

**Research, Education and Innovation:
vital driving factors in agriculture**

by

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Decision-making framework for Agriculture in 21st century

Case: The Netherlands within an international context

At the turn of the 21st century, as director of the Agricultural Economics Research Institute LEI of Wageningen UR, I stated that for the future direction of research: "current thinking regarding agriculture and its setting must be placed within an integrated social, economic and ecological context. In my opinion, the important things are corporate social responsibility and socially responsible action." This needed to lead to "the creation of value on all three axes or dimensions – economics, ecology and social norms and values – which thus provides the decision-making framework" for every actor within and outside agriculture.

In those days, thinking in the integrated social, economic and ecological context – also known as the three P concept: Profit, Planet and People – was still in its infancy. The fundamental frame of thought was that of sustainable development with an emphasis on development and not sustainability. The difference will become clear in course of the paper.

Today, the frame of thought for the three Ps and corporate social responsibility has become mainstream (Wempe, 2005) and amongst other things serves to connect the agricultural sector with society in new ways (Wijffels, 2005). Corporate social responsibility also formed the starting point for the recent vision of the Minister of Agriculture, Nature and Food Quality, Mr Veerman, entitled *Kiezen voor Landbouw* ("Choosing Agriculture") (2005). The addition of value to the dimensions Profit, Planet and People by means of balanced development will result in an increase in welfare for society in general and for agriculture as well. According to a line from the anthem my native Province of Zeeland: meaning "and welfare crowns the farmer's work."

I would like to briefly focus on the individual words of this theme:

Welfare): the *raison d'être* of economic sciences arises from the great significance of social welfare issues for human life, in particular the use or allocation of scarce resources and the distribution of the results. This fits in well with the integrated approach of Wageningen UR and others to technological and social sciences.

The farmer's work): not only the production of agricultural products, but a conscious choice – from multiple possible functions – of agricultural enterprises as part of chain-like or network-like structures in a natural environment.

Crown): "crowning with welfare" goes much further than financial rewards and, due to its relative character, is solely related to the positioning of agriculture and farmers within society. In short, alongside financial values, social appreciation is also important for the farmer as it is for every citizen.

The differences in welfare between people, enterprises, sectors, regions and countries (or blocks of countries) appear to be an important motive for the entrepreneurship and actions of actors, promoting and bringing about large-scale and permanent dynamism in businesses and policy. The three P concept and the concept of corporate social responsibility also provide the desired objective with the context and rules of play.

Current situation

Before we consider the prospects for the sustainable development of welfare within the agro-complex and the role of education, research and innovation, it is worth taking a look at the current situation regarding welfare as the crown on the farmer's work. In the Netherlands, the LEI has gathered and processed much data since 1940. During that time, we have observed major differences in farm results with on average moderate remuneration for the production factors of land, labour and capital. The differences between enterprises within the same sector as well as between the sectors are very large. These are all reasons for dynamism, and that dynamism is visible too, albeit too limited as yet. Measured in absolute terms, the family farm income of 30% of farms in the Netherlands is below the minimum wage level and, in terms of development, now lags far behind Dutch Small and Medium-sized Enterprises, having exchanged its unique top position for a place within the leading group in the EU. Little therefore seems to have come of the realisation of the objective of many farmers to have at least a fair share of the welfare of the Netherlands. However, this is often considered to be a conscious decision of entrepreneurs on farms with no successor, for example.

Also applicable to other countries, this generic impression of major differences in income as a component of welfare in cases of low remuneration for the production factors of labour and capital is typical of agricultural development that is structurally lagging behind in terms of its technological economic strengths (Ritson, 1977). In recent decades, a potentially higher level of welfare per person due to the use of production factors that are lowly remunerated within the entrepreneur's own enterprise, for purposes outside the enterprise has produced a continuous decline in the number of enterprises. The decision to close down the enterprise has so far seldom been forced. Instead, this has generally occurred upon the transition between generations, and this is still the case today. The decline in the number of active enterprises is logical and can be interpreted as positive.

