

Workshop 2: Farming and Rural Systems Methodologies

Using a systems approach to better understand the functional relationships between product innovations in agriculture and rural development

by Karlheinz Knickel

Abstract

This contribution deals with the role of agriculture in rural development. The following questions are addressed:

1. What could be the meaning of sustainable development of agriculture and the rural environment?
2. How can product innovations in agriculture address new societal needs?
3. Which *raison d'être* does an 'innovative' agriculture provide in environmental and social terms, and equally as an economic activity?
4. How can agricultural policy contribute strengthening the role of agriculture in rural development?

In the paper the actual and potential impacts that product innovations in the agricultural sector can have on rural development are examined and compared with the impacts of 'mainstream' production agriculture. It is examined in this context whether rural development will give rise to a multifunctional agriculture. The discussion draws on examples at the farm level and the regional level. The different dimensions of sustainable development are taken into account with a focus on the generation of agrarian income and employment as indicators of the socio-economic reinforcement of the rural economy.

In the analysis it is tried to assess the mechanisms of rural development with a focus on the role of farm families and innovations that are closely related to agriculture. The focus on those aspects that originate in and/or rely to an important extent on agrarian enterprises allows to obtain a clearer view of the possible contribution of agriculture to the process of rural development. Two case studies are used for an in-depth analysis and documentation of the functional relationships between agriculture and rural development. They are: (a) '*Rhoen-gold* dairy and organic farming'; and (b) 'Energy crops in Mecklenburg-Vorpommern'. The data given in the paper are derived from a corresponding EU funded research programme, the FAIR-programme "The Socio-economic Impact of Rural Development: Realities & Potentials".

In the case studies a transdisciplinary, systemic approach is used. The identification of key interfaces between different sub-systems and processes, and an in-depth analyses of linkages are seen as major opportunities for inter-disciplinary research and for organising the communication and exchange among different disciplines. The analyses presented in the paper illustrate how different disciplines allow different views of the same research questions and how the different views complement each other. The conceptual background of the research presented in this paper has been described by Van der Ploeg et al. (1999).

Concepts and policies related to the sustainable development of agriculture and the rural environment

A vital countryside is crucially dependent on a dynamic agriculture

Agriculture still is the predominant economic activity in rural areas and it has a considerable impact on both, the rural environment and RD. Environment in this context includes all aspects of the natural environment: bio-diversity, habitats, and resource protection, but it also includes landscape and other heritage features like stone walls. RD includes the human population, its life style, employment patterns, income structure and levels, housing conditions, and cultural aspects. People, whether they are living in rural or urban areas, care about the diversity of natural habitats and species, the architectural heritage of villages and the scenic beauty of the landscapes. The diversity of nature and landscapes also provides the most fundamental basis for the development of rural tourism (Knickel & Mikk 1999).

New types of economic activity

The aim to protect and if possible revitalise rural areas is closely linked with the question whether there are new types of economic activity and new ways to reorient and support farms. Obviously there are societal demands for recreative and touristic opportunities, high-quality (and usually 'region-specific') products, a high nature value environment, and, more generally, a vital and liveable countryside. The same societal demands can be understood as new opportunities emerging for farmers and other entrepreneurs in rural areas.

These new demands and new opportunities are so important because globalisation processes and the resulting cost-price squeeze are intensifying the pressure on farm families, the environment and resource use. The general trend is that total gross agricultural product is, for a multitude of reasons, stagnating while overall production costs are rising.

New priorities

Society and policy-makers increasingly recognise that a vital and liveable countryside - containing ecological values, cultural-historical, and also contemporary social values - is crucially dependent on the presence of a dynamic agriculture. The fact that RD is high on political agendas, and the way it is put forward reflects that. The broad trend is that agricultural policy moves away from being solely a sectoral policy towards a more integrated policy which contributes alongside other elements of public policy to the development of rural areas. The increased support given to a more environment-friendly and quality-oriented agriculture is an expression of this (COM 1997a,b, COM 1999).

