
AGRICULTURE AND INNOVATION - A NEGLECTED SECTOR IN INNOVATION RESEARCH AND INNOVATION POLICY

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Source: European Parliament

Rationales and empirical basis of the paper

Rationales

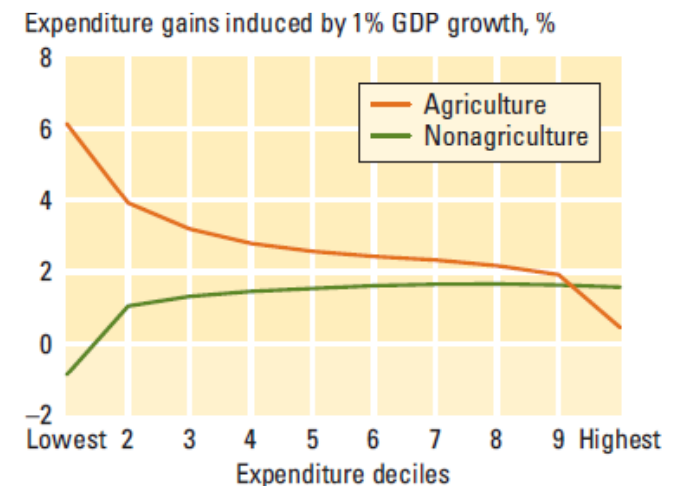
- To learn more about the general structural characteristics of the agricultural sector
- To better understand what the term 'innovation' really means in agriculture
- To discover the structure of innovation processes in agriculture and their systemic characteristics
- To assess how innovation in agriculture can be measured
- To identify whether and how innovation activity can be promoted in this sector

Empirical basis

- Contribution to Bokelmann, W., Doernberg, A., Schwerdtner, W., Kuntosch, A., Busse, M., König, B., Siebert, R., Koschatzky, K. and Stahlecker, T. (2012): *Sektorstudie zur Untersuchung des Innovationssystems der deutschen Landwirtschaft*. Berlin: Humboldt University

Role of agriculture in developing countries

- According to the Worldbank (WDR 2008), growth originating in agriculture is at least twice as effective in reducing poverty as GDP growth originating outside agriculture.
- Rapid agricultural growth can be triggered by either technological innovations (e.g. India: diffusion of high yielding varieties) or institutional innovations (e.g. China: household responsibility system and market liberalization) and contributes to major declines in rural poverty.
- The WDR 2008 states that agriculture can be the lead sector for overall growth in the agriculture-based countries (p. 6).
- In the Sub-Saharan area, agriculture accounts for 32 % of GDP growth.



Source: Ligon and Sadoulet 2007.