For many, the phenomenon of around ten enterprises closing down every day gives a negative impression of the agricultural sector, as if this indicates the departure of primary agriculture from the Netherlands. The picture that we see, however, is that the volume of total national production remains approximately the same and therefore that a reduction in the number of enterprises indicates continuing increases in scale per enterprise. The eagerness to continue farming is also expressed in the prices of scarce means of production like land, quotas and production rights. These prices are very high compared with other countries. This indicates that many entrepreneurs estimate their own prospects highly or that the non-financial aspects of farming are very highly valued.

Prospects

The very large differences in business prospects arise due to the big differences in quality of entrepreneurship and management. Many studies were published both before and after my PhD thesis on the causes of differences in farm profits (Zachariasse, 1974; Poppe and Van Meijl, 2004). Combined with innovation and possibly with technological developments, the driving forces behind the necessary renewal are made visible.

Such innovative developments are particularly impressive in greenhouse horticulture in the Netherlands. Problem areas in Planet and People aspects are tackled and resolved systematically. Dependence on the health of the soil, the chemicals and energy used, as well as the human factor in assessment and management, are being reduced more and more. The greater speed and consequences of technological developments are a current and continuing reason for major adjustments (information technology including robotisation, biotechnology, etc). The development of new materials is part of the reason behind the emergence of the concept of the bio-based economy. The exploitation of new technologies will result in economies of scale and thus promote the development towards large-scale enterprises (greenhouse horticulture and dairy farming). This will continue to be a prominent trend for (Dutch) agriculture and horticulture in the coming years.

The biggest challenge and now a predominating trend in the prospects of the agricultural sector still lies in the repeated realisation of a sustainable social and technologically-based balance between economics and ecology within a context that stretches from business to global level.

The foundations of that balance lie in our norms and values, in other words the way in which we and other people think about society and technological development. Those norms and values have not been indisputably scientifically or socially proven; they change over time. It is therefore a dynamic balance, dependent on the dynamics in our own thinking and appreciation and those of other people. That is why I am not talking about sustainability but rather about sustainable development. Due to changing insights (norms and values), it would actually be better to talk about developing sustainability and concepts of sustainability than about sustainable development (Douw, 2005).

The key words 'space', 'strength' and 'power' occur when exploring the prospects for the future development of welfare. It is not just acquiring space in the market and one's environment under one's own steam that is important, but also the voluntary or compulsory relinquishment of that space due to negotiations or competition. It's about changes in relationships between parties and, sooner or later, this will lead to changes in institutions.

Market organisation and international competition

The discussion about a world trade agreement revealed that the shrinking but increasingly capital and science intensive agricultural sectors will need to conform more and more to the interests of other major economic sectors. After all, the total effect on welfare of the liberation of trade is great.

The liberalisation of agricultural markets produces greater effects on welfare, particularly in the EU, Africa and a large part of Asia. The distribution of the effects on welfare impacts differently on developing countries.

The trend towards the further liberalisation of the markets explicitly sets the tone due to the effects on welfare. It has not yet led to free competition in agriculture. EU decisions relating to agricultural policies ensure that prices increasingly approach the expected world market price level. Consequently, the EU external border protection will continue to exist for the most important products, albeit at an increasingly lower level, and its role will become more of a safety net for crises. With regard to the prospects, a great deal therefore depends on the future development and distribution of global welfare.

In any event, agriculture and horticulture in the EU will need to gear themselves more towards a larger global market and competition. This will lead to increased pressure to expand enterprises, as this is the greatest weakness of European agriculture in terms of international competition.

Supply and demand on the agricultural product market

On a global scale, there are many interesting developments in the field of the demand for foodstuffs along with the issue of the extent to which local agricultural sectors can satisfy that demand. Technically speaking, the world food issue can certainly be resolved, but the solution will principally need to be found in the intensification of investments in infrastructure and knowledge rather than through expanding the cultivation area.

The market consists of a large number of submarkets with inconstant consumers who develop their own lifestyles and eating patterns. The method of production – by which I mean environmentally-friendly and animal-friendly – is becoming an increasingly important precondition. The desired sustainable production does not therefore always encounter the same level of sustainable consumption. Consumers and producers, initially grafted to each other, have grown apart due to individualisation and chain formation

The now frequently visible distrust on the side of the consumer/citizen could be converted into trust and appreciation by means of transparent certification systems.