The main objective is to ensure an environmentally sustainable and economically efficient agriculture and to stimulate the integrated development of rural areas. The new EU policy corresponds with the European Treaties, Article 39 of the Rome Treaty, and Article 130a of the Maastricht Treaty. It is in correspondence too with the principles expressed in the Cork Declaration. Regulation (EC) No. 1257/99 for Rural Development and the Special Accession Programme for Agriculture and Rural Development (SAPARD) are a concise expression of this new policy orientation (COM 1998b, COM 1999).

Research questions and approach used in the analysis

The analyses presented here 'zooms in' on the role of agriculture in the process of RD. The key questions addressed with respect to the functional relationships between agriculture and RD are: How can agriculture reorient itself towards new societal needs? Which strategies allow a satisfactory integration of economic, social and environmental needs? Which *raison d'être* does agriculture provide in environmental and social terms, and equally as an econo-

mic activity? How can agricultural policy and the farming communities themselves contribute to providing a future for rural areas? The fact that many family farms survive in the face of constantly changing conditions because they find ways to adapt is an important starting point for the analysis.

A systemic approach is used to deal with these different dimensions, and, more generally, the complexity of the functional relationships between agriculture and RD. Two case studies are used for an in-depth analysis and documentation of the functional relationships between agriculture and RD. They are: (a) Organic farming in the Biosphere Reserve Rhoen; and (b) Energy crops in Mecklenburg-Vorpommern.

The identification of key interfaces between different sub-systems and processes, and an in-depth analyses of these interfaces are seen as major opportunities for inter-disciplinary research and for organising the communication and exchange among different disciplines. The analyses presented in the paper illustrate how different disciplines allow different views of the same research questions and how different views complement each other. The discussion draws on examples at the farm level and the regional level. The different dimensions of sustainable development are taken into account with a focus on the generation of agrarian income and employment as indicators of the socio-economic reinforcement of the rural economy. The conceptual background of the research presented in this paper has been described by Van der Ploeg et al. (1999).

Key interfaces: agriculture, environment, RD

Table 1 provides an overview over nine important areas at the interfaces between agriculture, environment and RD. In the table agriculture is located in the central column in order to illustrate the importance of farming and the agricultural sector for both, the natural environment and cultivated landscape, and the socio-economic development of rural areas.

Table 1: Nine key areas at the interfaces agriculture, environment, rural development

	Environment and nature protection	Agriculture	Rural development
1. Cultural landscape and regional identity	maintenance of natural resources and of the diversity of cultural landscapes (agri-environmental programmes)	provision of support for agricultural marketing projects and product innovations (e.g. processing and marketing of organic milk; new crops, etc.)	short food chains from producer to consumer; high quality food products; regional labels; connecting RD plans with land-use and landscape planning, and with regional (landscape) models
2. Living space	maintenance of habitats; landscape related services; implementation of the EU Flora-Fauna-Habitat-Directive (Natura 2000), etc.	maintenance of the cultural landscape in conjunction with traditional farming systems; integration of landscape related services with other farming activities	maintenance of a vital and liveable countryside; offering of recreative and touristic opportunities; region specific green / rural tourism; maintenance of economic and socio-cultural diversity
3. Environment	protection of abiotic resources (soil, water, air / climate)	development of environmentally friendly forms of agricultural production	Promotion of resource efficient, 'clean' technologies in the non-agricultural sector
4. Nature protection	protection and enhancement of bio-diversity (protection of flora, fauna and habitat quality); implementation of the EU Birds Directive, etc.	sustainable use of the natural environment in farming; maintenance of traditional high nature value farming systems and semi-natural ecosystems (habitats)	development of tourism activities linked to nature, farming and culture

