the Plan stimulated a great deal of research, not much seemed to be going on specifically for the type of problems open-air vegetable production encountered in the Koekoekspolder. Many study groups are involved in experiments, however. Especially growers under glass tend to regard their glasshouses as mini-experiment stations and researchers as people who should help them experiment. But this does not apply to open-air vegetable production. And the section of the NTS which deals with this branch has its problems. The growers generally have a lower education than the glasshouse growers and a greater diversity of products. Both factors require a larger input of intensive guidance, which the small NTS section cannot afford (pers. comm. J. Proost). As we have seen, so far no study group has emerged for the specific purpose of adapting complex market gardens to the Plan.

An interesting aspect of introducing the Plan is that prevention, inspection and sanction all require services for making the current situation visible. Growers have their soil analysed every year to make
fertilizer application more accurate. Chicory growers made use of a new service for analysing nutrients in the roots as a basis for an accurate hydroponic mixture. Leaf stem analysis is a basis for fine-tuning fertilizer application in potatoes. A new laboratory has recently opened for soil testing and nutrient measurement in Zwolle in addition to the national center in Oosterbeek which traditionally carries out soil testing. The Co-operative had started a new laboratory for measuring pesticide residues. This laboratory is an addition to the laboratories for regular testing of produce of the Central Bureau of Horticultural Auctions, the Product Authority for Vegetables and Fruit and the AID. Various authorities, such as the AID, the General Testing Service of Produce (protecting the consumer), and the inspection service of the Central Bureau for Horticultural Auctions (protecting produce quality standards demanded by various markets), can swoop down on a grower's enterprise, a shop, the lot offered for sale in the Auction or waiting for transport in a shipper's yard, to take samples for inspection or to test emissions.

Observations

Though an intrusive and threatening piece of legislation made by the 'enemies' of agriculture, primary producers and the institutions which live off them, or thanks to them, have adapted surprisingly well to the Plan. It is obvious that the agricultural industry is sensitive to environmental arguments. Farmers are of two minds. On the one hand, they loathe the interference of government, on the other they recognize the need for regulation of pesticide use, and the capacity of legislation to prevent free riders and escalating toxic competition.

Consumers are not addressed by the legislation. There seems to be no effort to involve them in the interesting struggle of growers to make food production more sustainable or to educate them to understand the differences between biological, integrated and conventional types of production. Consumers' product quality norms ("one blemish and it becomes cattle fodder") seem to mitigate against more environmentally sound production methods. Sustainable production requires the involvement of the consumer and renegotiation of quality control criteria. Moreover, involving schoolchildren and others in the exciting search for sustainable methods seems a public relations opportunity of the first order.

The scale of institutional coverage is too large to adequately account for the diversity as represented by the open-air vegetable producers in the Koekoekspolder. Even if it did offer the required 'products', DLV is an absentee extension service. There is no ROC in the area. The experiment centre set up in the Koekoekspolder by growers themselves has been closed down because of lack of interest. The Co-operative which
has to cater for the Koekoekspolder is more interested in the large arable farms in the IJsselmeeerpolders. There is no study group which focuses on adjusting complex market gardens to Plan requirements. Officials seem to share the idea that the Koekoekspolder is conservative since it does not look like the Westland. Perhaps the growers in the Koekoekspolder represent a different, though also viable, 'farming style' (Bolhuis and van der Ploeg 1985). Whereas, in the Westland, producers under glass have become very specialized in yellow peppers, red Gerberas, white carnations, and so forth, the growers in the Koekoekspolder thrive on a diversity of crops and need it to maintain their incredibly complex crop rotations. They seem to be facing the music of adapting their complex systems largely on their own.

Access to extension advice has become more difficult and expensive at the very time when the Plan is stimulating a vigourous search for alternatives. Transition to sustainable agriculture seems to require intensive guidance of the learning process involved in adapting complex farming systems. Yet DLV's privatization mandate has locked it into a search for recipes which it can sell. It is developing 'business strategies' and adopting 'marketing models' (Tacken 1991a,b). Extension workers often seem to know too little about integrated agriculture themselves, cannot step out of their customary 'expert' role, and seem unwilling and unable to work as facilitators with farmers in joint search for as yet uncertain alternatives. Farmers are seen as adopters or users of science-based rules. They are not provided with the principles they need to compose their own rules. A typical example is the experiment to introduce 'integrated arable farming'. The project started out by imposing the system developed in the experiment station lock stock and barrel on the thirty-seven experimental farms. This led to resistance and loss of motivation on the part of the farmers involved. Now, integrated farming is regarded as a toolbox from which a farmer can pick and choose during his learning process.

