1. Norway is one of the most sparsely populated countries in Europe, with much of the country dominated by mountainous or high terrain. Only 3% of the land area is arable. Agriculture employs approximately 53,000 full-time equivalents, 2.1% of the country’s total employment, and 0.3% of Gross Domestic Product (GDP).

2. Over the past decades, the agricultural sector has witnessed significant structural changes towards fewer, but larger and more efficient holdings. The area under agricultural production has, however, remained fairly stable during this consolidation process.

3. The Ministry of Agriculture changed its name in 2004, becoming the Ministry of Agriculture and Food. This change signalled a wider scope of the agricultural policy, with increased attention to the complete value chain, from biological production to food and other products based on agricultural resources, including knowledge production. The past decade has also seen mergers between several agricultural research institutes.

4. In these country notes, AKS is understood as a network of institutions in the public and private sectors whose activities and interactions initiate, import, modify and diffuse new knowledge. The descriptions presented here primarily describe the relations between the authoritative power of Parliament and the Government, and the institutions within the AKS. Forestry and farming are understood as agriculture, while fisheries and aquaculture are not given that the responsibility for terrestrial and non-terrestrial biological production is divided between two ministries in Norway.

1. **Organisation issues**

   What is the organizational structure of AKS (and its components: Higher education, Research, Development and Extension)? What major changes have occurred over the last decade?

5. The last survey on the Norwegian AKS identified 90 organizations conducting R&D, including 20 institutes, 44 companies and 26 units within the educational system (universities and university colleges). Two universities and five research institutes comprise the bulk of the Norwegian AKS:

   - The Norwegian University of Life Sciences (UMB);
   - Norwegian School of Veterinary Science (NVH);
   - Norwegian Institute for Agricultural and Environmental Research (Bioforsk);
   - National Veterinary Institute (NVI);
   - Norwegian Forest and Landscape Institute (Skog og landskap);
   - Norwegian Agricultural Economics Research Institute (NILF); and
   - Norwegian Institute of Food, Fisheries and Aquaculture Research (Nofima).

6. **UMB** (founded in 1859) dominate higher education within the field of agriculture in Norway. It is also the largest research institution within the sector with 940 employees, half of whom hold scientific
positions. UMB has some 3800 students, of which about 430 are PhD students. Annually, the university confers more than 50 PhD degrees.

7. **NVH** (founded in 1935) is the only institution in Norway that is authorized to offer education and award professional and PhD degrees within the field of veterinary medicine and related sciences. The school is also responsible for the major part of all veterinary research conducted. NVH is a state-owned autonomous institution of higher education, with university level status. The school has a student body of 470, including 80 doctoral students.

![Figure 1. The Norwegian Agricultural Knowledge System](image)

Source: The Biennial Science Indicators Report for Norway, 2009, p. 10. The model is revised and simplified to fit the specific context.

8. **Bioforsk** (founded in 2006 by a merger) is a research institute under the Ministry of Agriculture and Food, with expertise in agriculture, food production, plant health, environment and resource management. Bioforsk strive for research-based innovation and value creation. The research divisions are represented in all major regions of Norway.

9. **NVI** (founded in 1891) is a national biomedical research institute in the fields of animal health, fish health and food safety, whose primary function is the supply of independent research-based advisory support to the governing authorities. The National Veterinary Institute is a governmental agency, funded by the Ministry of Agriculture and Food and the Ministry of Fisheries and Coastal Affairs. The institute is represented in all major regions of Norway.

10. **NILF** (founded in 1986) is an independent research institute under the Ministry of Agriculture. NILF provides background material for general agricultural economics decisions, economic development and decisions on farms and rural development.

11. **Nofima** (founded in 2008 by a merger) is a business oriented research institute organised as a limited company owned by the Ministry of Fisheries and Coastal Affairs, the Agricultural Food Research
Foundation and Akvainvest Møre og Romsdal. The institute is working on research and development for the aquaculture, fisheries and food industry. The institute is represented in all major regions of Norway.