Organisation and financing of the production chain

Increases in scale and internationalisation are continuing trends, both in the food industry and in the chain store sector. This development also concentrates the market power in a limited circle and requires similarly concentrated counterbalance or counterforce.

A connection to the varied desires of the various international markets and regions is needed. Market segmentation and production differentiation are the key words here. New sales patterns and institutions are necessary. Production chains and networks create a profile for themselves. The farmer's share in the consumer Euro is declining further and further. From a micro-economic perspective, this appears to be virtually inevitable.

However, the core question for many farmers and horticulturalists is still how a larger share of the added value in the production chain can be obtained. In my opinion, this is only possible by making risk-bearing investments in the links that are closer to the consumer, which receive a considerably larger share of the margin and generally more than cover their costs. Production chains that are still

regional or national will become international. As a result, cooperatives can ensure attractive supplements on top of the normal payment price (for example 4-5 cents on top of the milk price). Through downstream integration as far as the retail links of the chain, as done by a cooperative in the Netherlands, the margin in the total value chain is brought within reach of the collective of primary producers. Clustering creates strength and power, whether through the regrouping of collectives or not.

Tension between market and regional policy: from agriculture to rural entrepreneur

However, this pressure towards enterprise expansion seems to contrast with the objectives of the EU Committee for rural development.

In the past decade, a clear preference has become evident within the EU for a further decoupling of the market and incomes and using the instruments to promote stronger competitiveness on the global market and in rural development. Clearly, this should be accompanied by lower intervention prices. Part of the compensation for the lower prices will come from farm payments. However, these will increasingly be linked directly to efforts concerning the product nature and landscape (cross compliance). The farm payments will thus become a type of business reward for the efforts made by farmers to look after the product nature and landscape. From a communicative perspective in particular, it is important to interpret farm payments – which are partial compensation for the reduction in prices – as payment for the production of a product. After all, nature and landscape are collective goods; they must therefore be treated and valued as such, and this is no longer possible by means of the world market prices for agricultural products. Therefore the income of many farmers must not and cannot be earned solely through payments for their agricultural production function.

The self-evident autonomous and primarily production and productivity oriented technological economic development is becoming increasingly differentiated into separate business and rural functions. The number of possible functions besides the primary agricultural production function is continually rising. This concerns the so-called secondary functions of the agricultural sector: providing for nature, the landscape, residential space, recreation, water management, birds, biodiversity and cultural history, etc. Our research has revealed that the benefits of the secondary functions are generally much higher than their costs, but are not distributed in proportion to investments and efforts. New arrangements between the parties must create a win-win situation, whereby the secondary functions can gain more content and consequently create even greater effects on welfare.

Thanks to better interpretation, we therefore have a fast growing palette of primary and secondary functions in the rural area. New opportunities are arising. Influenced by the high oil prices, an important role as an energy supplier is within reach of the agricultural sector. In our exceptionally energy-dependent society, this could contribute to the appreciation of agricultural activities and therefore to the creation of a positive image of these activities.

Furthermore, agriculture could act as a supplier of raw materials to the chemical industry to a greater extent than is currently the case. Possibilities include fibres, washing powders, plastics and new materials.

Complete biodegradability of production and product remnants could ultimately lead to relatively attractive social costs, resulting in a "Green Cycle."

There are still many technological, economic and administrative issues in this field to be solved.

At the same time as this separation of functions is taking place, market orientation – or the focus on rewarding activities in these various functions – is increasing. New arrangements between cities and their surrounding areas will mean that the maintenance and use of so-called collective goods will be more subject to market forces where possible. Thus the farmer will gain an important multifunctional role in the rural area. He will become a rural entrepreneur, able to optimise all possible options relating to the intended goal function "the exploitation of space."

This creates scope for integrated rural development.

Conclusions on the decision-making framework for agriculture

It is clear that there will be great diversity in sets of preconditions for – and in – the manifestation of primary enterprises. The more varied and precise formulation of the preconditions will be provided both by society and the political world on the one hand (through management agreements, "environment products" and "landscape products") and by the market on the other hand (controlled specialities). The farmer can choose and try to optimise his enterprise within the thus accepted set of preconditions.