5. Basic supply	-	improvement of production, processing and marketing structures; promotion of high quality production and quality control	improvement of supply structures in rural areas; provision of demand-oriented basic supply systems (social infrastructures and services)
6. Land use and settlement structure	land consolidation and establishment of biotope networks; reduction of land use conflicts; integrating agricultural and nature protection objectives; landscape planning	improvement of living and working conditions in agriculture; maintenance of a minimum level of agricultural activities; development of new farm related services	village renewal; improvement of infrastructures and quality of living in rural areas; maintenance of a minimum population density; improvement of economic and settlement structures in rural areas
7. Jobs in rural areas	-	farm modernisation; supporting of pluriactivity and income combination	creation of attractive new jobs in rural areas; support for small and medium enterprises
8. Diversification	reduction of air pollution; promotion of renewable energy sources (production of energy crops; increasing crop diversity)	diversification of agricultural production; product innovations; non-food crops; new secondary products and farm-based processing technologies	development and diversification of non-agricultural sectors; improvement of marketing; creation of attractive new jobs; development of rural / 'green' tourism
9. Education and joint responsibility	environmental education; engagement in environmental and RD initiatives	agricultural training (farm management economics; resource use; marketing and market development; etc.); engagement of farm families in environmental and RD initiatives	provision of information, education and advice; formation of local / regional action groups; identification of people with their region; strengthening of joint responsibilities; improvement of urban-rural relationships

Source: Knickel (1999a)

Case studies

Case study 1: Organic farming in the Biosphere Reserve Rhoen

The first case study illustrates the substantial impact that the establishment of a relatively large new dairy and a new product line 'organic milk' has on the development of farming. Three other aspects are directly linked to that: First, the management of nature and landscape in the UNESCO Biosphere Reserve Rhoen. Second, the focus on high quality production and a 'new' product line (milk from organic production with a particular regional image, and high quality processed milk products such as quark, cream, etc.). And third, the close links with the further development of green (rural, agro-) tourism in the Rhoen. The Rhoengold products are advertised with the "Biosphere Reserve image" which is, therefore, going in line with the advertising strategy of tourist agencies and the gastronomy in the region.

Without the possibility to deliver their milk to the Rhoengold dairy many farmers would discontinue milk production and possibly switch to extensive grazing systems and quality beef production. It can be doubted however whether the quality beef markets are sufficient to sustain a much larger number of producers and to stabilise farming in such marginal grassland areas.

How does the activity relate to RD?

The case as a whole represents a good example of RD for three main reasons:

(a) First, it starts with the development of a very significant value added product line. The

Rhoengold dairy provides a new and growing market outlet and, as a consequence, an increasing number of farmers are converting to organic production. Total turnover of the dairy in financial terms has been 70-80 mio Euro in 1995 which makes *Rhoengold* one of the four largest dairies for organic milk in Germany. The organic milk product line accounts for 8-10% of total turnover. The new product lines which have been established are a direct and very professional response to the corresponding consumer demands (which is one of the most obvious ways of harmonising agriculture with the needs of society).

- (b) Second, the developments in the production and marketing sectors are closely linked with a number of other developments that are very favourable for the region as a whole: The Rhoengold dairy is linked with environmental improvements and positive socio-economic changes (income perspectives for many dairy farmers in the region; development of rural / green tourism; etc.).
- (c) Third, the developing market niche of organic milk products is (still) relatively independent of policy.

The case as a whole illustrates how multifaceted the transformation of agriculture can be: responding to new needs of society in terms of food quality, freshness of product, image of product, intact nature, etc. Simultaneously a strengthening of the economic basis of the regional economy as a whole can be observed above all expressed in the positive image of the region and its effects on rural / green tourism and the development of SMEs.

Structure of multi-functionality at farm level and embeddedness

A graphical presentation of the structure of multi-functionality in the case of organic milk production, processing and marketing (DE-02) is given in **Figure 1**.

