

Study on Investment in Agricultural Research: Review for Switzerland

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List of Abbreviations

Agroscope	Swiss Federal Research Institute for the Agri-food Sector
AKIS	Agricultural Knowledge and Innovation System
BERD	Business enterprise Expenditure on Research and Development
BFS	Swiss Federal Statistical Office
CHF	Swiss Franc
CTI	Swiss Commission for Technology and Innovation
ETH	Swiss Federal Institute of Technology
FiBL	Research Institute of Organic Agriculture
FOAG	Federal Office for Agriculture
FOS	Field of Science
FTE	Full Time Employment
GBAORD	Government budget appropriations or outlays on Research and Development
GDP	Gross Domestic Product
GERD	Gross Domestic Expenditure on Research and Development
HAFL	School of Agricultural, Forest and Food Science
Mio	Million
NABS	Nomenclature for the Analysis and Comparison of Science Budgets and Programmes
NACE	Classification of economic activities in the European Union
OECD	Organisation for Economic Cooperation and Development
R&D	Research and Development
SBV	Swiss Farmer's Association
SNSF	Swiss National Science Foundation
UAA	Utilised Agricultural Area
USYS	Environmental Systems Science
ZHAW	Zurich University of Applied Sciences

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FOREWORD

This report forms part of the deliverables from a project called "IMPRESA" which has been awarded financial support by the European Commission under the 7th Framework Programme.

The project aims to evaluate the impact of research on agriculture performed in the EU, collecting data on recent trends in investment in agricultural research, and developing a framework combining case studies, econometric analysis and modelling for assessing its impact. A first task is to prepare country-level analysis of the agricultural research expenditures and an assessment of the availabilities of data regarding public and private investments in agricultural research.

Agricultural research covers all research on the promotion of agriculture, forestry, fisheries and foodstuff production. It includes: research on chemical fertilisers, biocides, biological pest control and the mechanisation of agriculture; research on the impact of agricultural and forestry activities on the environment; research in the field of developing food productivity and technology¹.

More information on the project can be found at <http://www.impresa-project.eu>.

¹ <http://www.impresa-project.eu/glossary.html>

1. INTRODUCTION

Macroeconomic context of Switzerland

The Swiss Gross Domestic Product (GDP) per capita accounted for 74,000 CHF (€ 61,400) in 2012 (BFS 2014a). In 2009, it dropped 3.5 % as a consequence of the economic crisis. Since then it continuously increased annually by 0.1 to 2.2 %; reaching the level of 2008 again in 2011. The rate of unemployment showed a contrary development. The unemployment rate increased by 0.9% in 2009 and fluctuated in the following three years between 4.0 and 4.5% (BFS 2014b). Between 2008 and 2012 the GDP per capita was almost constant around 74,000 CHF with a slight decrease in 2009 to 71,100 CHF. Meanwhile, there was a GERD increase of 2,210 million CHF (+13.6%) (BFS 2014c). Overall it seemed that the weakened economic growth between 2008 and 2012 had no negative influence on the expenditures on R&D. According to the last Global Competitiveness Report (Dutta et al. 2014), Switzerland has the highest global competitiveness index. The report emphasizes that the Swiss economy is mainly driven by the stability of the macroeconomic situation and ii) the innovation of their companies.

Macroeconomics of the Agri-Food Sector

The primary sector in Switzerland is very small compared to the secondary and the tertiary sector and its share on the Swiss GDP decreased between 2008 and 2012. Depending on the source, the whole primary sector made between 0.65 and 0.73% of the Swiss GDP (BFS 2014d, Statista 2014). In contrast to the primary sector, the food and food service industries (production of food, beverages, tobacco, restaurants, catering) increased in the same period of time by 9.5% (BFS 2014d). The GDP of the food and food service industries accounted in 2012 for 3.2% of the total Swiss GDP.

The number of employees in the agricultural sector was continuously decreasing by 5.6% from 2008 to 2012 (BFS 2014e). At the same time, the number of employees in the food sector (food industry, food wholesale and retail, food service industry) increased by 4.6% (BFS 2010, BFS 2014n). In 2012, 531,000 employees worked in the agriculture and food sector. This accounts for 11% of all Swiss employees.

The Swiss trade balance of agricultural and forestry products is negative. The balance accounted a minus of about 4,650 million CHF (- € 3,859 million) in the year 2012 (BFS 2014f, BFS 2014g). The Swiss trade balance for food, beverages and tobacco is negative as well and amounted of -2,236 million CHF (- €1,855 million) in 2012 (BFS 2014o). The most important imported foods are vegetables, fruits and wine (BFS 2014f). They made more than 20% of all the imports in this sector. On the other hand, cheese was the most important exported food, accounting for 6.3% of the exports in the agricultural and forestry sector (BFS 2014g). There was a trend of decreasing imports between 2008 and 2011, which was broken in 2012. Meanwhile the amount of exports seemed to be stable.

Content of the report

The following report contains a review of the funding, expenditures of and trends in the Swiss agri-food research between 2008 and 2012. We start (chapter 2) with a short overview about the national agricultural knowledge and innovation system (AKIS). The next chapter provides information about the quantity and the intentions of public and private expenditures in research projects and research institutions (chapter 3). The main part of the report subsequently describes and discusses recent trends in agricultural research (chapter 4). The information for this report is mainly provided by literature research and statistic databases. Information which was not available in literature was gained through interviews and consultancy of experts in the agri-food sector. The list of the consulted experts is provided in the annex.

2. OVERVIEW OF THE SWISS AGRICULTURAL AND INNOVATION SYSTEM

2.1 Overview of the AKIS

The Swiss Agricultural Knowledge and Innovation System (AKIS) includes both public as well as private or semi-private actors (see Figure 1).



Figure 1: The AKIS-institutions in Switzerland in a broad understanding
Source: Barjolle 2011

2.2 Main actors

Farms and Food Industry: General Facts

Between 2008 and 2012, the number of employees in the agricultural sector decreased (Table 1) by 5.6% from 171,634 in 2008 to 162,028 in 2012 (BFS Die interaktive Statistikdatenbank). Parallel to this, the number of farms decreased in the same period. However, the number of organic farmers stayed constant during these years, accounting for about 10% of the farms. The number of farms shrank disproportionately to the number of total employees. More than 7% of the farms were abandoned between 2008 and 2012. In 2012, there were 56,575 farms in Switzerland. In the same period, the utilised agricultural area (UAA) stayed almost constant. It decreased only by 1% from 1'058'000 ha UAA to 1'049'900 ha UAA. The domestic food production increased between 2008 and 2012 slightly by 2.2% from 23,018 TJ to 23,529 TJ metabolisable energy (SBV 2013, SBV 2014).

The economic performance of Swiss farms was almost evenly distributed to plant production (42%) and animal products (47%), whereas other products and services accounted for 11% of the output (BFS 2014c). In 2008, the food industry in Switzerland numbered 2,500 companies, totally employing 62,200 people (BFS 2010).

Table 1: Number of employees in the agricultural sector and in the food industry and number of farms. Numbers in brackets denote number of employees in food and tobacco industry.

Year	No of employees in agricultural sector (organic in %)	No of farms	No of employees in food industry
2008	171'634 (10.0 %)	60'894	62'200 (65'325) ²⁾
2009	169'788 (9.8 %)	60'034	Not available ¹⁾ (66'050) ²⁾
2010	167'462 (9.8 %)	59'065	Not available ¹⁾ (65'750) ²⁾
2011	164'067 (10.2 %)	57'617	Not available ¹⁾ (65'525) ²⁾
2012	162'028 (10.7 %)	56'575	Not available ¹⁾ (66'500) ²⁾

Source: BFS 2014h, BFS Die interaktive Statistikdatenbank, BFS 2010.

¹⁾ Data collection every 4th year, no data collection in 2012

²⁾ Numbers in brackets denote number of employees in food and tobacco industry

Main Actors

The main actors of the Swiss Agriculture and Innovation System are the research institutions on the one hand, and the public and private foundations on the other hand. In the following paragraphs, the main actors are listed and briefly described.

Research Institutions:

There are seven important education and research organisations in the agri-food sector, namely the Swiss Federal Institute of Technology (ETH), Swiss Federal Research Institute for the Agri-food Sector Agroscope, Research Institute of Organic Agriculture (FiBL), AGRIDEA, School of Agricultural, Forest and Food Science (HAFL), Vetsuisse and Zurich University of Applied Sciences (ZHAW).

Federal Organisations:

ETH USYS: The Environmental Systems Science (USYS) part of the Swiss Federal Institute of Technology (ETH or FIT) lays his focus on international fundamental research in agricultural, food as well as in environmental science (ETH 2014a). In the following, "ETH" means "the agricultural research part of ETH".