This is also where the decisions and actions of entrepreneurs meet the economic, ecological and social milieus. Entrepreneurship is therefore a private-public activity in a social function.

The decision-making framework for this creation of added value in these economic, ecological and social dimensions has scarcely – or not yet – been elaborated in optimisation methodology. We do

measure the effects and results, for example in the Sustainability Scan, but there is as yet still no real optimisation. This remains a challenge for fundamental research.

On the one hand, choosing a link with chains and with the environment means restrictions. On the other hand, however, this means protection and/or rewards. Since Porter (1990), we are aware of the importance and the impact of the total complex as an entity. In addition to the natural conditions, man-made factors are also of great importance: governments, the knowledge system and the total network structure (the so-called system determinants).

Running an agricultural enterprise, whatever the set of preconditions, continues to demand a certain level of professional skill and entrepreneurship, and in principle does not change or differ in terms of the degree of difficulty according to the set of preconditions. The field of tension between the farm-economic patterns regarding the scale of production, for example, and the contribution of personally determined preconditions (free time, business philosophy, etc) will also continue to exist. Moreover, one can assume that despite the growth of the individual enterprise as indicated above, the common European agricultural model – with its primary production enterprises, largely manned and financed by the family (low-priced transference of the enterprise) and relatively small scale compared with the surrounding large-scale supplying and processing agribusiness – will retain the advantage in the land-based sectors for the time being. Principally caused by the rapid developments in scale size in glasshouse horticulture, for example, but also in other sectors, increasing dynamism is also evident in this regard. This means new challenges for monitoring and research.

There are also many changes in the position and role of governments. Both international and domestic factors affect agricultural policy in the various countries (or blocks). Interventions in the agricultural sector are taking place almost without exception, but with great variations in intensity and success. This gives these governments great influence over the international development and distribution of welfare. This is also the reason for the many consultations and negotiations at various aggregation levels. In general, governments want to withdraw more, leaving the different market parties in the market and society to arrange matters by means of self-organisation. In this respect, the decision made by the Dutch Minister for Agriculture, Nature and Food Quality is important. By choosing a shift from "taking care of things" to "making sure of things", the notion of "regulation where necessary, and focusing on facilitating" will be even more applicable. Thus the Minister reduces or shrinks the legal framework and provides more scope for corporate social responsibility as implemented in the enlarged scope beyond the statutory scope (Diederer, 2003). Behaviour within that scope arising from the self-organisation of the entrepreneurs concerned will primarily be assessed by civil society representatives like NGOs and monitored by the governments. Social

interest in production methods will gradually increase (NRC, 2005). Due to the trend towards the humanisation of animals, this particularly applies to animal production and could lead to alternative or identical forms of production, such as additional payments for "cows in the field."

I hope I have made it clear that there are certainly prospects for entrepreneurs in the agricultural sector under certain conditions. As entrepreneurs, they actively interact with their environment: society. By focusing on the aspects of Profit, Planet and People in a balanced manner within their enterprises, they can acquire a "licence to produce", giving them not only income and capital (value) but also the desired social position (appreciation). In short, I feel there are sufficient prospects to ensure that "welfare will crown the farmer's work" in the future too.

To conclude: earlier, I stated that space and the relationship between strength and power are key concepts when exploring the prospects for the future development of welfare. Taking a view of everything in the market, environment and society, the situation may be complex for many people. However, for entrepreneurs focusing on the future and the space, there are opportunities to achieve a good balance between strength and power.

A challenging environment for the farmer

This is the challenging environment for the farmer of today and tomorrow. The farmer must confront this situation with the combination of skills, management and entrepreneurship. Because of the increasing uncertainty at the more macro level, there is a clear trend towards more emphasis on entrepreneurship. "Where to go" is becoming more relevant than "how to get there". To cope with all the relevant and often uncertain aspects within these three tasks, the farmer needs more information in order to reduce uncertainties and risks of wrong decisions and activities. It can be stated that the knowledge intensity in all tasks has increased considerably in recent years. One of the reasons for this is because of the requirements to document and report all inputs and events in the production process for quality schemes and government regulations. An ever growing number of tools are offered to the farmer to facilitate the decision-making and administrative process. Research institutes play an important role in this type of transformation of knowledge for use at the farm. More may be done as will be reported later in this paper. To acquire and use this information and tools, the farmer needs education and training. The normal period of schooling will no longer be sufficient for the whole professional career; permanent lifelong learning has become essential for the modern farmer.

