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Final draft

Introduction

The world population currently is 6 billion people, and it is estimated that in the year 2020 there will be 8 billion people. This creates an enormous pressure on secure food production, food safety, and the environment. Not only population growth puts this pressure on human and natural resources, the fight against poverty and under- and mal-nutrition does the same. Agricultural education prepares the future generation of leaders, researchers, professionals, technicians and last but not least, innovative farmers, who collectively can meet the challenges of global sufficient food and food security.

Agriculture is international by nature. It is also the largest policy domain of the European Union. European Agricultural Policy making is comprised in the CAP, the Common Agricultural Policy. 'The Common Agricultural Policy has been the biggest, the most contentious and the one with the largest budget of all the Union's policy areas. The EU has more power in agricultural policy than it has in any other policy area and it has passed more legislation on agriculture than in any other single policy area. The future prosperity of the EU's agricultural sector depends on its ability to profit from the domestic and international opportunities that have emerged in recent years. The CAP has already gone a long way and has now the great potential to become a truly European model of agriculture for the 21st century' (<http://europa.eu.int/scadplus/leg/en/lvb/l04000.htm>; access 30.03.2006).

Figures about the agricultural sector in Europe are colossal. The imports into the European Union of agricultural and food products amounts to US\$ 69 billion. The exports from the European Union of these products amounts to US\$ 51 billion. There are 14,5 million persons working full time or part time on agricultural holdings in the EU. And there are 30,000 agricultural cooperatives in Europe which are employing another 700,000 persons (Source: http://www.copa-cogeca.be/en/copa_objectifs.asp (access 30.03.2006).

Agricultural education is strongly related to the food sector. 'The food and drink industry is one of the most important industrial sectors, a major employer and exporter in the EU. This sector is characterised by the diversity in its types of activities and in the end products manufactured. The products covered can vary from bakery, pastry, chocolate, confectionary products to modified starches or different food preparations. The European Commission is seeking to ensure the competitiveness of the European food industries in the context of the Common Agricultural policy (CAP) and the EU's obligations in the World Trade Organisation (WTO).' (<http://europa.eu.int/comm/enterprise/food/>, access 30.03.2006). The food sector in Europe counts over 26,000 companies, employing about 2.7 million people. The food industry is the 3rd industrial employer in the EU, with an annual turnover of 600 billion Euro (<http://europa.eu.int/comm/enterprise/food/intro.htm>, access 30.03.2006).

More than 70 % of the agricultural goods produced in the EU are used to be transformed into food industry products, many of them Non-Annex I-goods (NA I goods). Main product-groups of the NA I sector are processed dairy products, frozen fruit and vegetables, confectionery industry products, various prepared foods and sauces including pasta, ice-creams, soups, etc., non-alcoholic beverages, alcoholic beverages and spirit drinks, tobacco-products and processed starch products.

At the European level the agriculture and food sectors are being supported by the respective sectoral social dialogue committees. The framework for European social dialogue is laid down in Articles 138 and 139 of the Treaty establishing the European Community. Cross-sectoral participants in the social dialogue at European level are ETUC (<http://www.etuc.org/EN/>, access 30.03.2006), the European Trade Union Confederation representing employees, UNICE (<http://www.unice.org/Content/Default.asp?>, access 30.03.2006), the Union of Industrial and Employers' Confederations of Europe representing 36 employers' organisations in 22 member states, UEAPME (<http://www.ueapme.com/EN/index.shtml>, access 30.03.2006), the employer's organisation representing the interests, at European level, of crafts, trades and SMEs throughout Europe, and CEEP (<http://www.ceep.org/>, access 30.03.2006), the European Centre of Enterprises with Public Participation and of Enterprises of General Economic Interest, which is an international association of enterprises and organisations with public participation or carrying out activities of general interest, whatever their legal or ownership statute. The European social dialogue knows three modes: consultation (which is done for instance by the ACVT, the Advisory Committee on Vocational Training), bipartite dialogue (which takes place in the Social Dialogue