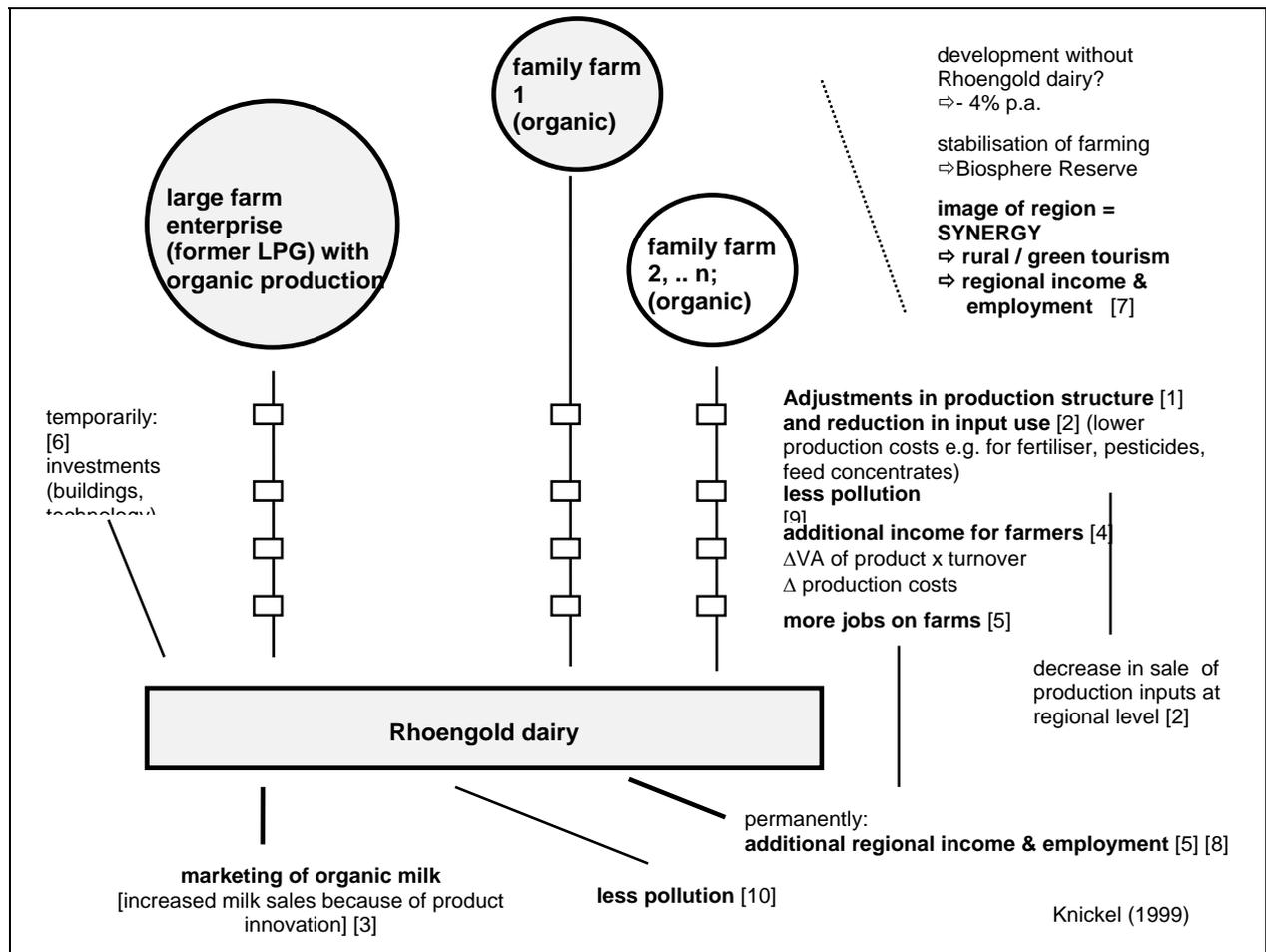
The main links are:

- the conversion to organic milk production with corresponding changes in farm and production structure [1], and in inputs and outputs [2];
- the sale of milk to the dairy [4], and the marketing of organic milk by the dairy [3];
- the resulting increase (or at least stabilisation) of farm incomes [4], an increase in agricultural employment [5] and a reduction in pollution [9].

The regional level costs and benefits are to be seen in:

- a temporary indirect effect resulting from the substantial investments in the dairy (buildings, technology) [6];
- a reduction in sales of production inputs [2];
- the positive linkages between the maintenance of environmentally friendly farming in the region and the development of rural / green tourism, and its effects on regional income [7] and employment [8];
- the reduction of pollution in milk processing in the dairy because of the better technology used now [10].