The Education, Research and Innovation triangle

This brings us to a closer observation of the education, research and innovation triangle. Together they may be regarded as the blades of a propeller that when correctly positioned may help to achieve a higher level of operation and performance. One can speak about knowledge chains with different links when education and research are regarded separately. In education we see the primary, secondary, higher and university level' and in research a distinction is usually made between fundamental, strategic and applied research. In the past, we used to see a kind of sequence in education and research and distribution by the extension to the farmers' level. Because of the higher education level of most farmers and due to the introduction of wireless access and transfer of knowledge and information in any place in the world, the typical knowledge chains are transforming into knowledge networks. This has produced more interaction between parties in education, research and - increasingly important - Practice. The more important role of Practice is the logical consequence of developments in the production chains and networks and the gradual withdrawal of governments in certain parts of the knowledge chains. Patterns of lifelong learning, public/private partnership in education and to an increasing extent in research and in co-innovation are developing in many countries around the world. These developments in the knowledge network must serve - to propel - the required developments in skills, management and entrepreneurship as it is the core of this paper.

Education

Starting with education, lifelong learning is vital. For skills and management, i.e. 'to do things right', competence learning is the new trend. This is the direct interaction between theory and practice that should lead to better understanding and capabilities. Development and training for entrepreneurship that is 'to do the right things', must also be a joint effort of education, Practice and very often research as well. Broadening the scope by meeting successful entrepreneurs inside and outside agriculture is essential.

One might say that conceptual thinking and acting in systems or models representing the issues in all three tasks of the farmer is required and that frequent up and down scaling of thinking over these domains form the real professional. Thus the farmer may cope with the increasing uncertainties and requirements. It is the exchange of risk and uncertainties by knowledge and the right treatment of public/private insurance opportunities.

Obviously, the perception of risk and uncertainties depends on the overall entrepreneurial climate. There is a major difference between the type and ranking of risks and uncertainties between the dairy

farmer in New Zealand and their EU counterparts. For an entrepreneur in a relatively small country, heavily dependent on the world market and relatively far away from consumers, international aspects like exchange rates, animal diseases and transport costs have high priority and impact.. Changes in product prices, the world economy and the political situation coupled with the increase in the risk perceived by changes in interest rates, reflect the fact that farmers fully acknowledge the free economic environment in which they operate and that changes worldwide may affect their business. Accidents, health problems and debt management were second and third in ranking and are related to the dependence on worldwide marketing and monetary situations and to the increase in scale of the operations of many New Zealand farms particularly on South Island (Pinochet-Chateau et al., 2006). Developments in education in agriculture towards lifelong learning produce more public/private partnerships. It also means that facilities to practise theory must be available in schools or in the direct environment. As I wrote in my PhD thesis, even farmers with proven success should be involved in the classroom or school facilities, as well as demonstrating their decision-making skills on their own farms. With regard to new technological developments, the ongoing adjustment of farms offers a much more state-of-the-art stage than schools or universities can ever provide. To learn about the background of such new investments and the fit within the farm or chain operation grants access to the so essential conceptual way of thinking. More and more often, these farmers are being remunerated for their efforts. Thus, skilled, successful farmers are becoming part of the agricultural education network for teaching and are demonstrating what the combination of skills, management and entrepreneurship means in modern agricultural enterprises. With easier access to research(ers), close cooperation is also growing between education and research. In the Netherlands, we are seeing increasing cooperation and exchange of capacities. Lifelong learning and the interaction between education, Practice and research can be regarded as a very prominent part of the knowledge of the future knowledge distribution system.

Research

In the research domain, we notice an internationalisation or even globalisation of the 'research market' and a greater impact of the production chain on the programme. In particular, multinational companies 'shop' around the world among the different centres of excellence. Because of the concentration into bigger international and therefore fewer only at national level operating production chains, these international companies are showing more interest in the research agenda of formerly only by government funded research centres. Consequently, partly due to the withdrawal of government, government budgets tend to go to fundamental and strategic research, while industrial

budgets fund applied research. A clear example of this is the situation in the Netherlands, but the same applies to Germany and other countries.