Agroscope: Agroscope is the Swiss federal research institute for the agri-food sector and is affiliated with the Federal Office for Agriculture (FOAG). Agroscope's research is based on the following six thematic priorities representing the challenges currently faced by the agri-food sector: (1) Ecological intensification; (2) Safeguarding natural resources; (3) Challenge of climate change; (4) High-quality food; (5) Improved competitiveness; (6) Vital and attractive rural areas.

Cantonal organisations with federal financial support:

HAFL: HAFL is the School of Agricultural, Forest and Food Science (www.hafl.bfh.ch).

Vetsuisse: The Vetsuisse faculty performs research mostly in the area of animal well-being in its research stations in Bern and Zurich (Vetsuisse 2014).

ZHAW: The Zurich University of Applied Sciences includes a school of life science and facility management (www.zhaw.ch).

Private Organisation with financial support from the Federal Office for Agriculture (FOAG):

FiBL: The Research Institute of Organic Agriculture FiBL is one of the world's leading research, information and documentation centre for organic agriculture (FiBL 2014).

AGRIDEA: AGRIDEA is the national competence centre for agricultural practice in Switzerland. Its mission is to edit, exchange and spread knowledge of agricultural praxis and research to farmers (FOAG 2007).

Industrial R&D:

The headquarters of Syngenta and Nestlé are located in Switzerland. Syngenta and Nestlé are two of the world's most important agri-food companies. In 2012, Syngenta spent CHF 1.18 million per year (€ 0.98 million, Syngenta 2013) and Nestlé 1.41 million

CHF per year (€ 1.17 million, Nestlé 2013) for research and development worldwide. Therefore, Syngenta and Nestlé are key players in the private funding and performance of R&D in Switzerland.

The Syngenta Foundation for Sustainable Agriculture works with partners in developing countries and emerging markets. Its mission is to create value for resource-poor small farmers in developing countries through innovation in sustainable agriculture and the activation of value chains. Sustainable improvement in human nutrition is one of the major issues in the portfolio of the Nestlé Foundation. During more than 40 years basic and applied research in nutrition has been supported by the Foundation in more than 50 developing countries.

Public funders of agricultural research:

The Federal Office for Agriculture (FOAG), the Swiss National Science Foundation (SNSF), and the Swiss Commission for Technology and Innovation (CTI) are the three most important public funders of agricultural research in Switzerland. In the following, they are shortly presented.

FOAG: The Federal Office for Agriculture has a priori access to the periodical service contracts with its agricultural-research partners as well as to specific research mandates and contributions. The performance mandate with Agroscope is based on the Swiss federal government's impact-oriented management principles, particularly those of the Integrated Performance and Impact Management model. In addition, there are periodic service contracts with FiBL and AGRIDEA, as well as with smaller agricultural-research institutions and research networks. Further mandates and contributions for urgent agricultural-policy-related projects are awarded quarterly by the FOAG to institutions that are competent and ideally networked in the field in question. One specific form of research contribution is financial aid for Swiss involvement in ERA-NET consortia, which deal with relevant, priority subject and problem areas.

SNSF: The Swiss National Science Foundation has been mandated by the Swiss Confederation to fund basic research and promote young scientists in Switzerland (SNSF, Strategy).

CTI: The Commission for Technology and Innovation, the Swiss innovation promotion agency, supports market-oriented projects and start-up companies (CTI 2014b). Furthermore, CTI provides knowledge and technology transfer.

Finally, the Swiss farmers are central to the Agriculture and Innovation System. They are represented by their professional organisations. The Swiss farmers' association represents 57,000 farmer families. Bio Suisse, the federation of organic farmers in Switzerland, represents 32 Swiss organic farmers' associations.

2.3 Governance

The Swiss Confederation and its constitution unite the will and interests of all its 26 cantons. However, the agri-food area is partly directed by the Federal Department of Economic Affairs, Education and Research and partly by the canton's governments. The FOAG is the executive institution and implements decisions taken by the electorate, the Swiss parliament and the Swiss government. It is responsible for formulating the Swiss agricultural policy and the research and education strategy in the area of agriculture and food. As mentioned above, Agroscope is directly subordinated to the FOAG and therefore it is the main instrument to fulfil their interests with respect to research. In contrast, the ETH Zurich is an autonomous federal institution established under public law and with its own legal personality (ETH 2014b). The ETH Board is the strategic management body of the ETH and is directly elected by the Federal Council.

3. AVAILABILITY OF DATA ON AGRICULTURAL RESEARCH EXPENDITURES

3.1 Overview of data availability

The Swiss Federal Statistical Office (BFS) collects data about the expenditures on research and development (R&D) of the Swiss government, which are published every second year. Data availability is summarized in Table 2.

Gross domestic expenditures on research and development (GERD) are provided on an aggregate level since 1981. However, as far as agricultural research and development is concerned, the available data is considerably less detailed and not consistently available for all sectors (business enterprises, government sector, higher education sector, private non-profit sector).

Business enterprise R&D expenditures (BERD) are collected on an aggregate level for all research areas from 1981 to 2008. However, data on business enterprise agricultural R&D expenditures is lacking.

Government budget appropriations or outlays on R&D (GBAORD) are available for all research areas as well as for agriculture since 1981.

Apart from single years, all data about the Swiss expenditures on R&D are available in the EUROSTAT database.

Additionally to data from the Swiss Federal Statistical Office (BFS), for this report, we used published annual reports from the different agricultural research organisations. Especially the reports of the FOAG and Agroscope provided a lot of information about the expenditures in agricultural R&D and about the funding mechanisms.

Table 2: Data availability for the main indicators

Indicator	Time series available
GERD	
All areas	
<i>All sectors</i>	1981, 1983-1992 every 3 rd year, 1992-2008 every 4 th year, 2012
<i>Business enterprise sector</i>	1981, 1983-1992 every 3 rd year, 1992-2008 every 4 th year, 2012
<i>Government sector</i>	1981, 1983-1992 every 3 rd year, 1992-2008 every 4 th year, 2012
<i>Higher education sector</i>	1981, 1983, 1986, 1988-1992, 1992-2010 every 2 nd year, 2012
<i>Private non-profit sector</i>	1981, 1983, 1986, 1988-1989, 1992-2010 every 2 nd year, 2012 1983-1992 every 3 rd year, 1992-2008 every 4 th year, 2012
By FOS (Agricultural sciences)	
<i>All sectors</i>	Not available
<i>Business enterprise sector</i>	Not available
<i>Government sector</i>	Not available
<i>Higher education sector</i>	2000, 2004, 2008, 2012
<i>Private non-profit sector</i>	Not available
By NABS 1992	
<i>All areas</i>	
<i>Chapter 6 - Agricultural production and technology</i>	
<i>All sectors</i>	2000, 2004
<i>Business enterprise sector</i>	1992, 1996, 2000, 2004
<i>Government sector</i>	1981, 1992, 1996, 1998, 2000, 2002, 2004, 2006
<i>Higher education sector</i>	Not available
<i>Private non-profit sector</i>	Not available
By NABS 2007	
<i>All areas</i>	
<i>Chapter 8 – Agriculture</i>	
<i>All sectors</i>	2004
<i>Business enterprise sector</i>	2004, 2012
<i>Government sector</i>	2004, 2006, 2008, 2010, 2012
<i>Higher education sector</i>	Not available
<i>Private non-profit sector</i>	Not available
BERD	
By NACE rev. 1.1	
<i>All areas</i>	1981, 1983, 1986, 1989, 1992, 1996, 2000, 2004, 2008
<i>A B - Agriculture, forestry and fishing</i>	Not available
<i>DA15 - Manufacture of food products and beverages</i>	Not available
By NACE rev. 2	
<i>All areas</i>	2008, 2012
<i>A - Agriculture, forestry and fishing</i>	Not available
<i>C10 C11 - Manufacture of food products and beverages</i>	Not available

Indicator	Time series available
GBAORD	
By NABS 1992	
<i>All areas</i>	1981, 1983, 1986, 1988, 1989, 1990, 1992- 2006 every 2 nd year
<i>NBS06 - Agricultural production and technology</i>	1981, 1986,1988, 1989, 1990, 1992-2006 every 2 nd year
<i>NBS1107 - Agricultural sciences</i>	Not available
By NABS 2007	
<i>All areas</i>	1981, 1983, 1986, 1988, 1989, 1990, 1992 – 2010 every 2nd year, 2012
<i>NABS08 - Agriculture</i>	2004, 2006, 2008, 2010, 2012 ¹
By BFS methodology	
<i>All areas</i>	1992 – 2012 every 2 nd year
<i>Agriculture</i>	1992 – 2012 every 2 nd year ¹

In black: data available in EUROSTAT database

In red: national data not available in EUROSTAT database

¹ Swiss GBAORD distribution according to NABS since 2012

3.2 National expenditure on research

The Gross domestic expenditure on R&D (GERD) is the total intramural expenditure on R&D and is the main aggregate used for international comparisons of investments in research and development. Usually, GERD is broken down in four sectors: business enterprises, higher education, private not-for-profit organisations and government. Below, we show the GERD distribution i) broken down by the four sectors of performance (Figure 3) and ii) broken down by the four sectors of funding (Figure 2).