Figure 1: Structure of multi-functionality in the case of the Rhoengold dairy



Income and employment effects

Socio-economic impacts have been calculated with representative farm and field level data on costs, benefits and labour input. Two types of farm were calculated: First, a large farm enterprise with 2,650 ha and 880 dairy cows (a former state co-operative). Second, a typical family farm in the region with a size of about 50 ha. This farm is more or less representative for family farms in the Rhoen. For both types the same calculations have been carried out. In both cases farm structure and farming patterns before conversion are compared with the situation after conversion to organic farming.

Summary of data on impact

	Farm level		'Rhoen'	
	Actual	Potential	Actual	Potential
Δ Added Value a) large enterprise	183,191	-	366,382	-
(Euro) b) family farm	6,306	-	18,918	201,792
Δ Employment a) large enterprise	0.1	-	0.2	-
(AWU) b) family farm	0.1	-	0.4 + 30*	3.0 + 30*

* Increased number of employees in Rhoengold dairy; 'Rhoen' incl. Lkr. Fulda and Lkr. Schmalkalden-Meiningen

Case study 2: Energy crops in Mecklenburg-Vorpommern

The second case study focuses on the development of energy crops as a new product and on the impact this could have in terms of the development of rural areas. An aspect which is directly linked to that is the development of short producer-consumer chains: The production of energy crops can meet local and regional level energy demands. Some farmers who are growing energy crops use these crops in the form of fuel on their own farm (tractor, other engines), in the car and/or for heating their house.

Currently energy crops for solid fuel production are mainly under pilot projects and investigation. Commercial scale production of energy crops is just beginning. Energy crops for liquid fuel production are already on the market in the case of methyl ester (RME) made of rape. Alcohol production from energy crops in contrast is still playing a more or less negligible role. The generally accepted view however is that in the future, energy crops and especially solid biofuels will play an important role for a more environmentally sound energy supply. It is a consensus within all political parties and nearly all groups being active in the field of energy and environment.

How does the activity relate to RD?

The growing, processing and use of energy crops relates to RD in a number of respects:

- First, energy crops will as renewable resources become much more important with respect to economic development and agricultural production in the next decades. The major reason being the necessary replacement of non-renewable resources in many production sectors.¹ The growing of energy crops is a first move in this direction, and it clearly represents a rather quick response to new societal needs. The much more far-reaching shift from food production to (renewable) raw materials for industry could eventually lead to a more substantial redefinition of the place of agriculture in (rural) society.
- Second, farmers are looking for new crops, in addition to the traditionally cultivated potatoes, sugar beats and cereals. The continuous development of new production and income opportunities is a vital part of the structural adjustment of the sector. In this respect is the case a classic example of a new crop enabling farmers to diversify their production and obtain additional income. Energy crops provide a chance to continue producing and to manage the countryside at the same time.

¹ In addition to the production of basic agricultural commodities there is a future in producing the raw materials and food and fibre products that are needed in tomorrow's society (non-sustainability of present industrial systems; consistency with the visions of futurists for a post-industrial society).

- Third, the move into non-food production represents a re-configuration of the use of rural resources, not only within the farm but also between agriculture and other rural activities. From the industrial standpoint are renewable resources an opportunity for the development and marketing of innovative and ecologically compatible technologies and products (e.g. biodiesel, lubricants, new industrial raw materials). The aim is to open up new markets for biodiesel especially in environmentally highly sensitive fields of application.

However, while the relevance of the production of energy crops with respect to RD appears clear, the development as such still is at a cross-roads. The two main scenarios are:

- A decentralised development of on-farm energy crop production, processing and use which can trigger off effects in a number of other fields of RD. A more decentralised development, processing and marketing of energy crops could to a certain extent change the relationships between agriculture and industry, at the same time providing new opportunities for SME in rural areas.
- The continuation of a simple productivist agriculture model, i.e. introduction of a new crop for conventional / industrial farming, highly dependent on external markets. The consequence would presumably be that after a short period of market relief the 'price-squeeze' will start again.