Committee and the Sectoral Committees) and tripartite concertation (for instance within the Tripartite Social Summit for Growth and employment, which is called 'the troika'). In the field of agriculture the European social partners who are part of the social dialogue are the EFFAT (www.effat.org, access 30.03.2006) from the employees side, and Geopa-Copa (www.copa-cogeca.be, access 30.03.2006), from the employers side. These social partners in the field of agriculture have come to several opinions and agreements on vocational training and employment in agriculture, such as the European Agreement on Vocational Training in Agriculture (on 05-12-2003), the Joint Declaration by EFA/CES-GEOPA/COPA on employment in agriculture (on 30.03.1995), the Opinion concerning training in agriculture (on 18.11.1993), the Opinion with regard to training for agricultural workers (on 26.11.1982), and the Opinion concerning the vocational training of and cessation of farming by agricultural workers in the context of the sociostructural measures proposed by the Commission (on 23.05.1979). In 2004 GEOPA has held a conference in which the implementation of the European Agreement on Vocational Training in Agriculture was reviewed. The report of this conference will be available soon from the GEOPA secretariat Brussels. What is interesting for agricultural education is the new attention for sectoral vocational education policy (Warmerdam, 1999) and sectoral qualifications (<http://communities.trainingvillage.gr/>, access 30.03.2006).

In this contribution, the strong links between agricultural research, education and extension are described. It is stated that agricultural education and extension are strongly based on agricultural research. Next it is stated that agriculture needs to be conceived of as a broad field, in which all sectors of the economy come together. It is also shown that there has been a lot of innovation, which resulted in broadening agricultural education towards fields like environmental studies, sustainable development, corporate social responsibility, food and nutrition and public health. Subsequently, because of the fact that food is a basic need for all human beings, it is stated that agricultural education is also strongly related to issues like poverty reduction and international development (see also Köhne & Stockmann, this volume). Next, the distinction is made between initial and continuing vocational education and training. It is shown that informal and non-formal learning are important for skills development of present farmers, and that formal agricultural education is essential for fundamentally raising the knowledge level of future entrepreneurs and employees in the agri-food complex. Finally, the world of agricultural education research is described.

Agricultural education, research and extension

Agricultural education is since long strongly related to agricultural research. Together with extension, they were the key ingredients of the knowledge system for the development of agriculture. Agricultural research produced new knowledge, that had to be disseminated to farmers by agricultural extension services, and agricultural education had to digest the relevant research results to integrate those in the curricula for future farmers and farm workers. Agricultural extension services are provisions to support rural development, farming practices, and other human resource development processes.

Agricultural research is supported by many institutions such as the CGIAR (<http://www.cgiar.org/>) (the Consultative Group on International Agricultural Research), at the World Bank in Washington, D.C.. They support research programs in product groups like Cereals (Rice, Wheat, Maize, Barley, Sorghum, Millet), Roots, Tubers, Banana and Plantain (Cassava, Potato, Sweet Potato, Yam, Banana and Plantain), Food Legumes (Chickpea, Cowpea, Beans, Lentil, Pigeonpea, Soybean, Oil Crops (Coconut, Groundnut), Livestock, Forestry and Agroforestry, Fisheries and Water Management.

Other relevant organisations are IFPRI (ifpri@cgiar.org), the International Food Policy Research Institute at CGIAR, and ISNAR (<http://www.ifpri.org/divs/isnar.htm>, access 30.01.2006) (the International Service for National Agricultural Research). The program of ISNAR comprises three major areas: institutional change, organization and management and science policy.

Agricultural extension (Van den Ban/Hawkins 1996) is privatizing in many countries, especially western, but also in non-western countries (Riveira/Alex 2004). This means that farmers have to pay for the service, whereas in many countries it has been free of charge, since it had a high societal priority to educate farmers to produce food in an efficient and effective way. This high priority was a consequence of the need to produce sufficient, safe and cheap food for the population. The numbers of extension professional indicate the importance of the service. For instance, in India there are about 100,000 extension workers. The teach farmers in all kinds of fields, such as animal diseases, plant diseases, integrated pest management, sustainable production, marketing, financial management and technological innovation.