In the Netherlands in the period 2004-2007, fundamental research (knowledge base) in the Wageningen UR institutes increased from 17 to 35 million Euros, while the more applied policy-oriented research declined from 80 to 60 million Euros. Within the applied policy research sector, the applied research for the primary sector declined even further on behalf of the policy research of the Ministry itself. At the same time more funding was available for the statutory tasks of the Ministry, such as the Farm Accountancy Data Network for EU obligations.

The use of research in real policy by governments is rapidly gaining priority. The Netherlands provide a good example. It starts with the organisation of the themes and programmes. In recent years, the involvement of policy makers in the Ministry and their interaction with researchers has intensified considerably. The total domain is divided into 10 clusters. Steering committees from the Ministry, including representatives of Practice, decide on annual programmes of various projects. For the programming of its fundamental/strategic research, Wageningen UR itself takes the lead. Every year, it organises strategic conferences for researchers and stakeholders from the Ministry, industry, Practice and NGOs. The programme is drawn up by Wageningen UR and is regarded as the R&D part of the work.

In the procedures to decide on the programmes for applied research, the orientation on direct demand is emphasised by the measurement of client satisfaction at programme level and by measurement of the transfer of knowledge at project level.

The following criteria are used to measure the satisfaction of direct and indirect clients: 1) relevance for MAFF policy and society, 2) carry-over of knowledge to users and 3) quality of output. A high score on these criteria is an important recommendation for researchers and their institute in their bid for future programmes.

By measuring transfer of knowledge through the criteria 1) contribution to discussion within MAFF 2) underpinning of policy choices, 3) use of results in policy choices and papers, 4) use of results in policy discussions outside MAFF and 5) use of results in consultations with NGOs and industry, the emphasis on utilisation is obvious.

Because of declining government budgets for research, the universities and research institutes have had to show more entrepreneurship for acquiring research contracts in the market. In almost all countries, it has become normal practice for researchers to do this. Wageningen UR has been quite successful in this respect. In recent years, some 120 million Euros have been financed by the EU

Commission, international and national industry, other Ministries than MAFF, NGOs and international organisations like the World Bank, FAO and international funds. A growing number of programmes are financed by several stakeholders together in public/private partnerships.

The main trends at this demand side for research are:

on the government side

- more Ministries want to and usually do participate in integrated issues;
- more separation between programming and capacities;
- more focus on intensive interaction between policy and research;
- opening up of former national research markets for international cooperation or even competition.

and on the industry side

- diversification of (inter)national knowledge sources: shopping around the world;
- development of in-house knowledge management by
 - filling gaps in one's own knowledge puzzle;
 - requesting tailor-made, often exclusive knowledge.

For research close to the user who is often the financer at the same time, the ultimate independence of the research is extremely important for the status of the researcher and the research institution in the long term. Particularly for Ministers who tend to focus more on the relatively short term, it is important to play the research game according to the well known rules of intellectual independence.

Examples in research and education

Many interesting examples can be cited with regard to recent developments in research. In this paper, examples from the Netherlands, New Zealand and Australia will be mentioned.

Recent developments in the Netherlands on entrepreneurship are:

- the establishment of a national Consortium for Entrepreneurship. The leader of the consortium is the National Farmers Organisation LTO. Partners are Rabobank, Wageningen UR, Agribusiness Cooperatives, the Young Farmers Network and the Ministry of Agriculture. The aim of the Consortium is to create awareness for and improvement of strategic choices among agricultural entrepreneurs by A) empowerment of entrepreneurship throughout the production chain, B) goal-oriented cooperation through joint investment in R&D and stimulation of innovations and C) coherence in approach to development of instruments and tools for

empowering entrepreneurship and assessment and certification by the Consortium of projects and tools for improving or assisting entrepreneurship;

- the formation of the Wageningen Agrocenter for Sustainable Entrepreneurship with an emphasis on strategic choices for future development of the farmer, the enterprise in its economic and social environment and 'training of trainers' for transfer of tools to Practice;
- regional knowledge centres or clusters to combine efforts from research, education and industry are in progress. They will provide facilities for stakeholder meetings to promote contacts. The centres will be important in the context of lifelong learning for early and late adopters who want to acquire information at a 'short distance'.