From 1992 to 2012, the total expenditures on R&D in Switzerland doubled and amounted to 18,510 million CHF (€ 15,360 million) in 2012 (Figure 2, Figure 3). As far as the development of the different funding sources between 1992 and 2012 is concerned, the R&D investments of the business enterprises increased steadily until 2008, where the share accounted for 68.2% of the total GERD. Subsequently, the expenditures of the private sector stayed constant, which may be explained by the economic crises. In contrast, the government's outlays started increasing after the year 2000 and almost doubled in the 12 years until 2012. Since 2008, foreign sources gained importance and amounted to 12.1% of the total GERD in 2012. In 1992, the share of the abroad sector was less than 2%.

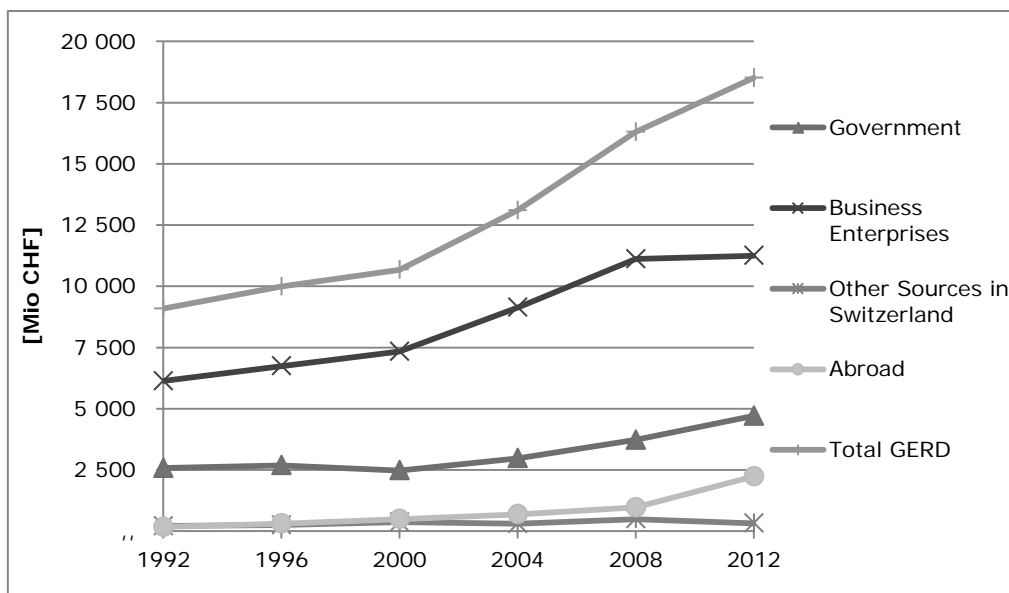


Figure 2: Swiss GERD distribution by R&D funding from 1992 until 2012. Data collection every 4th year.

Source: BFS 2014i

The Swiss GERD distribution by sectors of performance shows high R&D performance of the business enterprises and the higher education sector but low performance of the government and of the private non-profit organisations.

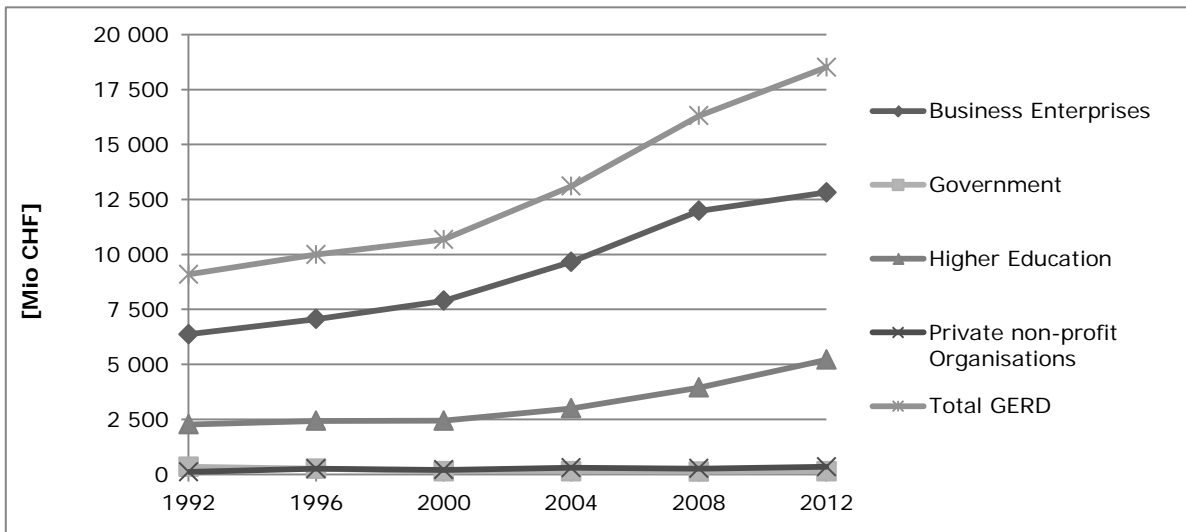


Figure 3: Swiss GERD distribution by performance in total and per sector from 1992 until 2012. Data collection every 4th year. Source: BFS 2014c

Switzerland has one of the highest GERD intensities of all the OECD countries (Figure 4). In 2008, it accounted for 2.73% and increased to 2.96% in 2012 (BFS 2014c). The average of the OECD countries was 2.33% in 2008 and 2.40% in 2012, whereas the average of the EU-28 member states was below 2.00%. The trend analysis in the EUROSTAT Swiss country report (EUROSTAT 2011) predicted a GERD intensity of about 3.50% in 2020 and slightly above 2.00% for the EU-28 average.

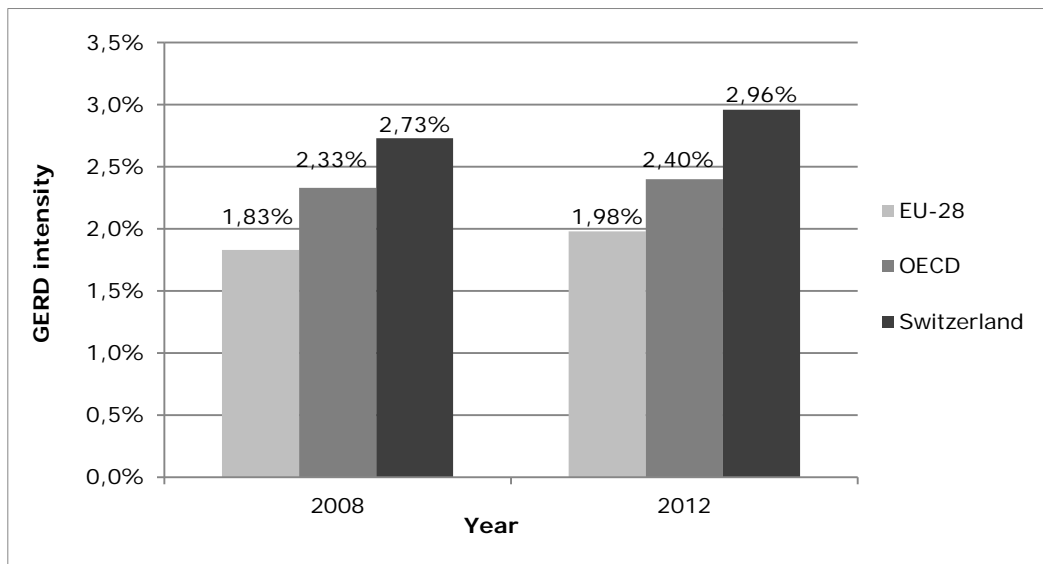


Figure 4: GERD intensity of Switzerland, the OECD average, and the EU-28 average in the years 2008 and 2012. Source: BFS 2014c, EUROSTAT 2011, EUROSTAT 2014, OECD 2014

3.3 Investment in agricultural research

3.3.1 Public and private effort

Government budget appropriations or outlays on R&D (GBAORD) mean all appropriations by central government allocated to R&D in government budgets. Data on government R&D appropriations therefore refer to budget provisions, not to actual expenditure.

The Swiss government's budget provisions for R&D (GBAORD) increased from 2,850 million CHF in 1992 to 5,445 million CHF (€ 4,518 million) in 2012 (BFS 2012, BFS 2014j). The share of governmental provision for agricultural R&D on the total GBAORD fluctuated between 1% in 2006 to 3% in 2002. In 2012, the share of agricultural R&D on the total GBAORD amounted to 1.6%.