12. **Skog og landskap** (founded in 2006 by a merger) is a scientific institution regarding use of forest resources, forest ecology and the environment. The institute is a national institute under the Ministry of Agriculture and Food, providing knowledge to the authorities, industry, commerce and the public in order to contribute to the sustainable management and formation of values of land resources through research and data collecting. The institute has 220 employees.

13. The industrial sector is also a part of the AKS, but specific companies are not referred to here (ref. introduction above).

14. The last decade has been characterized by the following structural changes:
   - In 2005, the UMB was transformed from an agricultural university college (*Norges landbrukshøgskole*) to a university. The institution has, as a follow-up of the European Bologna Declaration, restructured its courses, credits and degrees to meet European standards.
   - In 2006, the Norwegian Institute for Plant Research, the Norwegian Institute for Soil and Environmental Research and the Norwegian Centre for Ecological Agriculture merged to form Bioforsk.
   - In 2006, the Norwegian Institute for Soil and Land Mapping and the Norwegian Institute for Forestry Research merged to form Skog og landskap.
   - In 2008, Akvaforsk, the Institute for Aquaculture Research (*Fiskeriforskning*), the Norwegian Institute for Food Research (*Matforsk*) and Norconserv merged to form Nofima.

15. Who is responsible at government level for the AKS and its individual components? Please describe and comment on any major changes made during the past decade or currently being proposed.

16. Parliament and the Government decide the overall policy for education, research and innovation. The Ministry of Education and Research has the main responsibility for education and research policy, and governs the higher education institutions, universities and university colleges. The Ministry of Agriculture and Food is responsible for food and agriculture-related policymaking and the national agricultural research institutes.

17. Most of the research institutes mentioned above have the status of administrative institutions with special authority under the Ministry of Agriculture and Food. There is close co-operation between UMB, NVH and the independent institutes.

In what manner is AKS (and its components) financed both from public and private sources? What changes in funding the AKS activities have occurred during the past decade?

Institutes, industries and universities participating in the AKS in Norway derive resources for R&D from both public and private sources (summarized in Table 1). Public sources are the dominant source of funding, and financed 53% of the research and development in 2009. The public funding of research in the AKS increased by about one quarter during the last decade.
### Table 1. AKS R&D expenditure in Norway in 2009 by source of funds and performing sector (NOK '000)

<table>
<thead>
<tr>
<th>Source of funds</th>
<th>Institute sector</th>
<th>Industrial sector</th>
<th>Education</th>
<th>Sum AKS</th>
<th>All sectors</th>
</tr>
</thead>
<tbody>
<tr>
<td>Government:</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>NRC</td>
<td>277</td>
<td>33</td>
<td>84</td>
<td>393</td>
<td>n.a.</td>
</tr>
<tr>
<td>Basic</td>
<td>80</td>
<td>-</td>
<td>174</td>
<td>255</td>
<td>n.a.</td>
</tr>
<tr>
<td>Ministries</td>
<td>195</td>
<td>26</td>
<td>15</td>
<td>236</td>
<td>n.a.</td>
</tr>
<tr>
<td>SkatteFUNN</td>
<td>-</td>
<td>13</td>
<td>-</td>
<td>13</td>
<td>n.a.</td>
</tr>
<tr>
<td>IN</td>
<td>-</td>
<td>9</td>
<td>-</td>
<td>9</td>
<td>n.a.</td>
</tr>
<tr>
<td>Private funds:</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Industry</td>
<td>118.3</td>
<td>403</td>
<td>34</td>
<td>556</td>
<td>17 600</td>
</tr>
<tr>
<td>JA/FFL</td>
<td>112.6</td>
<td>7</td>
<td>26</td>
<td>146</td>
<td>146</td>
</tr>
<tr>
<td>Abroad</td>
<td>37.1</td>
<td>12</td>
<td>7</td>
<td>56</td>
<td>3 400</td>
</tr>
<tr>
<td>Other</td>
<td>23.2</td>
<td>-</td>
<td>-</td>
<td>23</td>
<td>1 500</td>
</tr>
<tr>
<td>Sum AKS</td>
<td>843</td>
<td>502</td>
<td>341</td>
<td>1 686</td>
<td>41 900</td>
</tr>
</tbody>
</table>

n.a.: not available.