For management development, the following may be mentioned, among others:

- the public/private partnership on 'Science-based knowledge in the field' for arable farming. This 8 million Euro programme is financed by the Ministry and industry on 50/50 basis and aims at the transfer of 'Wageningen knowledge' in management tools for direct use on the farms. The processing industries at the end of the production chains have contributed the 4 million Euro co-financing in order to streamline the production in quantitative and qualitative terms. The initiative for this programme came from the director of the biggest arable enterprise in the Netherlands, the 1,700 ha Wilhelminapolder, in a meeting with the Minister of Agriculture. The programme will take four years;
- the Dairy Academy. In a programme mainly financed from special funds of the Ministry in the initial phase but which must become self-propelling later on, knowledge is exchanged among farmers, i.e. farmers learning from each other. In very inventive and original ways, farmers meet each other. Other Learning Networks have also been established by Practice, often in cooperation with research and education.

For innovation purposes in some branches:

- specific institutions have been established. For example in horticulture, the innovation organisation SIGN has initiated the search for an energy-producing glasshouse. Prototypes are now being tested in practical conditions and the prospects are very promising. In dairy farming, the new organisation Courage is working on innovative dairy systems. These new organisations are public/private partnerships with a clear lead from industry.

Very interesting examples can be mentioned from New Zealand and Australia.

In the very important dairy sector in New Zealand, forces are bundled in:

- dairy 21 'a peak body with membership from Fonterra, Livestock Improvement, Dairy In sight, Dairy Companies Association of New Zealand, Dexcel and AgResearch'. Together they make up the 'Strategic Framework for New Zealand's dairy farming and industry 2005-2015. Clear and smart goals are set for the future and the plan heavily relies on feedback from researchers, consultants, agribusiness and farmers. The Strategic Framework is to guide all investors and providers regarding the priorities set by the dairy industry to attain its productivity and production goals. Environmental sustainability, the Farmers' adoption of technology and knowledge and the farmer's and company goals are all addressed in this overall sector plan. Partly due to the exceptional position of Fonterra in the New Zealand's' dairy sector, this type of sector plan relating to education, research and innovation, among others, may be expected in more countries and can be regarded as the ultimate phase in development of public/private partnerships, the more so since it is backed by financial sources from the whole sector. The time horizon is set at 10 years with flexibility on actions in the shorter and longer terms.

In Australia several initiatives have been taken. In:

- creating our Future, the Agriculture and Food Policy Group reported in 2006 to the Minister of Agriculture on the principal issues and challenges for the sector in the next 10 to 15 years. It concerns four main parts: markets, competitiveness, natural resources and adapting to change. It is a joint effort by all stakeholders in Australian agriculture with special focus on innovation and marketing, effective supply chains, reduction of 'red tape' and emphasis on communication public/private partnerships;
- national Research Flagships, a programme launched in 2004 for a 10 year period, with priorities in research in: food, health, water, energy, light metals and oceans with priorities in each of these areas. In the Food Future Flagship, these are: advanced Genetics, Breed Engineering, Consumer Engagement, Innovative Processing, Quality Biosensor and Value Chain improvement and integration. It is a huge programme designed and financed by government, industry and the research community. International partners are welcomed.

In all three countries, banks are active in the development of entrepreneurship:

- Rabobank Netherlands with courses on succession. Part of the course is a psychological test of the potential successor to learn about his 'future learning curve'. The programme was developed

in association with Wageningen UR – Agrocenter for sustainable entrepreneurship and Young Farmers Network;

- Rabobank Australia New Zealand with extended courses. Both the Farm managers Program and the Executive development program (strategic leadership) are open to participants from both countries and although fairly costly, they are well booked. These programmes were developed in consultation with the University of Queensland;
- ANZ in New Zealand has a course on Entrepreneurship together with Massey University, Auckland University and Melbourne University