According to BFS (2014j), the actual governmental provisions for agricultural R&D varied considerably between 1992 and 2012 (BFS 2014j) with a peak in 2004 of CHF 115 million (€ 74 million) and a low in 2006 amounting CHF 35 million (€ 22 million). Since then, the agricultural GBAORD increased again, reaching 85 million CHF (€ 70 million) in 2012 (see Table 3). However, this strong fluctuation is not confirmed by the actual governmental agricultural R&D expenditures. Indeed, the governmental budget expenditures for agricultural R&D in the same period varied less between CHF 71 and 85 million (€ 45 - 70 million) (Table 3). Thus there is a discrepancy between the agricultural GBAORD and the governmental budget expenditures for agricultural R&D.

Table 3: Comparison between the governmental budget provisions for agricultural R&D (GBAORD) and the Governmental budget expenditures for agricultural R&D between 2000 and 2012 in million CHF (million Euro). Data collection every second year.

Source: BFS 2014j

Year	Governmental budget provisions agricultural R&D (GBAORD)		Governmental budget expenditures agricultural R&D	
	Million CHF	Million Euro	Million CHF	Million Euro
2000	75	48	84	54
2002	90	61	77	53
2004	115	74	74	48
2006	35	22	72	46
2008	75	47	71	45
2010	80	58	77	56
2012	85	70	85	70

There are little data available for the business expenditures on agricultural R&D (BERD) since 1996 (Figure 5). The expenditures exceeded 400 million CHF in 1996 before they nearly decreased to 50 million CHF (€ 33 million) in 2000 (BFS 20145). From 2004 until 2012, the agricultural BERD increased from 276 million CHF (€ 179 million) to 328 million CHF (€ 272 million). However, the reasons for the found variations in the business expenditures between these years are unclear. The Federal Statistical Office stresses that the allocation of R&D expenditures to the different areas is not always easy (BFS 2015). Therefore, no trend in the expenditures of the private business sector can be identified.

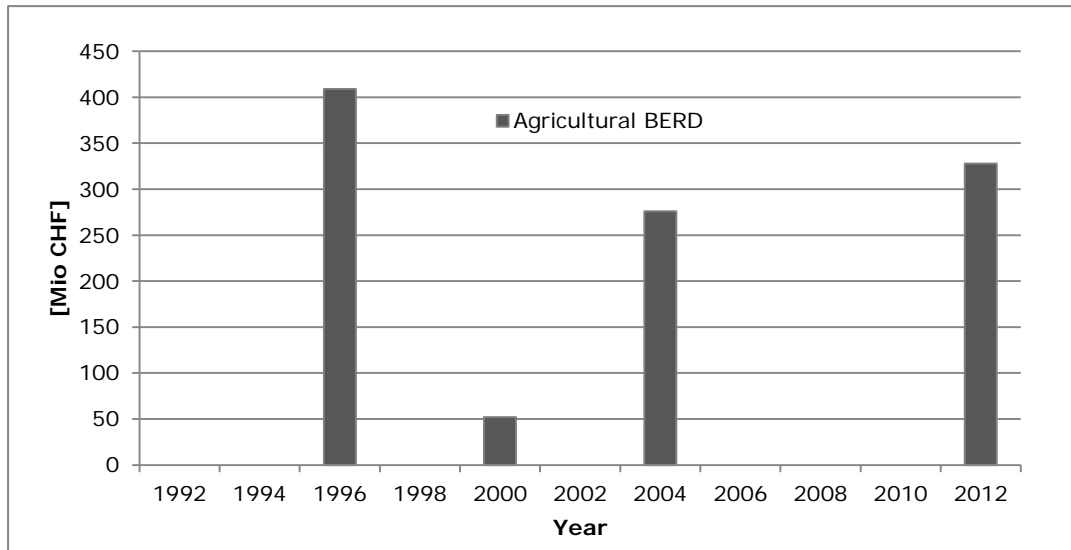


Figure 5: Development of the investments by business enterprises (BERD) in agricultural R&D. Data collection every 4th year. Data from 1992 not available; data from 2008 not separately for agriculture available.
Source: BFS 2014k

3.3.2 Research and extension effort

The shares of the research expenditures and of other expenditures of six education and research organisations in the Swiss agri-food sector are shown below (Table 4). ZHAW is excluded in the table, because of its little relevance in agricultural research. ETH, Vetsuisse Universities and HAFL have a mandate for education from the federal and cantonal governments thus considerable part of the expenditures are dedicated to education. Contrarily to HAFL and Vetsuisse Universities, research at ETH is much more important accounting for 66 % of the expenditures. Agroscope also has a strong focus on research but has to fulfil as the federal research institution monitoring and legal tasks in agricultural legislation which amount 37% of the total Agroscope expenditures. In contrast to the above mentioned institutions, FiBL and AGRIDEA put a substantial amount of resources and effort in extension services. Whereas AGRIDEA has a governmental mandate for agricultural extension, wherefore most of the 99 % of other expenditures are used for extension services, FiBL is first of all a research institution (71% of the expenditures are for research) with strong commitment to development cooperation, extension, education and communication of research results which account for 29% of the total expenses. However, the development aspect becomes more and more important in projects in development cooperation and extension.

Table 4: Shares of research and other expenditures of ETH Agrar, Agroscope, FiBL, HAFL, AGRIDEA, and Vetsuisse Universities in 2012.

Year	Share of Research Expenditures	Share of other Expenditures	Total
ETH	66%	34%	100%
Agroscope	63%	37%	100%
FiBL	71%	29%	100%
HAFL	20-39%	61-80%	100%
AGRIDEA	1%	99%	100%
Vetsuisse	39%	61%	100%

Source: BFS 2014m, FOAG, Factsheet 2012, Agroscope 2014, Survey AGRIDEA 2014, Survey FiBL 2014, Survey HAFL 2014

3.4 Gap analysis

In general, data availability about R&D in Switzerland is good but mainly on an aggregate level. Gross domestic expenditures on agricultural research and development (GERD) are provided however not very detailed and not consistently in long time series for all sectors (business enterprises, government sector, higher education sector, private non-profit sector). Government budget appropriations or outlays on R&D (GBAORD) are available for all research areas including research on agriculture since 1981. The Swiss Federal Statistical Office BFS switched GBAORD distribution to NABS in 2012.

As far as business enterprise R&D expenditures (BERD) are concerned, BERD on total is only available until 2008. But BERD for the agricultural sector is not provided.

Most of the data were only collected for every second, and some only for every fourth year. Apart from single years, all data collected by the Swiss Federal Statistical Office BFS are available to EUROSTAT and the OECD databases.

4. RECENT TRENDS REGARDING INVESTMENTS IN AGRICULTURAL RESEARCH

Below we present trends regarding the investments in agricultural research from two different sources: from the analysis of available statistics (4.1) and from the analysis of a consultation of research institutions (4.2).

4.1 Analysis of available statistics

Gross domestic Expenditures on total R&D

Below, we show the distribution of the gross domestic expenditures on total R&D (GERD) i) broken down by the four sectors of performance (Table 5) and ii) broken down by the four sectors of funding (Table 6).

In 2008, the GERD accounted for 16,300 million CHF (€ 10,270 million) (Table 5). In the following four years, it increased by 14% and reached 18,510 million CHF (€ 15,360 million) in 2012 (BFS 2014c).

According to the sector analysis by NABS 2007, the total R&D performance was mainly conducted by business enterprises and by higher education institutes. The share of the business enterprises on the total expenditures amounted to 69.3% in 2012 and the share of the higher education sector to 28.1%. Private non-profit organisations (1.8% in 2012) as well as the government sector (0.8% in 2012) accounted only for a very small part of the expenditures (Table 5). While the performance of the higher education sector increased 3.9% during the time period of interest, the relative performance of the business enterprise sector decreased 4.2%.

Table 5: Swiss GERD by performance in total and per sector. Numbers in EUR were calculated with the average exchange rate of the corresponding year (see Appendix II).

Source	Year2008 [Million CHF]	Year2008 [Million EUR]	Year 2012 [Million CHF]	Year 2012 [Million EUR]
Total GERD	16'300 (100%)	10'270	18'510 (100%)	15'360
Business Enterprises	11'980 (73.5%)	7'550	12'820 (69.3%)	10'640
Higher Education	3'940 (24.2%)	2'480	5'210 (28.1%)	4'320
Private non-profit Organisations	260 (1.6%)	160	340 (1.8%)	280
Government	120 (0.7%)	80	140 (0.8%)	120

Source: BFS 2014c

Looking at the GERD by sectors and source of funding (BFS 2014i), the business enterprise sector invested the biggest amount of financial resources in R&D (11,250 million CHF, € 9,335 million in 2012) (Table 6). However, the share of the business enterprise sector on the total GERD decreased 7.4% between 2008 and 2012. In contrast, the government - as the second biggest investor - increased its share in this time period 2.6%. The confederation and the cantons raised their investments from CHF 3,725 million (€ 2,350 million) in 2008 to 4,705 million CHF (€ 3,905 million) in 2012. In addition, the investments from abroad also increased in these four years. The amount of 2,235 million CHF (€ 1,855 million) in 2012 equalled an increase of 130% between 2008 and 2012. Other sources were not as important, accounting for 3.0% in 2008 and 1.7% in 2012.