Diversity of agricultural education

Agricultural education differs significantly worldwide (Moore 2004; Tajima 2004; Mulder in press). From an vocational education systems perspective, at secondary level there are comprehensive high schools that teach agricultural subjects as elective courses or tracks, specific schools for vocational-agricultural education, and dual trajectories with a school component and a component of working and learning. This working and learning component can be distinguished in two modes: the internship mode and the apprenticeship mode. Interns normally do not have a labour contract, apprentices normally have a learning-working contract with an employer.

From a curriculum content perspective, animal and plant sciences are the traditional fields of study, and the majority of students were enrolled in programs in these. However, especially in industrial and post-industrial societies, agricultural education has diversified considerably, in some cases to such an extent that the institutions of agricultural education have problems with maintaining the phrase agriculture of agricultural in their name. Currently, only a small proportion of the students in agricultural education are enrolled in programs that are directly aimed at jobs and professions in the primary sector. Many more are following environmental, food and nutrition (see Fegebank, this volume), biotechnology, geo-informatics, consumer, farm management, business management, economics, sociology, health and communication programs to name a few. At the secondary level gardening, pet care, and equine studies are quite popular. So it can be observed that agricultural education has broadened considerably, and this process is still going on.

The diversification of agricultural education is strongly related to the composition of the so-called agri-food complex, the set of organisations and institutions that are collectively working for the production and distribution of sufficient food that is safe and of good quality. The agri-food complex exists of organisations and institutions in the primary sector, trade (wholesale, business-to-business and retail), industry (feed, machinery, biotechnology), and services (logistics, auction, financing, insurance, regulation and quality control, risk assessment, chain control, consultancy).

Because of the fact that agriculture is directly aimed at an existential need of human beings, there also is wide concern about malnutrition (including obesity), hunger, poverty reduction (Sachs 2005) and the HIV/Aids pandemic (Brinkman et al 2006). There are many international programs to fight against these major problem areas. And in agricultural education there are also programs that prepare professionals for this field.

Apart from that, there is a distinction between initial and post-initial education and formal and informal learning. Since this is a general characteristic of all vocational education, this topic will not be elaborated here, but it will be addressed in the section on agricultural research.

Agricultural education research

Agricultural education research is a small although interesting sector-specialisation of educational research. It gets its legitimacy by the very nature of agricultural education. Lots of discussions have been held about the uniqueness of agricultural education research. Whilst much research that could be done in the field is mere educational research applied to the field, the content-related research is specific, that means research that is related to the innovation of the agri-food complex.

Research in the field of agricultural education is reported in different journals, the Journal of Agricultural Education and Extension (JAEE, <http://www.jaee.nl/>, access 30.03.2006), the Journal of International Agricultural and Extension Education (JIAEE; <http://www.iaee.org/journal.html>, access 30.03.2006), and the Journal of Agricultural Education Online (JAE; <http://pubs.aged.tamu.edu/jae/>, access 30.03.2006), and the Journal of Extension Systems (<http://www.jesonline.org/index.htm>, access 30.03.2006). But of course every now and then agricultural education research appears in one of the journals in the field of education, training, and human resource development.

There are several national and regional associations of agricultural educators, such as the National Association of Agricultural Educators (NAEE) in the USA, the Asia Pacific Association of Educators in Agriculture and Environment (APEAEN), and the Agricultural Education Division of the Association for Career and Technical Education (ACTE). At the annual National Agricultural Education Research Conference, the latest research is presented. The Association of International Agricultural and Extension Education (AIAEE) is an active association that has regular conferences. The European Seminar on Agricultural Extension and Education (ESEE) is a bi-annual conference of researchers in this field, although the extension part clearly dominates, which is sometimes reflected in the variations of the title of the Seminar, being on Agricultural Extension *and* Education or just on Agricultural Extension Education.