*Source: NIFU*

18. Grants for research through the Norwegian Research Council (NRC) for assets subject to competition and for basic funding of research institutes counted for the main part of the public funding.

19. Four Research institutes (Bioforsk, NILF, NVI and Skog og landskap) receive fund to develop knowledge for the Government and subordinated agencies. These are counted as development funds, and the major part is used for R&D.

20. A dominant share of the R&D in the industrial sector is financed by the industry itself. The agricultural fund is financed by a levy on a number of agricultural products that are sold, and accounted for 9% of total financing.

21. The Agricultural Agreement (JA) between the Government and the two farmer unions allocate funds earmarked to cover the needs for knowledge for the ministry and the farmers through research.

22. The Foundation for Research Levy on Agricultural Products (FFL) was established in 1970. The Fund's capital is built up through a research fee when goods are delivered by farmer or when goods are imported. A Board allocates the funding to research where the results must be open.

23. The public advisory service (the Norwegian Agricultural Extension Service discussed below) is four-fifths financed by private means and one-fifth financed with funds from the annual agricultural agreement between the Government and the agricultural organisations representing the farmers. The level of funding of this agreement has been stable during the last decade.
2. Objectives, priorities, and outcomes

- What is the government policy regarding the nature, scope and role of AKS (and its components)?
  What major policy developments have occurred during the past decade?

24. The government declaration emphasise that competitiveness and innovative capabilities should be increased through investment in knowledge and research. An important factor for future performance is to ensure that basic and continuing education keep an adequate level. Recently, the government presented a report on the current educational situation in the agricultural area.

25. All sector-specific policy documents follow up the Government's most recent White Paper on agriculture and food, presented in 1999. The policy is further developed through the annual budget propositions from the Government to the Parliament. The Government is currently working on a new White Paper to be tabled in Parliament in 2011. The AKS policy is integrated in the general Norwegian policy for research and innovation. The national policy on research is outlined in the White Paper on Research of 2009; and the policy on innovation is outlined in the White Paper on Innovation of 2008.

26. During the last decade, climate change and food security has been given more attention. In addition, food is not only understood as a commodity, but as an integrated part of a chain of knowledge from basic research to the culinary experience, and other products and externalities from the agricultural bio economic resource base.

- What are the main objectives of AKS (and its components)? How have these changed during the past decade? What are the main instruments to achieve those objectives? How have these been developed during the past decade?

27. The main objective for the agricultural policy is national food security: development shall be sustainable; socio-politically by maintaining farming throughout the whole Norway and a basis of living; economically by providing a basis for increased value creation; and environmentally friendly by managing resources, taking climate change into account. During the past years, food security, climate change and relations to adjacent industries have been given greater emphasis in policy development.

28. In order to obtain this objective, the AKS must increase the skills among producers and organisations within agriculture, forestry, food industry and adjacent economic activity. The AKS supports the authorities with updated knowledge needed for regulation the sector, and the politicians in making knowledge based decisions. Finally, the AKS must inform the public about food safety and sustainable agriculture. In short, the AKS is meant to bring forward new knowledge through research, to use the results in teaching, and to disseminate the results to the farmers in order to continuously develop agricultural practice. Subordinate agencies and research institutes are important instruments to achieve these objectives. Subordinated agencies use, and to some extent define the needs for, knowledge from the research institutes. There are four research institutes under the Ministry of Food and Agriculture (see first question) that is partly financed directly by the Ministry. Another important instrument is research funds allocated through the Norwegian Research Council.

29. The main instruments are (funding described more fully above):

- The Annual Agreement on Agriculture (JA) between the Government and the two farmer unions.
- Grants for research through the Research Council of Norway (for basic funding of research institutes and assets subject to competition).
- Grants for knowledge development directly to research institutes.
- Definition of statutes for research institutes subordinated to the Ministry of Food and Agriculture.
- Regulation of the Research Levy on Agricultural Products (FFL).
- The Research Council participate on arenas where international research policy is formulated, with emphasis on the European Commission.

30. During the last decade, the ministries have reduced their role as administrative organs in favour of their role as political secretariats. At the same time, political decisions have been recognised as highly complex, underpinning the need for policy to be based on research results.