If it is assumed that non-food crops will soon and rapidly increase in importance in terms of both production and usage, it will be necessary to shape this process and its outcomes for the greatest benefit to agricultural and rural communities, and to provide well-targeted support to a more decentralised development.

Structure of multi-functionality at farm level

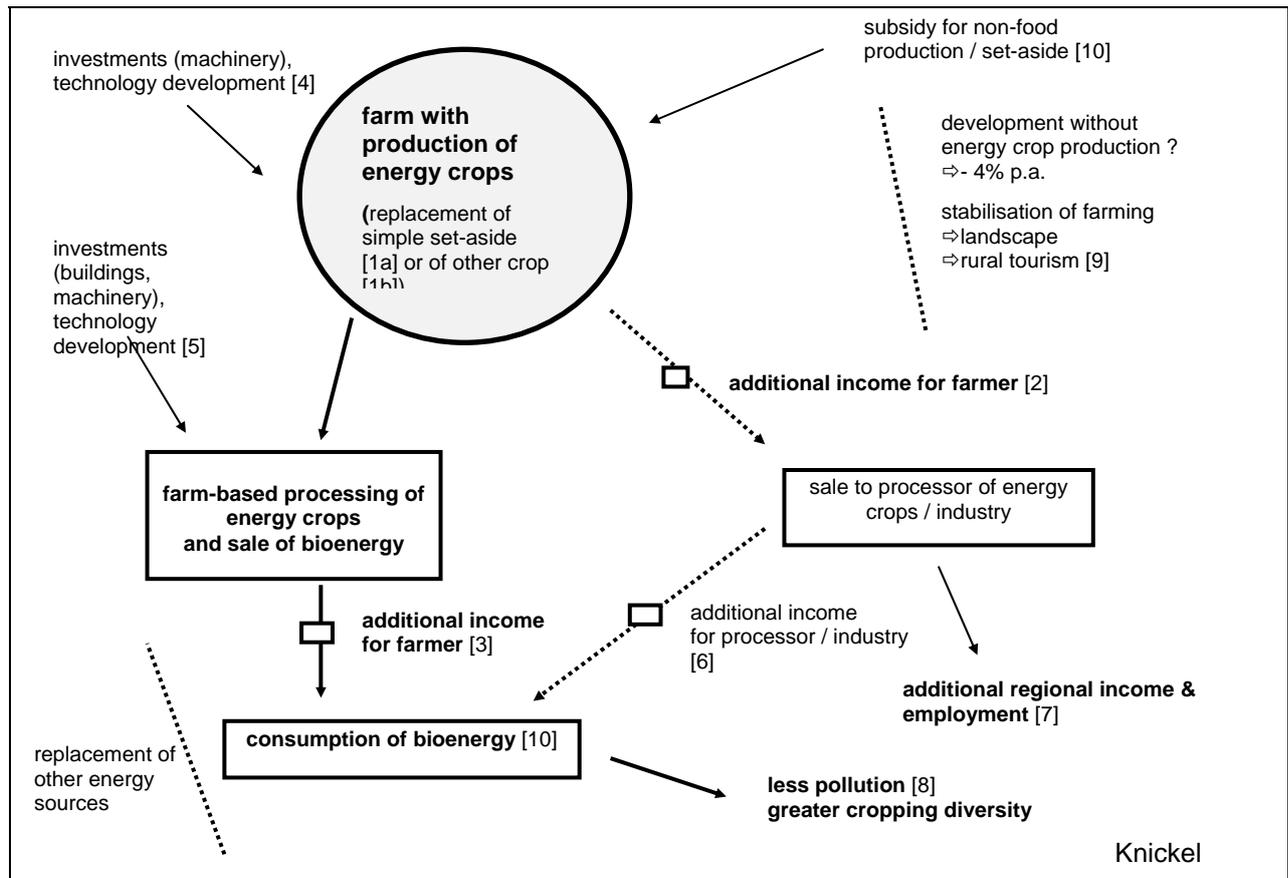
In order to be able to quantify Δ value added at farm level it is necessary to identify the main changes in costs and benefits first. A graphical presentation of the structure of multi-functionality in the case of the production of energy crops is given in **Figure 2**.