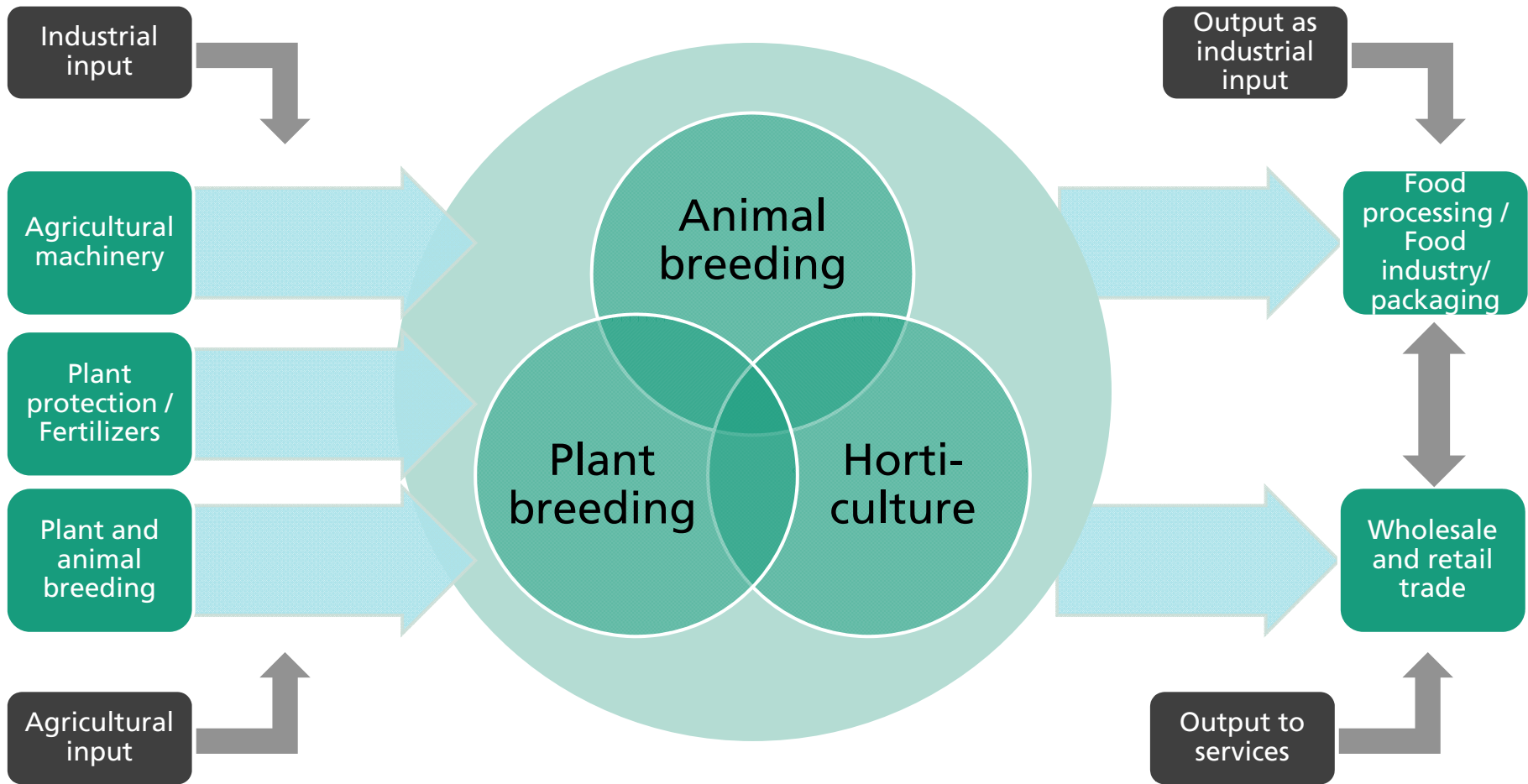
Note: Based on data from 42 countries during the period 1981–2003. Gains are significantly different for the lower half of expenditure deciles.

Source: WDR 2008

Agriculture in developed countries

- While in developing countries agriculture accounts to 20 % and more of GDP (e.g. Tanzania 45,8 %), its GDP contribution is much lower in developed countries (e.g. United Kingdom 1.0 %).
- Agriculture has great potential in securing natural resources, in environmental protection and in sustainable development.
- The agricultural sector is a core element in the food chain and therefore strategically and economically important.
- The general competition between crop production for food and for bio fuels applies to developed countries as well.
- Agricultural production has a systemic character due to its close linkages to input suppliers (fertilizer industry, agricultural machinery etc.) and output processors (e.g. food industry, food trade and retail).
- Agriculture itself is not a homogeneous sector and consists of different production chains like animal breeding, plant breeding, and horticulture.