31. As mentioned above, public funding of R&D has increased by one-quarter in the last decade. As a part of this, a competitive element in the basic state funding has been introduced and which aims to build capacity in research institutes for sector-relevant expertise and high quality research services for the industry and the public sector.

- How are priorities set for AKS as a whole (and for its components)? What major changes in priorities have occurred during the past decade?

32. The AKS, understood as a network, includes both public and private organisations, and thus priorities by both parties. Following the hierarchical line, the priorities for public funds are reflected in the budgets, which are adopted by the Parliament, and thus the main pattern is a top-down process. Though, this is also a bottom-up process responsive to suggestions from subordinated agencies and the industry. In the end, the subordinated universities and institutes adopt their own strategies loosely connected to national policies.

33. Generally, the budget for higher education corresponds to the number of students. Public funds for research have increased in the last decade, including those for the AKS, as a result of the government’s long term goal of R&D-investment reaching 3% of GDP.

34. Annual negotiations between the government and organisations representing Norwegian farmers allocate certain funds and other policy instruments aimed at increasing knowledge in the sector.

- What major changes have occurred in programs, staff numbers and funding levels of AKS and its components during the past decade?

35. R&D in the AKS employs approximately 1400 full-time equivalents (FTEs), including approximately 700 FTEs within the institute sector, 400 within the industrial sector, and 300 within the educational system. Females are under-represented in permanent fixed positions, whilst over-represented in lower temporary positions. There will be significant recruitment needs over the next few decades.

- What changes have occurred in student intake by area of study within AKS and level of degree/diploma? How do these changes relate to existing or expected future employment opportunities?

36. Over the past decade, student numbers within the Norwegian AKS have fallen sharply, both within tertiary and vocational education. From more than 1600 students in 2001, less than 1100 students were enrolled in agriculture-related courses at Norwegian universities or university colleges in 2008, with 193 degrees being awarded that year (114 Bachelor degrees, 66 Master’s degrees, and 13 doctoral degrees). Animal science is by far the most popular area of study, both at the undergraduate and postgraduate levels. Forestry and forest and wildlife management follows at the undergraduate level, whereas plant sciences and primary industry studies are favoured by postgraduate students.

37. The Norwegian labour market is tight and the market for graduates in agriculture is strong. Forecasts estimate the demand to grow further during the next decade. With declining student numbers, the
Norwegian AKS is facing considerable recruitment challenge. Over the coming years, there will be considerable demand for graduates in ecology, nature management and land use management, followed by agronomy, forestry, animal science and plant science.

- What has been the impact of developments in the agricultural sector, markets, and policies, and consumer demand on priorities and functioning of AKS during the past decade?

38. General policies on impact assessment, as well as new legal acts in the area of nature diversity, water management and food production and food safety, require the AKS to emphasis even broader societal and environmental dimensions. Hereunder, the new legal framework for nature diversity regulates issues such as alien species, genetic resources and habitats. These regulations require additional assessment of the environmental effects of agricultural practices.

39. There is a general requirement that a socioeconomic analysis should be carried out when considering new policies and new regulations. This requirement is not new, but historically impact assessments, as well as regulatory requirements, have focused on areas such as agronomical aspects in relation to plant and animal breeding and risk assessment with regard to human, animal and plant health.

- How has AKS contributed to agricultural and food policy formation, to public understanding of policy issues and to policy implementation during the past decade?

40. Activities to inform the public have increased in the last decade and public understanding of policy issues is considered important. A recent trend is increased coverage of research related issues in the media.

41. The relevant universities and institutes are formally requested to provide knowledge-based advice on an ad hoc basis, and, when needed, to carry out targeted research or knowledge reviews. This provides decision makers in the agriculture and food sector with information on different options and the consequences of policy choices.

42. In 2004, a permanent scientific committee on food safety (VKM) was established to strengthen the scientific quality and integrity of scientific advice and risk assessment in the sector of food and agriculture (pesticides, additives, microbiological, natural toxins, plant health, animal welfare, GMO, etc.). This development puts more emphasis on a scientific and knowledge-based policy formation with regards to risks (some assessments include a risk-benefit analysis). The committee should primarily address national needs and not overlap with committees at the European (EFSA) or the international levels (the UN bodies such as JECFA, JEMRA and JMPR).