The Netherlands is a country in which agricultural education research has a strong tradition. The chair group Education and Competence Studies conducts a research program in the field of agricultural education. In 2003 a five year program was finished. Part of it was on computer-supported collaborative learning and work in agricultural education. Lutgens/et al (2002), Verburch/et al (2002), Van Oene/et al 2003, and Veldhuis-Diermanse/et al (2006) reported difficulties in the implementation of computer-supported collaborative learning and cooperation amongst teachers. This implementation seemed to depend on contextual factors to a large extent. Only if the e-communication platforms were introduced in a setting in which asynchronous computer-based communication was natural, students and teachers perceived added value and in these situations computer-supported cooperative learning has potential. This for instance was the case during internships; the e-communication platform enable efficient communication between students and students and teachers. When this way of learning and working was tested in situation in which face-to-face contact was also possible, the added value appeared to be limited. Similar results were found by Stephenson/et al (2005). During the course of the program, the focus was changed towards content-related competence development (see also Røben, this volume), which led to publications on competence-based human resource management in green education (Mulder et al, 2003), competence-based green education (Wesselink/et al 2003), and learning questions, opportunities and motives for workers in the agri-food (Lans/et al 2003). Competence needs to be understood in a wide sense here, unlike the narrow meaning attributed to the concept as described by Edwards/Nicoll (2006). Mulder (2004) formulated generic principles for competence-based vocational education that are founded on a holistic education philosophy. Wesselink/et al (2007) have elaborated these principles based on a Dephi-study under a group of educational experts, and came to a matrix of principles by levels of implementation. With this matrix program teams of teachers can position the program in this matrix, and decide upon further improvement of the program.

Apart from that a lot of effort is invested in studying the opportunity of developing longer-lasting educational trajectories for graduates from senior-secondary agricultural education (Lans/et al 2003; Lans/et al 2004), which led to initiatives of creating alumni learning networks at secondary agricultural education level. This is a phenomenon which has a long history in certain countries, but certainly not commonplace in the Netherlands.

Now the emphasis is on competence development and green education, related to change in the agri-food complex (Mulder 2002; Mulder/et al 2003) and sustainable development (Biemans/et al 2003). Three projects are running, one the (1) experiential, (2) inspirational, and (3) assessment aspects of competence-based green education. The project on experiences with competence-based education is aimed at revealing discrepancies between the intentions of developers of competence-based education and students. The project on inspiration and competence-based green education is aimed at implementing interesting learning arrangements in educational institutions for green education which are based on metaphors developed in research on learning of entrepreneurs. The intention is to try to integrate more authentic learning approaches in initial education. The project on the assessment of competence-based green education is to point at major problems such as the quality of the assessors, the limited context and content validity of the object of assessment (such as role plays and simulated tasks), and time needed for good assessment. Biemans/et al (2004) pointed at the pitfalls of competence-based education, and ways to overcome them. Weigel/et al (2006) analyzed the way in which the concept of competence is used in the development of vocational education and training in England, France, Germany and the Netherlands.

In Europe, agricultural education is sometimes under the Ministry of Agriculture, and sometimes under the Ministry of Education (or ministries with comparable names). The monographs on vocational education and training in the member states from the EU (e.g. Christopher, 1999; Circé, 2000; Twining, 2000) are not explicit on the place of agricultural education within the structure of education in the respective countries. The question of which Department in the government is responsible for agricultural education is not a simple question either, since the structure of governments in EU member states varies considerably.

In many cases, it is the concern of the Ministries of Agriculture to have the relevant agricultural research results implemented in the programs of agricultural education, but also in other parts of the educational system. For instance, lifestyle is such a concern, and the Ministry of Agriculture in the Netherlands promotes healthy behaviour. It supports programs in elementary education to stimulate the eating of healthy food, with program materials called 'Taste Lessons'. There are many more comparable initiatives. It is the deliberate intention of the Dutch Ministry of Agriculture to put emphasis on such content-related issues when it comes to financing agricultural education research. The context in which this research is financed may change due to the re-arrangement of the funds to stimulate innovation of agricultural education. Therefore, projects that are being implemented at the moment, all have a strong contextual perspective, such as improving sustainable development, corporate social responsibility, entrepreneurship and intercultural competence.