Agricultural value added chain

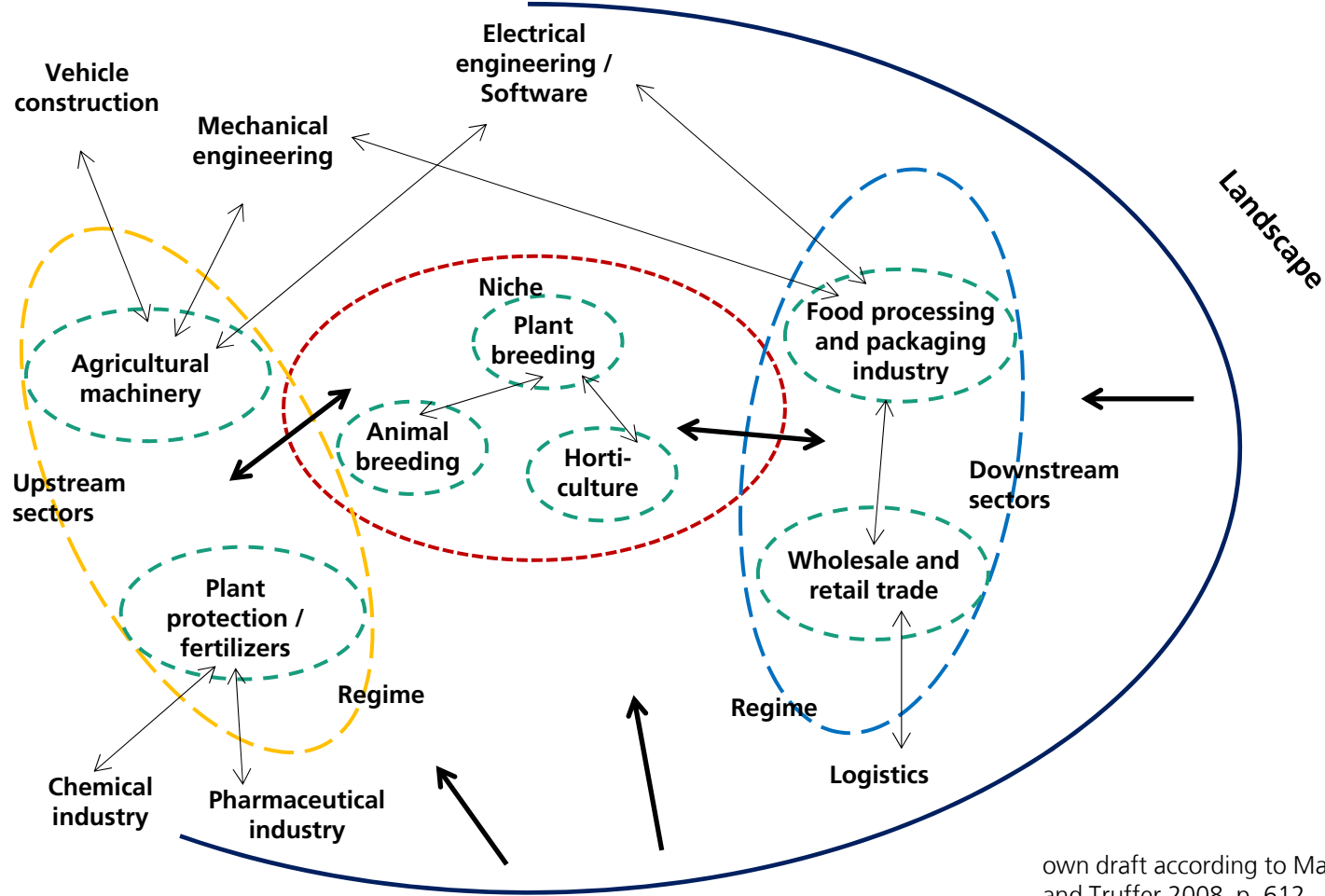


own draft

Assumptions regarding the systemic perspective

- Innovations in agriculture result from innovative activities in the different upstream sectors, from innovation and demand impulses from the downstream sectors food and trade and from innovative activities in the three core agricultural sectors themselves.
- Due to the linkages with and dependencies from upstream and downstream sectors, it can be expected that a comprehensive agricultural innovation system does not exist.
- Also within the core agricultural sector different production regimes and organizational fields exist.
- It is therefore necessary to regard agriculture as different (overlapping) sectoral innovation systems (Malerba 2002), or its constitutive sub-sectors as different niches in a multi-level framework technological innovation system (Markard and Truffer 2008).