3. Relationships and networking

- How does AKS relate to the general scientific/educational community? How does AKS relate to any general science policy? How does AKS relate to the general higher education policy? Are there separate research institutes and higher education institutes dealing with agriculture or do AKS activities occur in general institutions?

43. The AKS is linked to the general science and higher education policy. Considering the AKS as research carried out for the agricultural sector, not including basic research within biology, etc., there is a considerable connection between basic research in other fields and agricultural science. The educational background of some 500 researchers affiliated with Norwegian universities and colleges include agriculture (43%), mathematics and science (34%), technology (6%), social sciences (6%), medicine and health sciences (1%), humanities and unspecified backgrounds (9%). Diverse backgrounds support transfer and combination of knowledge across disciplines. In addition to being connected to the general scientific
community, the Norwegian AKS is well suited to perform applied research in view of its close connections to the industry.

44. The AKS performs about 4% of all R&D in Norway. Approximately 25 organisations in the research institute and industrial sectors and the education system perform 75% of sector-specific R&D. In total, about 90 organisational units perform sector relevant R&D. A substantial part of this activity is concentrated in the south-east part of Norway.

45. Higher education at the university level has to be research-based. Consequently, the link between research and higher education is an inevitable part of the AKS. There are several independent research institutes that have their own network for the dissemination of their results, or they use the same channels as UMB. Some rural colleges educate candidates in agronomy. These courses of study are somewhat limited and research activity at those colleges is very modest. They are not involved in advisory services.

46. Components of the Norwegian AKS have a history of multi-institutional and multi-functional collaboration. There is substantial financing across sectors (Table 1). The Norwegian Research Council emphasises collaboration in their assessments of applications for research projects. Also, an increased number of research projects carried out for industry has also resulted in extended cooperation and formation of networks.

47. The Norwegian Agricultural Extension Service (Norsk landbruksrådgivning) is an organisation with 26 000 farmer members (more than 50% of all farmers) and 270 employees that through 41 counselling units develop knowledge and offer advise throughout the country. The organisation is a link between research and agriculture, and develops and tests for knowledge through local trials. About 800 field trials are conducted annually, as a basis for counselling in plant production, engineering, industrial, economical and environmental measures.

48. During the last ten years, the number of members in the Norwegian Agricultural Extension Service has been stable, whilst the number of units has been reduced and centralised. The services have become more holistic, covering farmer needs including business support, environmental plan of work, industrial and agricultural technical assessment, in addition to the traditional area of crop cultivation.

49. In 2009, a regional research fund was established in order to strengthen regional research and innovation. There is so far no evidence whether this generic instrument has strengthened the regional interaction between the industrial sector, the educational system, the institutes and the regions within the area of agriculture.

3. Internal AKS co-operation

50. The UMB and the institute sector co-operate within plant health and related areas. The NVI has comprehensive interaction with the UMB and the University of Oslo.
51. As described in the response to the first question, significant efforts have been made to create a larger research milieu through organisational and spatial concentration of NVI, NVH and UMB. The reorganisation will be completed in 2018.

- What opportunities for increased cooperation among the components of AKS have been identified and what mechanisms have been developed to encourage AKS cooperation during the past decade?

52. The Research Council of Norway emphasis on the development of cross-disciplinary research programmes and other incentives have stimulated co-operation at a general level. The physical and organisational concentration of the AKS may open new opportunities for co-operation. Co-location is important in order to get as high output as possible from investments in new research infrastructure. In addition, there is on-going discussion as to whether to establish an innovation centre in accordance with the new locus of agricultural research in Norway, and which may also open further co-operation with the industrial sector. The outcome of this process is not known.

5. Cross-country co-operation

- What have been developments in international cooperation among developed countries and emerging economies, and with developing countries?