The IKC, as a 'second line' organization which must deal with 'intermediaries' and is not allowed to communicate directly with primary producers, has a mandate heavily imbued with the linear thinking of the technology transfer model (e.g., Kline and Rosenberg 1986). This led to strategic planning without involvement of the growers concerned. There is little evidence that farming systems were taken into account when developing the extension plan.

It seems that IKC and DLV have insufficiently grasped the fundamental change in sense-making activities required for the move to more sustainable forms of agriculture. Thus they remain stuck in linear models and focus on ready-made recipes for adoption. Given their lack of staff resources and the too wide gauge mesh with which they try to 'catch' the diversity of Dutch agriculture, it seems not too far-fetched to
conclude that farmers' own inventiveness and creativity must be mustered as much as possible in the development and exchange of alternative solutions. Part of the reason for the slow change is that the farmers' organizations and the Landbouwschap themselves seem not to have grasped the nature of the change and have, therefore not effectively used the influence they actually have in research and extension programming. Examples are the lack of activity of the 'Horticultural Committee' in the Koekoeckspolder, the lack of influence exerted by farmers in the boards of the DLV and the lack of insistence on farmer participation in the IKC's strategic extension plan.

Of course, centralized technology development and transfer continue to play important roles, also in introducing more sustainable agriculture. Methods for making things visible (e.g., mineral bookkeeping, pesticide registration) and the development of resistant cultivars are important contributions. But that does not change the expectation, supported by international experience, that facilitating sustainable agriculture implies a shift from technology transfer to facilitation of learning processes (Röling 1992c).

The last observation takes a knowledge system perspective (e.g., Röling 1992b). As we have seen, the performance of the system in terms of innovation is expected to be optimal when the actors engaged in the various knowledge processes form an articulated, synergistic whole. Innovation used to be valued only as a condition for staying in the market place (i.e., productivity and competitiveness). Now it is also a condition for sustainability and survival in terms of compliance with regulations. The Plan has given innovation a new urgency, and established new performance criteria for the knowledge system. Hence it is of interest to analyse the actors involved in implementing the Plan in terms of their mutual articulation, their functional differentiation, integration and linkage, and co-ordination (Engel 1992). Such an analysis, if participatory, can help actors understand their mutual roles, and supports joint learning for better performance.

When productivity and competitiveness were the main concern, research, extension, education and producers were seen as playing specialized roles along a 'science-practice continuum'. As a result of legislation such as the Plan, policy-making must now be recognized as an important independent source of information, and a special actor (the Consulentschap) has emerged which specializes in policy information. Policy is a crucial contextual factor inducing and shaping the generation and utilization of knowledge and technology, and an essential determinant of their relevance. Farmers actively anticipate policy, assess its likely impact and speculate on its change as a result of EC politics. They choose different strategies in dealing with policy, from wait-and-see to an active effort to be ahead of the game. Research to analyse farmers'
policy behaviour is overdue, as is policy as a sub-system of the knowledge system and the new linkages and tensions this creates.

The Plan has galvanized the agricultural industry into active search for survival. The case study revealed a strong commonality of interest between the commercial institutions and the growers as a strong coordinating force. Together, they are engaged in a highly creative effort to find ways to satisfy the criteria of the Plan. But specialized niches such as market gardening in the Koekoekspolder seem to have to find their own solutions.

The commonality of interest with farmers does not seem to extend to the actors who operate within the ambiance of government. Given the dwindling resources the EC and government are willing to make available for agriculture, these actors are squeezed and engaged in battles for territory which reduce their integration and co-ordination within the knowledge system. Thus IKC has been given the mandate to act as a second-line institution which does not deal directly with growers and farmers (thus avoiding the territory of DLV). This mandate does not allow essential participation of growers in extension programming, as we have observed. AETCs, ROCs, DLV and SEV struggle to retain their separate identities, although their division of labour and funding undermine the reason for their separate existence. The struggle affects essential linkages, prevents synergy and reduces the capability of the knowledge system at the very time an optimal performance is required.