Multi-level framework agricultural innovation system



own draft according to Markard and Truffer 2008, p. 612

German agriculture - general characteristics

- Number of farms: 588,000 (1995), 360,000 (2009) -
- Farm land: 17,344,000 ha (1995), 16.890.000 ha (2009), of which 861,000 ha (2007) are used for ecological farming
- Agricultural employment: 1.08 mill. (1995), 866,000 (2009) -
- Share of agricultural employment in total employment (2010): 2,15 %
- Share of gross value added: 1.27 % (1995), 0.84 % (2009) -
- Production value of goods: around 40 bill. Euro (2010)
- Operating results: 36,489 Euro (2006/2007), auf 30,843 Euro (2009/2010) -

German agriculture - innovation indicators

- Indicators measuring resources (e.g. R&D expenditures), results (e.g. patents, publications), and progress (e.g. products) are adjusted to 'classical' industry-related innovation processes.
- Both agriculture and the service sector deviate in their innovation behaviour from this classical model.
- While analyses, surveys and statistics mainly cover innovation processes in the manufacturing industry, and sometimes in the service sector, there is little knowledge and information about innovation in agriculture.
- Although a large agricultural statistical reporting system exists (e.g. as basis for agricultural subsidies), this sector is neglected in innovation statistics.
- Available statistical data have to be treated with care as well as the interpretation of these data.

Indicators: R&D Expenditures in Mill. Euro 2007-2010

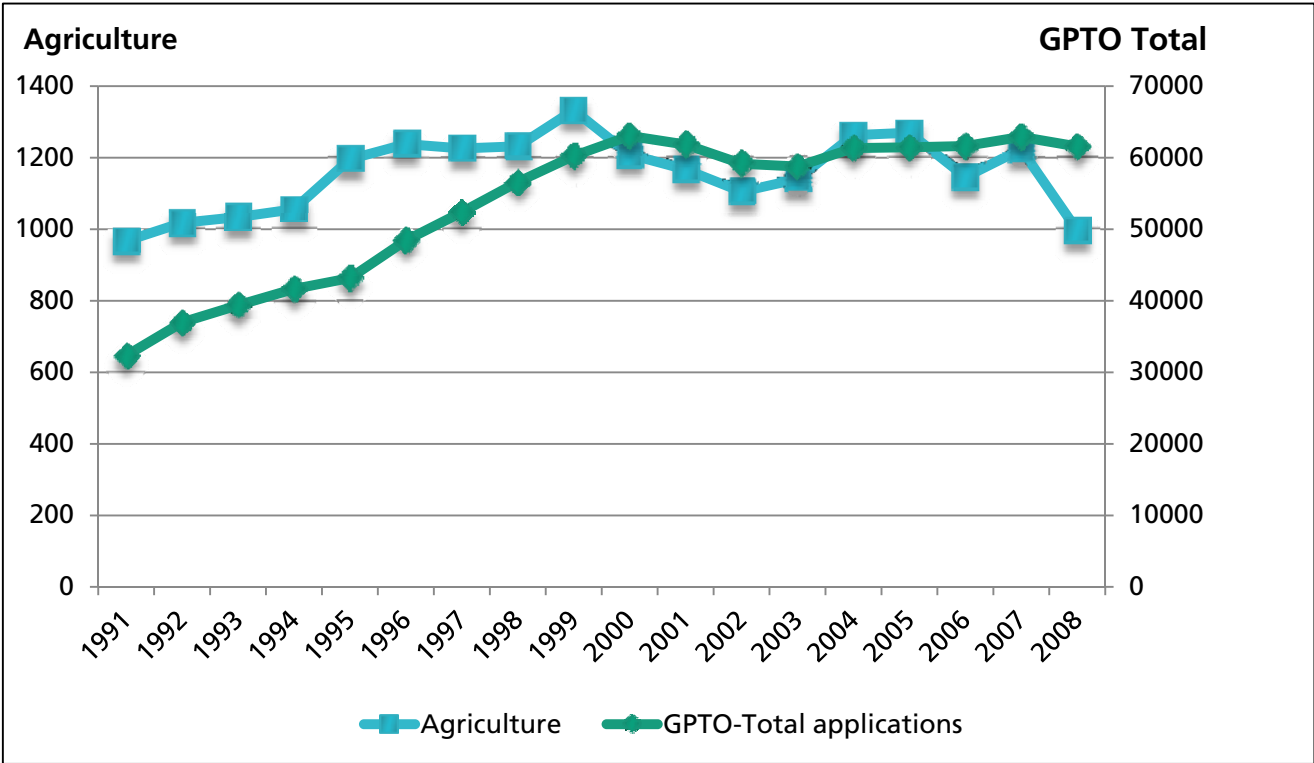
Sector	2007		2008		2009		2010	
	Total	Intra-mural	Total	Intra-mural	Total	Intra-mural	Total	Intra-mural
Agriculture, Forestry, Fisheries	136	94	142	99	165	117	187	133
Manufacturing Industry	47,412	37,934	50,907	40,778	49,068	39,172	50,518	40,364
Industry total	53,447	43,035	57,304	46,073	55,927	45,021	58,402	47,091
Share Agriculture.. in Industry (%)	0.25	0.22	0.25	0.21	0.29	0.26	0.32	0.28