Innovation

Innovation is important to obtain a competitive advantage and to earn above average profits (Poppe and Van Meijl, 2004). They show that there are relatively few in house research activities in agricultural holdings except in the Dutch glasshouse horticulture sectors. In these sectors, in-house research is required to create new varieties; in floriculture alone, some 800 new varieties enter the market each year! Because of the relatively small scale of primary farms, they cannot usually afford extensive innovative research. Adoption of technologies developed elsewhere and cooperative research are the main strategies in this sector. It is very interesting to see that sectors without (much) market regulation very often show much more innovative behaviour than sectors with heavy market regulations. Examples are the Glasshouse horticulture sectors in the Netherlands which has a really amazing innovative attitude and the Dairy sector in New Zealand. There is usually less innovation in uncompleted chains. The different links tend to compete more with each other than cooperate in their struggle for added value. As seen by Fonterra, for example, a chain needs a clear leader to organise and direct the innovation process.

Innovation is often induced by circumstances. Famous examples are the innovations in tomato varieties after the Dutch tomatoes were qualified as water bombs in their main market Germany. Increasing differences in income may signal innovation and adjustments too. Again in Dutch glasshouse horticulture, a new wave of innovations is taking place because of the high oil/gas prices for new energy concepts and because of rich opportunities involving the robotisation of logistics in the production process to rapidly scale up operations up to a glasshouse of about 100 ha.

A notable feature of the new innovation processes is the declining role of extension services. The main reason for this is the new networks of knowledge distribution with direct access to researchers by innovation-oriented farmers. This even more the case as it is usually the bigger farmers who are

most involved in innovations. On account of their position and behaviour in the knowledge network, it seems that the position of non company-related extension services is deteriorating.

Van Galen and Bunte (2003) found that the innovative capacity (measured as introductions of new machinery or other input in the Netherlands or of a new market concept) was limited to approx. 3% of all holdings. However, looking at the Dutch sector as 'one company', this means 3,100 innovations every year. A comparison with companies of the same size may be made. Usually the investments have an incremental character, in particular in the mechanisation of the production process. Innovators handle more radical innovations and see a greater effect on profits and market share. The authors found (again) that adoption follows the well known S-curve. The most important bottlenecks for innovations were uncertainty on government policies with restrictive policies and high costs in second and third place. The first is most important for innovators since they usually have the ability to find solutions for the other two.

Diederer, Van Meijl and Wolters (2002/3) found structural differences between front runners and laggards in innovation and adoption. They found that innovative farms are larger, have more market power, show clear entrepreneurial behaviour, are well informed and their operations grow faster than the non or less innovative farms. Innovators do not differ much from early adopters but they are usually more eager to acquire knowledge: they make more use of external sources of information and are more involved in the actual development of innovations.

The same authors found that adoption behaviour depends on more farm characteristics than size and market power alone. The innovative farmer is usually quite young and the cash flow is better developed than the solvency of the farm. The latter shows higher investments and loans. Besides environmental and information characteristics, persistency in innovative involvement is a clear behavioural characteristic of the innovator.

Conclusions

Important developments and changes in the knowledge chains and networks do occur in agriculture. Education and research have become much more demand driven by government and industry. The involvement with payment of successful farmers in the education and training of skills, management and entrepreneurship to future farmers and colleagues shows the high level of education and performance among farmers today. Consequently, the production chain has had an increasing impact on applied research and is a result of the partial transfer of government budgets from applied to more

fundamental and strategic research. These developments in the knowledge network have caused a declining role of the extension services.

New systems of distribution of knowledge and information are developing. An important feature is the 'shortening of distances' between the actors in the knowledge network, in particular between the front runners in the primary sector and the researchers. The 'Ivory Tower of universities and institutes' is being rebuilt into an 'open house' by openings through internet and personal networks. New types of learning networks are developing for the early and late adopters by internet, but also by academies, master classes, group networks and regional knowledge centres where representatives of education, research and innovation will meet each other and students and farmers as well. Because of these new types of distribution of knowledge and information, the role of the traditional extension services is declining.

Direct access to knowledge and information is vital for performance, development and in particular for innovation. The innovation process is greatly influenced by the overall entrepreneurial climate of policies and society. A transparent agricultural production and marketing process and good communication is required to act in a balanced economic, ecological and social way in order to add to individual and social sustainability.

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