In France, the ministry of Agriculture (Ministère de l'Agriculture, de l'alimentation, de la pêche et des affaires rurales) is responsible for agricultural education since the start of agricultural education in 1848 (Circé, 2000). There have been efforts to harmonise agricultural education with the educational sector that falls under the responsibility of the Ministry of Education. In the field of agriculture, there are 858 secondary schools all over the national territory (overseas territories included) that teach agriculture. In higher education there are 25 schools (engineering schools, four veterinarian schools, one institute for teacher education and one school specialized in teaching landscape). In higher education, the Ministry of Education is also in charge of three schools of engineers in Toulouse, Dijon and Nancy.

In Germany the situation is more complex than in France because of the composition of the nation in Länder. That makes that the responsibilities for vocational education and training are at different levels, the state (Bund), and the Länder. Food safety, public health and agriculture in general are part of the responsibilities of the Federal Ministry of Consumer Protection, Food and Agriculture. This ministry is also responsible for some initial and further vocational training regulations as for farmers or dairy masters. Responsible for occupation regulations in the field of food-production is the Federal Minister of Economics and Labour. And the Ministries of Culture (Kultusministerium) in the Länder are responsible for the school-based and company-based agricultural education.

In the United Kingdom the situation is complex too. Structures in education and educational administration differ for England, Scotland, Wales and Northern Ireland. Each has devolved responsibility for setting their own policy in these areas. However, the issues regarding education are the same throughout the UK. England will be taken as an example. In England, education in all areas up to 16 is the responsibility of the Department for Education and Skills (DfES). Beyond 16, the responsibility for funding and appraising of the quality of provision for publicly funded providers of agricultural education is again the responsibility of DfES, but a number of other bodies are involved in defining employer's needs and setting detailed curricula. Setting the detail of the curriculum is the responsibility of the learning providers themselves and various public bodies with responsibility for setting standards for the quality of provision, of which the key one is the Qualifications and Curriculum Authority (the QCA). The agricultural and land-based colleges collectively have an umbrella organisation - NAPAEO. The Department for the Environment, Food and Rural Affairs (Defra) also has some input in terms of influencing what information and skills need to be learned, particularly by land-managers and farmers, as indeed does the UK's Food Standards Agency in the area of food. Two Sector Skills Councils (SSCs) within the UK also have a role here in setting the skills agenda for specific sectors. These are 'Lantra', for land-based businesses including agriculture, horticulture and related areas, and 'Improve' for the food and drink industry.

In more general terms, the Ministry of Agriculture in the Netherlands also promotes so-called 'knowledge circulation'. The classical notion of transfer of knowledge by the Research-Development-Dissemination strategy is abandoned, and a new strategy of stimulating multiple-stakeholder cooperation processes is implemented. This is organized in a Green Knowledge Cooperative, a network organization of institutions who provide green education. The emphasis in the Cooperative should be on collective knowledge construction. Which, at the end of the day, should help the competence development of students and workers.

A special line of research which is strongly related to the agricultural sciences in general, and to the environmental sciences in particular, is the research on learning for sustainable development. There are many programs and projects that are and have been conducted, especially on the question as to how implement the issue of sustainability in the curriculum of various parts of education. Corcoran/Wals (2004) and Wals/et al (2004) collected and presented a wealth of material on this topic.

Finally the research on the sectoral approach in skills or competence development can be mentioned (see also Winterton, this volume). The sector skills development strategy is adopted widely in the United Kingdom, and is implemented already for years in various countries with a strong bipartite or tripartite governance of vocational education and training. Research shows that the sectoral approach is promising, but also has a number of pitfalls (Winterton 2006). Sectoral vocational education policy had strong pluspoints (Warmerdam 1999), and is appreciated in vocational-agricultural education because of its link with sectoral stakeholders, who can have a powerful influence on the innovation of education. However, in European projects on competence development in the agri-food and environmental sector, no consistent relationships were found between the level of the objectives of these projects and the presence of social partner organisations in the project partnerships (Mulder 2006).

To conclude this contribution, it can be said that agricultural education builds competence for innovation of the agri-food complex, innovation that is badly needed for food security, food safety and sustainable development,

goals that are essential for the world population. Agricultural education research should support this, and has to be implemented with and for the actors in the system.

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Key words

Agricultural education
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