Source: Stifterverband (2011)

R&D intensity 2010: 0.68 %

But: Data for agriculture are sample data. 47 % of the internal R&D expenditures come from Lower Saxony, only 10.2 % from Northrhine Westphalia and 5.4 % from Bavaria. This does not reflect the economic distribution of agriculture in Germany.

Indicators: Patent applications at the GPTO - German applicants



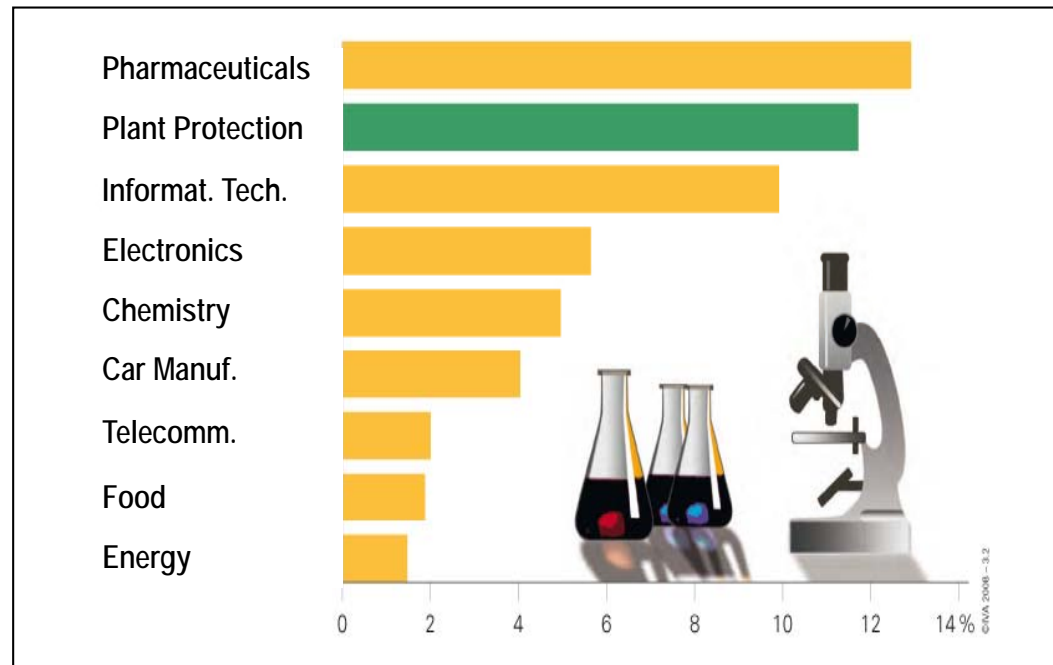
- Share of agricultural patents decreased from 3.1 % (1991) to 1.6 % in 2008
- Either decreasing patenting activity and/or technological shift to industries which supply different sectors, including agriculture