The analysis of the structure of the multi-functionality of energy crop production leads to the following main changes and links at farm level [the numbers given correspond to those in the figure]:

- (i) replacement of simple set-aside by the cultivation of energy crops [1a]; resulting in additional production inputs and the crop output;
- (ii) alternatively to (i): replacement of conventional crops by energy crops and the corresponding adjustments in cropping patterns and inputs / outputs [1b] (wheat has been selected because it is the most common cropping alternative); in this case crop rotational constraints need to be taken into account;
- (iii) sale of oil seeds to processing industries and resulting income for raw product [2];
- (iv) alternatively to (iii): processing of the energy crops on the farm and resulting additional income [3] (some of the biofuel is already consumed on the farm; only the surplus is sold on the energy market).

In each alternative the related increases in net revenue and changes in labour allocation and employment levels are examined.

Figure 2: Structure of multi-functionality in the production of energy crops



Income and employment effects

Model calculations show that the assumptions underlying the comparison of energy crops with conventional crops, and the selection of reference crops and crop rotations have a very significant impact on the outcomes. The results indicate that socio-economic impacts could be substantial. The value added of growing non-food oil seed rape in Mecklenburg-Vorpommern instead of simple set-aside of land is 590,550 Euro. The aggregated employment effect of growing non-food oil seed rape instead of simple set-aside of land is 16.7 AWU.

The effects on the regional economy (multiplier-effects) depend strongly on the future development of the linkages between the producers of energy, and the traders and consumers of energy. A more decentralised development could mean that the agricultural sector itself manages not only the production but also the processing and marketing of energy crops. Smaller scale rural area based processing industries could be involved as well. In this case the effects on the rest of the (rural) economy would be much more pronounced than in a more centralised, merely production-oriented development.

BRENNDÖRFER (1999) found that in 1999 there were approx. 80 smaller scale plants for the processing of oilseeds (for energy and other technical purposes). 90% of the plants were in southern Germany; 70% alone in Bayern and Baden-Wuerttemberg. The author found that these smaller plants are particularly concentrated in regions without larger plants that can be found along Rhein and Elbe. He indicates that there could also be a correlation with smaller scale farming.

Summary of data on impact

	Field level (1000 ha)		Mecklenburg- Vorpommern	
	Actual	Potential	Actual	Potential
Δ Costs (Euro)	+ 432,000	-	+ 2,743,200	-
Δ Benefits (Euro)	525,000	-	3,333,750	-
Δ Added Value (Euro) *	93,000	-	590,550	-
Δ Employment (AWU) *	2.63	-	16.7	-

Excl. processing and knock-on effects in the regional economy

Conclusions

Farm structural development is not following a simple dichotomised pattern

The agricultural structural changes which have been taking place since the 1950s are characterised by scale enlargement, specialisation, and spatial concentration - all resulting in a large reduction of agrarian employment. At the same time it is increasingly recognised by society and policy-makers that a vital and liveable countryside - containing ecological values, cultural-historical, and also contemporary social values - is crucially dependent on the presence of a dynamic agriculture. It is increasingly recognised too that a strict 'segregation' of different functions - living, producing, recreating, nature production, water collection, etc. – is not desirable. The two case studies indicate that product innovations in agriculture a) provide very significant *raison d'être* in environmental and social terms, and equally as an economic activity, and b) that agriculture still has an important role to play in rural development?

The two cases also indicate that farm structural development is not following a simple dichotomised pattern (as assumed by many analysts): On the one hand, a group of large-scale, high-tech farms that are competitive on the world market. On the other hand, an increasing number of farms that anticipate emerging niche markets. The two groups are often described in terms of an 80% / 20% relationship. In reality there may not be such a clear division, real developments being much more complex.