Table 6: Swiss GERD by funding. Numbers in EUR were calculated with the average exchange rate of the corresponding year (see Appendix II).

Source	Year 2008 [Million CHF]	Year 2008 [Million EUR]	Year 2012 [Million CHF]	Year 2012 [Million EUR]
Total GERD	16'300 (100%)	10'270	18'510 (100%)	15'360
Government	3'725 (22.8%)	2'350	4'705 (25.4%)	3'905
Confederation	2'355 (14.4%)	1'485	2'835 (15.3%)	2'355
Cantons	1'370 (8.4%)	865	1'870 (10.1%)	1'550
Business Enterprises	11'115 (68.2%)	7'005	11'250 (60.8%)	9'335
Other National Sources	490 (3.0%)	305	320 (1.7%)	265
Abroad	970 (6.0%)	610	2'235 (12.1%)	1'855

Source: BFS 2014i

4.1.1 Public

According to the Swiss Federal Statistical Office, the budget provisions of the Swiss Government on R&D (GBAORD) strongly increased between 2008 and 2012 (Figure 6). The total expenditures amounted to 4,160 million CHF (€ 2,620 million) in 2008 and to 5,445 million CHF (€ 4,520 million) in 2012, which corresponds to an increase of 31 %. The agricultural GBAORD accounted for 85 million CHF (€ 71 million) in 2012, which is only 1.6% of the government's total budget for R&D (BFS 2014j). Although the agricultural GBAORD increased between 2008 and 2012, the relative increase of 13% was much smaller compared to the total GBAORD increase of 31%.

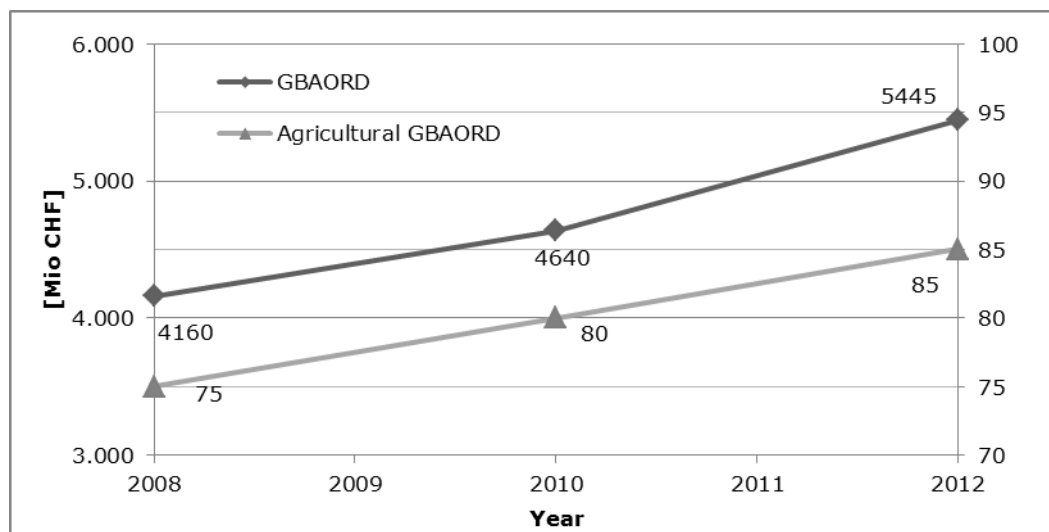


Figure 6: Total GBAORD and agricultural GBAORD of Switzerland between 2008 and 2012.

Source: BFS 2014k

In 2008, Switzerland invested 0.73% of its total expenditures in R&D, which was below the average of the EU-28 member states (Figure 7, BFS 2014j). However, the share of the governmental expenditures increased constantly to 0.92% in 2012. In contrast, the OECD average and the average of the EU-28 member states decreased after the peak in 2009. In 2012, both - the EU-28 and the OECD - were below their level of 2008 with a share of 0.73 and 0.68%, respectively.

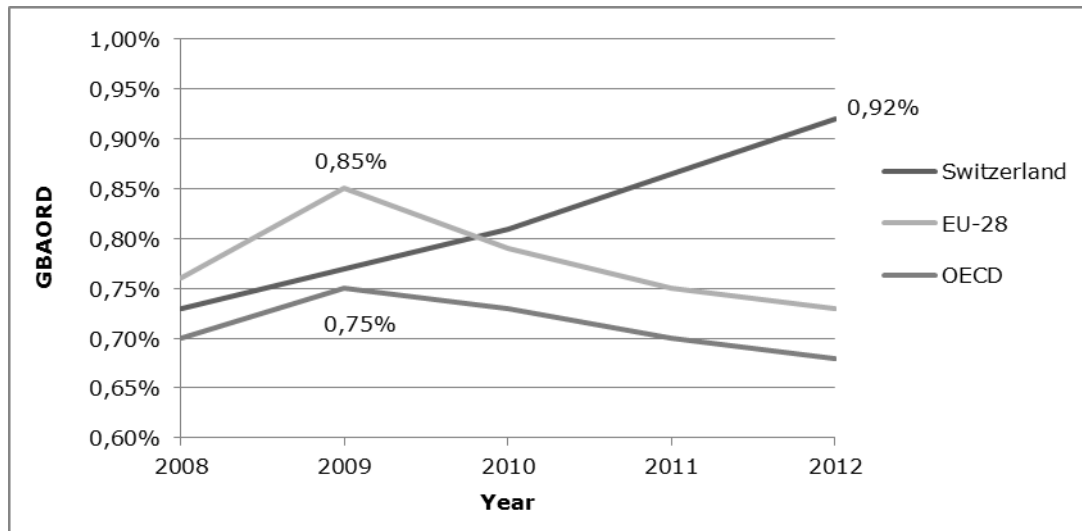


Figure 7: GBAORD as percentage of the total expenditures of Switzerland, the average of the EU-28 and the average of the OECD from 2008 until 2012.
Source: BFS 2014k

The Federal Office for Agriculture (FOAG), the Swiss National Science Foundation (SNSF) and the Swiss Commission for Technology and Innovation (CTI) are the three most important public funders of agricultural research in Switzerland.

FOAG agricultural research expenditures

The research expenditures of the FOAG are presented in Table 7. After the decrease of the expenditures in 2010 and 2011, the budget was planned to steadily be increased. The FOAG planned a continuous increase of their outlays of about 1 million CHF (€ 0.8 million) per year from 2013 until 2016. FOAG research funding includes for the period from 2008 to 2013 the public funds for FiBL and additional funds for research on fireblight (FOAG 2012).

Comparing the governmental budget provisions for agricultural R&D (agricultural GBAORD) with the total expenditures of the FOAG on agricultural R&D, we see that FOAG's expenditures amounted annually to more than CHF 69 million in 2010 and almost CHF 87 million in 2012 (FOAG, Factsheets 2008, 20112) and thus were similar to the Swiss agricultural GBAORD of 85 million CHF. However, apart from FOAG, there are also other governmental organisations providing funds for agricultural R&D. Furthermore, the cantons are important funders of the universities of applied science such as HAFL and ZHAW. Thus, as the FOAG expenditures on research corresponded closely to (2008 and 2010) or were even higher (2012) than the budget provisions on agricultural R&D documented in the agricultural GBAORD, the agricultural GBAORD seems not to include all governmental budget provisions for agricultural R&D and thus underestimate the efforts of the Swiss governmental organisations for agricultural R&D.

Table 7: Expenditures of the FOAG on R&D. Numbers in EUR were calculated with the average exchange rate (see Appendix II) of the corresponding year. For 2015 and 2016 the average exchange rate of 2014 was used.

a=actual number, b=budget, c=finance plan, d=estimate.

Year	Research contracts in 1000 [CHF] and [EUR]		Research funding in 1000 [CHF] and [EUR]		Agroscope funding in 1000 [CHF] and [EUR]		Total in 1000 [CHF] and [EUR]	
2008 ^a	654	412	6'080	3'833	63'039	39'737	69'773	43'982
2009 ^a	660	437	6'873	4'553	67'203	44'517	74'736	50'912
2010 ^a	642	465	6'258	4'533	63'395	45'922	69'653	50'920
2011 ^b	478	388	6'125	4'968	63'789	51'739	70'392	57'095
2012 ^b	318	264	5'452	4'524	80'983	67'200	86'753	71'988
2013 ^b	697	566	5'843	4'747	81'416	66'149	87'956	71'462
2014 ^c	535	439	5'951	4'882	63'880	52'404	70'366	57'725
2015 ^c	543	445	6'040	4'955	64'837	53'189	71'420	58'589
2016 ^d	550	451	6'130	5'029	65'810	53'987	72'490	59'467

Source: 2008-2010 and 2014-2016: FOAG 2012; 2011-2013: FOAG Factsheets 2011-2013

Agricultural research expenditures of the Swiss National Science Foundation and the Commission for Technology and Innovation

Currently, there are two National Research Programs (NRP) of the Swiss National Science Foundation (SNSF) in the area of food and agriculture (SNSF, National Research Programmes (NRPs)):

1. NRP 68 "Sustainable Use of Soil as a Resource": 13 million CHF (€ 10.5 million) in 5 years (2013-2017)
2. NRP 69 "Healthy Nutrition and Sustainable Food Production": 13 million CHF (€ 10.5 million) in 5 years (2013-2017)

Also in other research programs, the Swiss National Science Foundation funds research in agriculture or food. The financial volume of these projects is, however, negligible.