53. The internationalisation of Norwegian research and research policy is increasing. Norway participates actively in European Research Area (ERA). Further co-operation, e.g. with other Nordic countries, is to be co-ordinated with the ERA-NET (European cooperation between national research programmes) and the planned Joint Programming Initiative (JPI) in the agriculture area. Norway also participates in EU’s Framework Programme (FP7) for Research and Technological Development, and increased efforts are aimed at promoting greater use of large-scale common infrastructure through the European Strategy Forum on Research Infrastructures (ESFRI). In many areas related to agriculture, Norway shares specific, common research interests with the North America. Hence, mobility programmes, specifically designed to strengthen research co-operation with the United States and Canada have been launched.

54. There has been a gradual shift in the priorities in research cooperation with emerging economies (BRICS), going from purely aid motivated to a focus on global grand challenges. Still, dedicated funding of research co-operation towards, for example, India and China is related to priorities set by the aid and development policy, and to a large degree funded by the State Aid Agency. With regards to developed countries, Norway has supported capacity building of higher education and research in agriculture and food production issues through the Norwegian programme for Education, Research and Development (NUFU) and Norad’s Master Programme (NOMA). Noragric as a centre at the Norwegian University of Life Sciences has played an important role in developing institutional collaboration agreements with the university’s many partners in Africa, Asia and South East Europe.

- What were the drivers of recent developments and is there scope for further co-operation?

55. The main driver for international co-operation is efficient division of labour and opportunities for solving global challenges. Global food security and the challenges of climate changes strengthen the significance of further international co-operation in the AKS. There are large differences in the drivers of the perceived need for intensified co-operation, ranging from capacity building in developing countries to the need for internationalisation of research and higher education in Norway. For the BRICS countries, and for China in particular, the policy emphasis is co-operation on an equal footing on a broad range of topics, to 1) solve major global challenges; 2) increase the quality of research; 3) get access to the newest knowledge, infrastructure and equipment, in some cases also data and talent; and 4) pave the way for businesses. Another trend is the increased international multilateral funding of research, motivated both by
global challenges and the increased competitiveness of a group of countries (e.g. EU’s FP7). Structures resembling the ERA are discussed in other parts of the world, in particular among the industrialised advanced countries in eastern Asia, that also link up to the ASEAN countries.

6. Toward the future

- Please describe the outcome of any self assessments or evaluations of changes which have occurred in AKS and its components during the past decade. What lessons have been learned in order to guide the activities of AKS in the coming decade?

56. In 2001, the Carlson Committee presented a report on how co-operation, organisation and the division of labour could improve agricultural research. The Committee concluded that three former institutions, the Norwegian Institute for Soil and Environmental Research (Jordforsk), the Norwegian Institute for Plant Research and the Norwegian Centre for Ecological Agriculture, should be merged into a single organisation.

57. In 2010, the Sponheim Committee was given a similar mandate, which resulted in a report in 2010. The Government is currently evaluating this report, which may lead to changes within the AKS. In particular, the Government is looking into changes to make the institute sector more efficient, especially in the area between the institute sector and the subordinated agencies of the Government.

- What major challenge is your AKS expected to face during the coming decade?

58. The main challenge is to develop the agricultural knowledge system coherently in order to meet overarching goals in an efficient manner. This includes meeting both the needs and wishes of the farmers and food industry, and of the authorities, including subordinated agencies.

59. There is a need for better knowledge about the impact derived from investments in the AKS as a mean to develop the system. As described above, committees continuously analyze the performance and suggest improvements. Still, it is necessary to systematically follow-up on the management of the AKS in order to improve its performance.

60. Another challenge is to maintain a balance between research for solving immediate problems and research for providing fundamental knowledge for future needs.

61. Recruitment of high quality science-oriented students to undergraduate and graduate programmes, as discussed above, will continue to be an important challenge. Even more important, due to the Norwegian practice of allodial title, farmers often do not acquire land until the age of 50. This presents tremendous challenges to the education system, particularly with regard to vocational training.

- Please give a general overview of experience/proposals for greater cooperation/coordination/integration among research/higher education/extension and suggest any conclusions from your country experiences, which you would wish to bring to the attention of the Joint Conference.

62. In order to use financial and human resources in an optimal way and avoid unnecessary overlap, it will be increasingly important to co-ordinate national and international research activities.

63. It seems crucial for the global community that results from research are disseminated and used in an efficient manner. Therefore, we recommend support for open access to publication channels.