Patent class A01 (Agriculture; Forestry; Animal breeding; Hunting; Trapping; Fisheries)

own searches in the patent database PATSTAT (GPTO and EPO)

Innovation activities in related upstream and downstream sectors

R&D expenditures as share of turnover



- High R&D intensity in plant protection and fertilizers
- Significant R&D activities also in agricultural machinery
- R&D intensity in German food industry low (less than 1 %).

- Agricultural innovations are mainly generated in upstream sectors (plants, machinery, fertilizers)
- Impulses for innovation in agriculture from the food industry are low

What do these innovation indicators tell us?

- R&D expenditures (absolutely and relatively) increased over time, but what does this indicate?
- R&D focus is on new products and new developments, but who is developing and which kind are these 'products'?
- R&D is mainly carried out in upstream sectors which reflects a strong dependency on innovative inputs from these sectors.
- Profound empirical data on R&D / innovation activities in the agricultural sector itself do not exist.
- Income statistics indicate that the average farmer does not have money and capacities to innovate, unless his farm belongs to bigger companies.
- Agriculture is more user than producer of innovations.
- Innovations result from problem-solving activities (in the barn, on the farmland), based on own experiences and the use of available machinery and related technologies supplied by other sectors.

Policy implications

- The in itself fragmented agricultural core sector seems to be the weakest part of the multi-level framework agricultural innovation system.
- Innovation in agriculture exists, but the degree of novelty is different from other sectors (less technical, more practical).
- Due to major innovative inputs not directly originating from agriculture, the competence in handling these new products or processes is not well developed, nor are the products in all cases well adjusted to the needs of farmers.
- The fragmented structure of the agricultural sector and the technological dependency from other industries makes it necessary to address the several regimes and niches of the agricultural innovation system differently by policy measures.
- On the general level, the strengthening of R&D, technological development and innovation activities along the value chain and the ability to adapt technologies and innovations from a user perspective seem to be appropriate approaches.

Policy implications

- Initiate and expand R&D and innovation oriented support measures, taking into consideration transfer and implementation issues and successful projects as possible role models
- Establish incentives for apply-oriented R&D activities at universities and non-university research institutes
- With regard to the practical application and improving the diffusion and adaptation process:
 - Establish farms as demonstration objects on the regional level (peasants as multipliers)
 - Risk reduction in case of innovative investments and new processes
 - Qualify peasants as innovative entrepreneurs (qualification measures, life-long learning, entrepreneurship education)

Policy implications

- Given the fact that the value chains and innovation activities in the agriculture sector are at least as complex as in many industrial sectors, awareness raising and motivation vis-à-vis cooperation and networking within the innovation process are crucial:
 - Actors within the value chain and private consumers
 - Establish effective interfaces towards and between adjacent industries
 - Guarantee cooperation and communication on the different steps and between the different disciplines
- Consequently network and network management approaches should be an integrated part of innovation policy in the agriculture sector:
 - Innovation platforms, professional decentralised management organisations
 - Participative communication platforms
 - Network coordination
 - Public Relation

Implications for further research

- Secondary statistical data analyses for covering innovation activities in sectors that do not fit the common innovation pattern known from manufacturing industry are not sufficient.
- More quantitative and qualitative data and information (case studies) are necessary to better understand the rationales and basic characteristics of innovation in agriculture.
- Taking into consideration the heterogeneity of the agriculture sector and a dynamic caused by current trends: shift to new energy sources and consequences for the agriculture sector (e.g. biogas plants)
- Focus on the shift of value chains and innovation perspective
- Existing public support initiatives have to be evaluated and scientifically supported in the course of its implementation to generate evidence on their effects and possible failures

Thank you for your attention!

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