The problem policy makers are facing is that large-scale, high-tech farms that are competitive in the world market could well be less compatible with the more recent RD strategies. Although to a certain extent both can exist very well alongside each other and can profit from each other, it is more common that frictions arise. Obviously, an agricultural sector that is above all characterised by scale enlargement and rationalisation provides much less opportunities for employment, and has in RD terms much less favourable micro–macro relations. More often it is the opposite that farm expansion and scale enlargement can involve such high (transaction) costs (and social costs) that it increasingly turns out to be counterproductive.

Van der Ploeg et al. (1999) stress that the new activities exist alongside the mainstream farming activities, and that *“the impact of RD will be mainly centred on the ‘innovative farms’ in the bipolar model.”* The same authors emphasise that for example the relation between the high-tech pole and the 'innovative' pole could in employment terms well be the other way around, i.e. 20% / 80%. Clearly, in a 'multifunctional' agricultural sector many more farms and rural SMEs are able to generate an additional income.

Creation of new markets and production of new commodities

The continuous reduction in producer prices and the simultaneously increases in production costs force farmers to adjust their activities in order to maintain an adequate household income. Particularly in regions with less productive land is mainstream mono-functional agriculture facing significant constraints. The most common pattern of adjustment in such areas (as in the case study area Rhoen) is pluriactivity and income combination. A distinctive feature of pluriactive households is their limited dependence on agriculture as an income source. Bryden et al (1992) found that many households on small and medium sized farms do not become marginalised because they have recourse to pluriactivity of one kind or another: *“They may be economically marginalised from mainstream production but in socio-economic terms they have adapted to change.”*

Van der Ploeg et al. (1999) emphasise that RD requires, both in its ‘traditional’ and in the new elements, a wide range of innovations. An important question is whether and to what extent the agricultural sector is able for such a process of continuous change, innovation, and development. A second, related question is how to stimulate rural (entrepreneurial) human capital in a way as to develop such a process in both the short and the longer term.

The two case studies indicate that very different strategies are being employed to respond to the cost-price squeeze situation and the intensifying pressures on resource availability. Van der Ploeg et al. (1999) refer to the strategy of *‘forward integration’* and the so-called *‘forgotten variant’*. The latter strategy relates to the creation of new markets and the production of new commodities and services and / or the realisation of new types of cost reduction. The same authors stress that these new strategies are not unique. *“They are situated alongside other developments such as ongoing scale enlargement, ongoing technology development, supply-chain integration and optimisation, specialisation particularly in knowledge-intensive products, etc. Indeed, in many cases the mentioned strategies are interwoven in complex ways.”*

Towards multifunctional farms

From the above it may be concluded that multifunctional farms that are highly diverse may become more important again in the future. Farms that generate only about half of income from mainstream commodities and where additional income sources could be nature management, production of quality products, agritourism or an off-farm job are becoming more common. Within each field of activity a wide range of specific forms and mechanisms might be located. Rural development can in this respect be regarded as a set of activities with which new social needs are anticipated. Of course, mutual relations can vary highly, not only between farms but also through time. A number of recent developments may be of great importance in the interpretation of the multifunctional farm. ‘Economies of scope’ are an alternative to ‘economies of scale’ as the sole path along which to imagine (and design) farm development.

Creating synergy

An important characteristic of the two case studies is that a strict ‘segregation’ of different functions - living, producing, recreating, nature production, water collection, etc. - is not desirable. Actively constructed synergy is a key idea too in the UNESCO Biosphere Reserve concept. In the particular case of organic farming in the Rhoen there is considerable synergy in terms of the regional branding of foods; the relative popularity of the new product lines which have been established; the linkage between the image of the region and the further development of rural tourism. The synergy between organic farming and the development of rural tourism is a particularly clear example of synergy. The image of the area has been largely improved because it is linked with the brand and image of *Rhoengold* milk, and because the association of economic and environmental improvements is considered very

positive. A first conservative estimate is that at least 10-20% of all tourist mainly come to the area because of its pronounced rural image which is very popular now because of a) the Biosphere Reserve, b) the *Rhoengold* organic milk product line and c) its association with organic farming and the high nature value systems in the Biosphere Reserve.

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