In recent years, project funds of the Commission for Technology and Innovation (CTI) increased for projects in the area of agriculture. The financial resources rose from 1.3 million CHF in 2011, to 1.4 million CHF in 2012 and 1.9 million CHF in 2013 (CTI 2014b). Meanwhile the expenditures on food technology projects varied between 0.7 million CHF in 2011, to 2.5 million CHF in 2012, and to 1.4 million CHF in 2013. Therefore, no trend on the expenditures on food technology projects was seen.

Altogether the SNSF and the CTI fund on average agricultural research with around 6.7 million CHF per year, which is about the amount the FOAG spent in research funding (Table 7). Therefore, SNSF and the CTI are important public funding institutions for agricultural research.

4.1.2 Private

The business enterprise expenditures (BERD) accounted by far for the biggest proportion of the Swiss R&D expenditures (BFS, 2014i). In 2008, 11,115 million CHF (€ 7,005 million) and four years later 11,250 million CHF (€ 9,335 million) were invested in R&D by private enterprises (see also Figure 2). The percentage of private investments was as high as 68.2% of all investments in R&D in 2008. The food sector made little investment in R&D (NOGA 2008, sectors 10-12). The total expenditures accounted for 124 million CHF (€ 78 million) in 2008 and for 61 million CHF (€ 38 million) in 2012, which equalled

a decrease of 50% in four years. The total BERD into the agricultural sector accounted for 328 million CHF in 2012. Data for 2008 were not available. Business enterprises invested almost four times more in this sector than the government, which's expenditures amounted 85 million CHF (€ 71 million) in 2012. The biggest amount of resources was dedicated to the R&D of the pharma sector, totally accounting for almost 3,800 million CHF (€ 3,150 million) in 2012.

In 2012, the worldwide expenditures on R&D of Syngenta and Nestlé accounted for 1,18 million CHF (€ 0,98 million) and 1,41 million CHF (€ 1,17 million), respectively (Syngenta 2013; Nestlé 2013). The specific data for Switzerland were only available for Nestlé, where the research expenditures in Switzerland amounted to 933 million CHF in 2012 (Nestlé 2014). However, since Nestlé mostly performs R&D in the field of food processing, those data could not be taken into account to cross-check the agricultural BERD.

4.2 Results from the consultation on recent trends

4.2.1 Volumes of expenditure

The expenditures on agricultural R&D of ETH, Agroscope, FiBL, HAFL and Agridea are presented below (Table 8). Data derive from public sources (BFS 2014I, Agroscope 2011, 2013, 2014) and were collected during a survey from those institutions where no data were publicly available (Survey FiBL 2014, Survey HAFL 2014, Survey Agridea 2014). As both HAFL and AGRIDEA did not want their data to be published in detail, below data from these institutions is only included in the total. For ETH, data from 2008 were not available and we show data from 2009. For FiBL, the entire expenditures of the institute are presented which slightly overestimates the institute's expenditures in R&D. Data from Vetsuisse Universities and ZHAW were not available.

As R&D expenditures of Vetsuisse Universities and ZHAW could not be included in the calculations below (Table 8), we cannot provide the total agricultural R&D expenditures of the Swiss research institutions conducting agricultural research. In 2012, the total R&D expenditures of ETH Agrar, Agroscope, FiBL, HAFL and Agridea amounted to CHF 177.044 million (€ 146.913 million). Compared to 2010, this corresponds with an increase of 12%.

Table 8: Agricultural R&D expenditures of ETH Agrar, Agroscope, FiBL, HAFL and Agridea for 2008, 2010, and 2012. Numbers in EUR were calculated with the average exchange rate of the corresponding year (see Appendix II).

Research Institute	R&D expenditures in Million CHF (EUR)		
	2008	2010	2012
Total	149.409 (94.183) ¹	158.122 (114.540)	177.044 (146.913)
Of which			
ETH	n.a. 2009: 51.329 (32.36)	55.224 (40.00)	56.103 (46.56)
Agroscope	76.81 (48.42) 13.77 (8.68) +63.04 (39.74)	80.00 (57.95) 16.60 (12.02) +63.40 (45.93)	98.07 (81.38) 17.09(14.18) +80.98 (67.20)
FiBL	16.24 (10.24)	18.403 (13.33)	18.241 (15.14)

Sources: FOAG: Factsheet 2008, Factsheet 2010, Factsheet 2012, FOAG, 2012, Agroscope 2011, Agroscope 2013, Agroscope 2014, BFS 2014I, Survey AGRIDEA 2014, Survey HAFL 2014, Survey FiBL 2014

¹Estimate because ETH data from 2009 included

The agricultural research expenditures of Agroscope, increased substantially between 2010 and 2012 by 26%. This increase in the agricultural research expenditures is due to the fact that i) the Swiss national Stud Farm was integrated in Agroscope and ii) Agroscope was required to report third-party funds. In the same period, agricultural research expenditures at ETH and FiBL were almost constant.

HAFL showed constant R&D expenditures from 2008 until 2012, whereas those of AGRIDEA decreased by 50% (Survey HAFL 2014, Survey AGRIDEA 2014). Given the fact that HAFL and AGRIDEA have a strong focus on education and extension, respectively, the total R&D expenditures of both institutions were much lower than those of ETH, FiBL and Agroscope.

4.2.2 Trends in research input

There was only very little comparable data available about personal resources of the Swiss agricultural research institutions. The problem was the different classification for staff used by the administration. Therefore two tables with different classification system are shown in the following.

There was no major change in the investment in personal resources at ETH and Vetsuisse Universities (Table 9). Most of the research was performed by researchers and assistants, whereas the professors and the other lecturers only accounted for a small proportion of the total research staff. Nevertheless, there was one considerable change of resources from “Researchers and Assistants” to “other lecturers” of almost 10 full time equivalents between 2010 and 2012 at ETH. In contrast, the Vetsuisse Universities reallocated parts of their resources from “Professors” and “other Lecturers” to “Researchers and Assistants”. Generally, from 2009 to 2012, the number of employees in full time equivalents decreased slightly at ETH from 223.4 to 213.7 employees whereas it stayed almost constant at Vetsuisse Universities.

Table 9: Numbers of employees of ETH and Vetsuisse: Professors¹⁾, other Lecturers²⁾, and Researcher & Research Assistants³⁾ in 2009, 2010 and 2012 in full time equivalents. Numbers were estimated based on BFS data.

Year	2009			2010			2012		
	P ¹⁾	L ²⁾	R&A ³⁾	P ¹⁾	L ²⁾	R&A ³⁾	P ¹⁾	L ²⁾	R&A ³⁾
ETH	13.7	9.0	200.7	15.0	8.9	197.3	14.5	17.0	182.2
Vetsuisse	33.9	32.8	295.9	31.6	35.0	297.9	30.8	27.7	310.3
Total	47.5	41.9	496.6	46.6	43.8	495.1	45.3	44.6	492.6

Source: BFS 2014I

The employment of research staff (without technicians) at FiBL and AGRIDEA are presented in Table 10. There were only four researchers with a BSc degree employed in 2012. The employed researchers with an MSc degree increased by around 45% between 2008 and 2012, whereas the number of PhD's stayed almost constant.

Table 10: Numbers of employees of FiBL and AGRIDEA by PhD¹⁾, MSc²⁾, and BSc³⁾ in 2008, 2010 and 2012. Numbers are based on the survey.

Year	2008				2010				2012			
Position	PhD	MSc	BSc	Total	PhD	MSc	BSc	Total	PhD	MSc	BSc	Total
FiBL	39	12	2	53	43	18	2	63	39	18	4	61
AGRIDEA	2	2		4	1	2		3	1	1		2
Total	41	14	2	57	44	20	2	66	40	19	4	63

Source: Survey FiBL 2014 and Survey AGRIDEA 2014

HAFL had a different classification concept for their employees and numbers were only available for 2012. In 2012, HAFL employed 44 lecturers, 43 research associates and 26 assistants (Survey HAFL 2014). Most of the lecturers and researchers had an MSc degree, a part of the lecturers had a PhD degree and most of the assistants plus a small part of the research associates had a BSc degree.

Lacking data and different collecting systems make it almost impossible to draw comparisons and to identify development trends in research staff of the Swiss agricultural research institutions.