This situation is aggravated by the semi-commercial technology transfer model which has been imposed on IKC and DLV in the context of ‘withdrawing government’. Also, the ambivalent position of DLV as a private foundation, but still largely paid for, and ordered about by, the Ministry, has severely hampered the emergence of a client-driven role for extension which fits the new situation. Instead of being sensitive and responsive to growers’ needs, DLV is forced into a role which so far seems incompatible with the situation created by the Plan and other laws.

Notwithstanding farmer representation in all the relevant places, countervailing clout of the clients of the knowledge system to remedy this situation is strangely lacking, presumably as a result of failure to appreciate the kind of knowledge system performance which would be in their interest. But the case study suggests that growers are willing and able, often with energy and enthusiasm, to search for more sustainable methods of production in the new context created by environmental regulation . . . a resource so far insufficiently tapped in order to develop a knowledge system supporting more sustainable forms of agricultural production in the Netherlands.
Notes

1. Synergy means, in a nutshell, that the whole is more than the sum of the parts. A system has 'emergent properties' which cannot be understood from the properties of the parts (Checkland 1981). These properties emerge when there is synergy between the parts. A heap of spare parts does not show synergy.

2. The article is based on an unpublished case study (Roling 1992a) which was carried out in the summer of 1992 as part of a training exercise with international students following the International Course on Rural Extension (ICRE) of the International Agricultural Center (IAC) at Wageningen. I am indebted to Mr A. Beldman and Ms J. Buter for setting up the exercise and collecting many of the data used, as well as to the participants who helped me see what was going on. They are Hajem Halesah (Jordan), William Santor (Malaysia), T.J. Gopal (India), Wafa Dikah (Lebanon), Tossaporn ‘Ban’ Sariyant (Thailand), Kuang Hong Min (China), Muhammed Tahir (Pakistan), Abdul Jalil Bin Ibrahim (Malaysia), Jaap van Driel (Netherlands), Rahmattullah Khan (Pakistan), Lersiri Lamwilai (Thailand) and Martin Muwereza (Uganda). I would like to thank the IAC/ICRE, and particularly Mr. M. Lanting, for the opportunity provided. Ms J. Proost, Mr J. van Driel, Mr P. van Tilburg, Mr P. Engel, Dr N. Somers and professor C. van Woerkum have kindly provided constructive and helpful comments on earlier drafts. Of course, the author remains entirely responsible for the views expressed.

3. Rapid Rural Appraisal refers to a toolbox of methods which have developed in the search for alternatives to random sample surveys and other expensive and time-consuming methods of social research. Usually RRA relies on the active participation and understanding of local people to develop a rich picture of a problem situation with respect to rural or farming system development or natural resource use (see McCracken, Pretty and Conway 1988).

4. The Inter-ministerial working party included the Ministries of Public Housing, Spatial Planning and Environmental Management; of Welfare, Public Health and Culture; of Social Affairs and Employment; and of Agriculture, Nature and Fisheries. The very fact that different ministries were involved is significant: crop protection had become an issue which could not be left in the hands of the Ministry of Agriculture. It was no longer a question of changes which were feasible for the agricultural industry, but of hard targets imposed by non-agricultural interests, regardless of the consequences for agriculture.

5. Different approaches to pesticide reduction can be distinguished. In conventional farming, pesticide application is routine, calendar-based, preventive and often high as an insurance. 'Guided control' means that pesticides are applied on the basis of careful scouting, involving considerable knowledge of symptoms and contingencies (weather, crop variety, etc.). 'Integrated Agriculture' or 'Integrated Pest Management' emphasizes the use of biological controls with chemicals as a last resort. 'Biological or ecological farming' rejects all use of industrial poisons.

6. Chicory roots are produced by arable farmers on light soils. These are bought by market gardeners and kept in cold storage. The roots are subsequently used to pull shoots which are sold as a vegetable which can be cooked or eaten raw in salads. The crop has become very popular especially as a winter vegetable. Pulling of shoots takes place without soil in stacked containers in special barns in which temperature and humidity can be controlled. The roots grow in circulating water, premixed with nutrients and fungicides.
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