4.2.3 Funding mechanism and priority settings

Below, we distinguish between two funding mechanisms for agricultural research and development in Switzerland:

1. **Basic federal grants:** Basic federal grants are federal or cantonal financial contributions which are usually mandate based.
2. **Project-oriented funds:** Project-oriented funds derive from both public (secondary-party funds) and private resources (third-party funds).
 Secondary-party funds are public resources which in most cases are obtained competitively from federal resources (e.g. FOAG, SNSF, CTI), European Research Programmes, or from international organisations (e.g. FAO, UNCTAT).
 Third-party funds derive from private resources e.g. from foundations, non-governmental organisations or business enterprises.

While detailed information about the funding mechanisms of ETH, Agroscope, and Vetsuisse Universities was available from national statistics (BFS) or published reports respectively, data about the funding mechanisms of FiBL, HAFL and AGRIDEA needed to be collected through a survey.

Table 11 shows the share of basic federal grants and project-oriented funds on the total of ETH, Agroscope, FiBL, HAFL, AGRIDEA and Vetsuisse. As to the latter, for Vetsuisse Universities, only the shares for the total research expenditures were available but not separately for the Vetsuisse agricultural research expenditures.

Table 11: Share of basic federal grants and project-oriented funds of ETH, Agroscope, FiBL, HAFL, Agridea and Vetsuisse for 2008, 2010, 2012 (in %).

¹⁾Share of total R&D expenditures were used, because for Vetsuisse share of agricultural R&D was not available.

Research Institute	Basic federal grants			Project-oriented funds		
	2008	2010	2012	2008	2010	2012
ETH Agrar	n.a. 2009: 65.2%	60.7%	62.9%	n.a. 2009: 34.8%	39.3%	37.1%
Agroscope	82.1%	79.2%	83.7%	17.9%	20.8%	16.3%
FiBL	29.0%	25.7%	25.9%	71.0%	74.3%	74.1%
HAFL	0%	0%	0%	100%	100%	100%
AGRIDEA	0%	0%	0%	100%	100%	100%
Vetsuisse ¹⁾	n.a. 2009: 86.7%	81.4%	75.0%	n.a. 2009: 13.3%	18.6%	25.0%

Source: BFS 2014m, BFS 2014n; Agroscope 2011; Agroscope 2013, Agroscope 2014; Survey HAFL 2014; Survey AGRIDEA 2014; Survey FiBL 2014

From Table 11 three different funding models can be deduced. Firstly, agricultural research at HAFL and Agridea is financed only by project-oriented funds. Secondly, ETH and FiBL receive basic federal grants but show a high share of project-oriented funds amounting around 35-40% for ETH and more than 70% for FiBL. Thirdly, Agroscope and Vetsuisse Universities have a high share of basic federal grants amounting more than 70% of their total research funds.

Overall, the share of project-oriented funds increased until 2010, before it slightly decreased again in 2012. This trend was seen for ETH, Agroscope, and FiBL. In contrast, the share of the total project-oriented funds of the Vetsuisse Universities was still increasing until 2012. The funding mechanisms of HAFL and the AGRIDEA did not change.

The increase in project-oriented funds of ETH Agrar, Agroscope, HAFL, Agridea and FiBL is confirmed by the actual numbers (Figure 8). From 2008 to 2012 the project-oriented funds increased by 16% amounting CHF 56.1 million (€ 46.55 million) in 2012. The project-oriented funds include both private and public funds (e.g. from SNSF and CTI). However, it was not possible to receive detailed information to which extent public and private sources contribute to project-oriented funding. In the same period, the total basic federal grants increased as well by 19% amounting CHF 121 million (€ 100.4 million) in 2012. The increase in the basic federal grants is mainly due to increased funds of Agroscope as a result of the integration of the Swiss national Stud Farm in Agroscope as reported in subchapter 4.2.1. The basic federal grants of CHF 121 million in 2012 are considerably higher than the governmental budget provisions and expenditures for agricultural R&D published by the Swiss Federal Statistical Office (BFS 2014j; see also Table 3) which amounted in 2012 CHF 85 million (€ 70.5 million). Thus, the agricultural GBAORD and the governmental expenditures on agricultural R&D are underestimated by BFS.

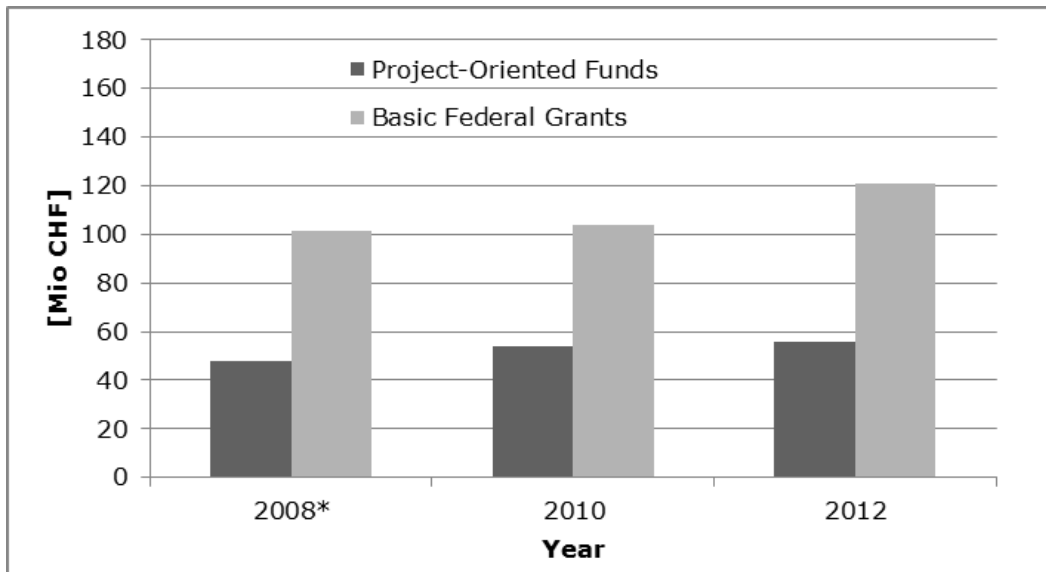


Figure 8: Total basic federal grants and project-oriented funding for ETH Agrar, Agroscope, FiBL, HAFL, and AGRIDEA from 2008 to 2012 (in million CHF). *Data from 2009 used for ETH.
 Source: BFS 2014i, BFS 2014m; Agroscope 2011, Agroscope 2013, Agroscope 2014, FOAG 2012, Survey HAFL 2014, Survey AGRIDEA 2014, Survey FiBL 2014

4.2.4 Type of research

With respect to total Swiss research expenditures, in 2012, 5,640 million CHF (€ 4,680 million) were invested in basic research, 7,515 million CHF (€ 6,240 million) in applied research, and 5,355 million CHF (€ 4,450 million) in experimental research (Figure 9). Between 2008 and 2012, the total expenditures in applied research increased by 45% and that of basic research by 29%. However, the expenditures for experimental research decreased by 20%.

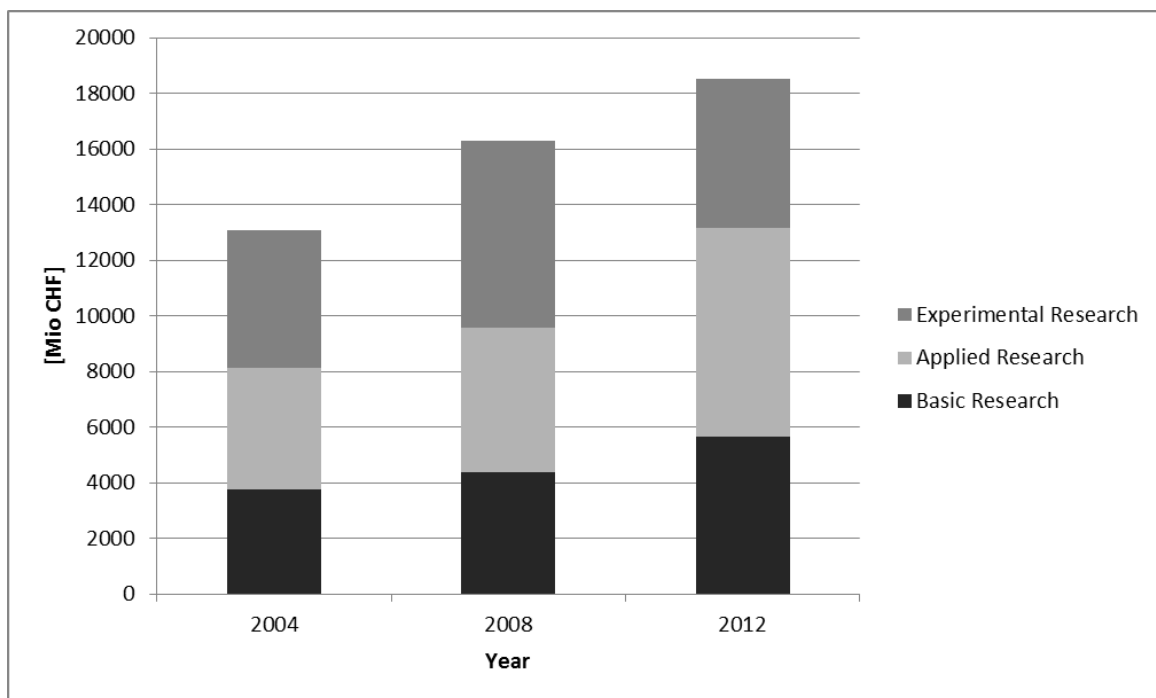


Figure 9: Type and volume of total research expenditures in Switzerland between 2004 and 2012.
 Source: BFS 2014c

The trend towards applied research was found for the business enterprises, the government, as well as for the private non-profit organizations (data not shown, BFS 2014h). However, the business enterprises had the biggest influence on this trend. Their investments in applied research increased from 3,760 million CHF (€ 2,440 million) in 2004 to 4,450 million CHF (€ 2,810 million) in 2008 and to 6,550 million CHF (€ 5,440 million) in 2012. The trend towards more investment into applied research was not observed for the higher education sector because the higher education sector is expected to provide especially basic research which was by far the most important research type, and its share on the total expenditures further increased between 2008 and 2012 (FOAG 2012).

4.2.5 Topics

The research topics in agricultural sciences are determined from three sides. First and most importantly, there is the agricultural policy including a strategy for agriculture. In this context, the Swiss Federal Council commissioned FOAG to develop a research concept for agriculture for the period 2013-2016 (FOAG 2012). Secondly, there are Syngenta and Nestlé from the private sector with their own research strategies and business plans. And thirdly, there are the individual research strategies of the independent research institutes. Although the research institutes are independent, they are all more or less influenced either by the public funding or by the funding of the private sector.

Agricultural Policy of Switzerland 2014-2017 (FOAG 2014):

The four major goals of Switzerland's agricultural policy are the following:

1. To guarantee a secure and competitive food production and supply;
2. To efficiently use resources and to promote a sustainable consumption;
3. To strengthen the vitality and attractiveness of the rural area;
4. To promote innovation and entrepreneurship in the area of agriculture and food.

These major goals of the agricultural policy are implemented in the strategy of Agroscope and its six thematic priorities, which are:

1. Ecological Intensification
2. Natural Resources
3. Climate Protection and Change
4. Food and Nutrition
5. Competitiveness
6. Rural Areas

Business enterprises:

The two key players of Switzerland's private sector strictly concentrate on food (Nestlé) and on agriculture (Syngenta), respectively. The Nestlé research focus lies on different subjects along the food chain. Moreover, the Nestlé Research Center (NRC) has established two research chairs at EPFL (Swiss Federal Institute of Technology, Lausanne); one chair in *Energy Metabolism* and one in *Neurodevelopment* (Nestlé 2014). On the other hand, Syngenta focus on the improvement of plant production by developing quality seeds and crop protection products (Syngenta 2014).

Research Institutes:

The interests and strategies of the different research institutes in Switzerland vary a lot. FiBL and the Vetsuisse Universities are mainly into agricultural sciences (FiBL 2014, Vetsuisse 2014). In contrast, ETH Zurich, and HAFL perform agricultural as well as food research (ETH 2014a, HAFL 2012 and 2013). A summary of the main research topics of the relevant research institutes is presented in the following:

1. *Food security*: Food security is a major issue of the society and a constantly growing challenge because of the rapidly growing population. On the one hand, food production has to be extended through improvement in efficiency, plant protection and other measures. And on the other hand, food quality has to be increased through measures in food production and processing. These are core competencies of ETH and HAFL.

2. *Food safety*: Food safety is an important part in the research strategies of all institutes. The focus of FiBL lies on the production site in order to provide safe agricultural plant and animal products. The Vetsuisse Universities are specialized on animal health, which can also severely affect food safety. HAFL focus more on the processing step, whereas the ETH covers the whole food chain.

3. *Environment and Health*: The environment and health of humans, animals and plants is very important in times of climatic change, under- and malnourishment. FiBL as the organic research institute in Switzerland is dedicated to environmental issues and ETH deals with environment and health in the departments of Environmental Systems Science and in the department of Health Science and Technology.

4. *Resource Scarcity*: Sustainability is a buzzword mentioned in most of the research strategies. Resources can be saved for future generations by sustainable food production and processing. Especially for FiBL, sustainability is a very important part of the research strategy.

4.3 Trends from other sources

All the available sources were presented in the other parts of the report.

5. DISCUSSION

In principle in Switzerland, data availability is good on an aggregate level for all research and development areas. However, data gaps exist for research and development in the agricultural sector. Time series include in most of the cases data for every second, in some cases for every fourth year. Data about the research institutions, which were important for this report, were collected for the first time in 2009.

Data on agricultural R&D provided by FOAG and from ETH (since 2009), Agroscope and FiBL was very detailed whereas the details provided in the annual reports and available statistics of Vetsuisse Universities, HAFL and AGRIDEA were low. Even though data from HAFL and AGRIDEA could be collected in a survey, it was not possible to receive all data asked for and thus the data from the survey were incomplete. Furthermore, both institutions wanted that their data is published only in totals and not in detail. For the Vetsuisse Universities and for the ZHAW no data were available for agricultural R&D. All the agricultural R&D expenditures of the Vetsuisse Universities are included in the veterinary R&D statistics and not separately available. Due to resource constraints, Vetsuisse Universities were not able to respond to the survey and deliver more detailed data on agricultural R&D. Thus, the picture on Swiss agricultural R&D expenditures is incomplete and the total research efforts of all Swiss research institutions conducting agricultural research and development could not be calculated. Data gaps for single years or for single areas respectively make it difficult to interpret the data and to identify trends.

According to the agricultural BERD, most of the financial resources for agricultural R&D were coming from private investors. Hence, detailed analysis of the private sector seems to be very interesting for a follow-up project.

While we identified seven institutes relevant for research in agriculture, namely ETH, Agroscope, Vetsuisse Universities, FiBL, HAFL, ZHAW, and AGRIDEA, during the data collection, ZHAW was partly excluded from the report. The reason of this was that neither the BFS nor the FOAG considered the Zurich Universities of Applied Science in their calculations about agricultural research. However, agricultural research at ZHAW will become more important in the future. Furthermore, it needs to be stressed that not only ETH Agrar conducts agricultural research at university level. Several non-agricultural departments at Swiss universities conduct some agricultural research in individual projects. Moreover, also some research done e.g. in environmental sciences could be attributed to agricultural research and vice versa. However, it was not possible to assess to which extent non-agricultural research departments or groups respectively conduct and contribute to agricultural research.

6. CONCLUSIONS

Agricultural research and development in Switzerland is a very interesting and dynamic area. Overall, the investments in R&D in general and also in agricultural R&D clearly increased between 2008 and 2012, which can be seen in the increasing GERD of Switzerland. In contrast to most of the other OECD countries, the expenditures in R&D of the Swiss government did not seem to be influenced by the worldwide economic crisis. This could be elucidated from the increasing GBAORD between 2009 and 2012, where the GBAORD's of most of the other countries were decreasing. The private expenditures are not very well analysed, wherefore the influence of the instable economy on the private sector remained unclear.

According to the national BFS statistics about research types, applied research became more and more important during the time period of interest. The share of applied research increased between 2008 and 2012 by 45% whereas expenditures for experimental research decreased by 20%.

Research is mainly performed by researchers and research assistance, mainly hold an MSc or PhD degree. No trend of change was detected in the education status of the researchers. However, data about the research institution's employees were incomplete and not always comparable.

Within the last four years, the relevance of project-oriented funds increased suggesting that project-oriented funding becomes more important for the Swiss agricultural research institutions. However, in the same period of time also the total basic federal grants increased.

In this report, we contrasted i) public expenditures on agricultural R&D with the governmental budget provisions for agriculture (agricultural GBAORD) as documented by the Swiss Federal Statistical Office and ii) the agricultural GBAORD with the total federal basic funds as reported by the Swiss agricultural research institutions. In both cases we found a discrepancy between the figures. It seems that the agricultural GBAORD and governmental expenditures on agricultural R&D collected by the Swiss Federal Statistical Office underestimate the total federal budget provisions and expenditures on agricultural R&D in Switzerland.

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APPENDIX I: LIST OF CONSULTED PERSONS

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APPENDIX II: EXCHANGE RATES

Table 12: Average exchange rates for used for EUR/CHF and USD/CHF.
 Source: <http://www.finanzen.ch/devisen/>.

Year	1 EUR [CHF]	1 USD [CHF]
2000	1.5574	-
2002	1.4666	-
2004	1.5437	-
2006	1.5732	-
2008	1.5864	-
2009	1.5096	1.0852
2010	1.3805	-
2011	1.2329	-
2012	1.2051	0.9378
2013	1.2308	-
2014	1.2190	-