The Web of Global Seed Trade

- Commercialization and Commoditization of Plant Genetic Resources

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Abstract

Production of food has become a global enterprise with relatively few multinational companies controlling the major production of plant seeds. The availability of intellectual property rights on plants, the strengthening of the patent system and the market concentration in seed production are all reasons why private sector plant breeding has grown and expanded its reach creating a world of oligopoly in seed trade.

The commoditization of seeds and industrialization of agriculture has several impacts on social, economical and ecological scales in both less developed countries and the industrialized world. Farmers and consumers all over the world are subjected to the impacts of the global world agriculture has become.

This thesis sets out to examine the processes behind the situation we have today, how we ended up in this situation and why. Impacts of the globalized and concentrated seed trade are also pondered over and, finally, a look is taken at how the situation even affects consumers and farmers in a Nordic country of welfare, Finland.

Language: English
Key words: seeds, intellectual property rights, patents, genetic engineering, biodiversity loss, plant breeding, biopiracy

EXAMENSARBETE

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Sammanfattning

Matproduktionen har blivit en global business där produktionen av frön separerats från den övriga odlingen och enbart ett fåtal företag dominerar marknaden. Marknadskoncentration i kombination med förstärkningen av IP-rättigheter och patentlagar har gjort det möjligt för ett fåtal företag att dominera den globala marknaden och produktionen av frön.

Oligopolin inom fröproduktionen har både sociala, ekonomiska och ekologiska konsekvenser som odlare och konsumenter i både de mindre utvecklade länderna och i den industrialiserade världen känner av.

Detta slutarbete har som mål att utreda processerna bakom den situation vi har idag, hur vi hamnat i denna situation och varför samt följder som detta orsakat. Slutligen tas även en titt på hur situationen inverkar på odlare och konsumenter i Finland. Resultaten påvisar att historiska processer samt förstärkningen av patentlagar och IP-rättigheter har försvagat odlarnas och konsumenternas ställning på marknaden.

Språk: Engelska
Nyckelord: Frön, IP-rätter, patent, genteknik, minskning av biodiversitet, växtförädling, biopiratism

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Tiivistelmä

Ruoantuotanto on kasvanut maailmalaajuiseksi liiketoiminnaksi, jossa vain muutama yritys hallitsee globaalia siementuotantoa. Kasvinjalostajien oikeuksien vahvistaminen IP-oikeuksilla ja patenteilla on antanut yksityiselle sektorille oivan mahdollisuuden kasvaa ja voimistua. Ajan myötä oligopoli siementuotannossa on mahdollistunut ja elämme nykyään globaalissa maailmassa, jossa siementuotanto on erkaantunut maataloudesta.

Siementen tuotteistaminen ja maatalouden teollistuminen vaikuttavat sekä vähemmän kehittyneissä maissa että kehittyneissä maissa sosiaalisella, taloudellisella ja ekologisella tasolla. Maanviljelijät ja kuluttajat ympäri maailmaa saavat tuntea globaalin maatalouden mukanaan tuovat seuraukset.

Tämän opinnäytetyön tavoitteena on selvittää tämän tilanteen takana olevat prosessit. Työssä haetaan vastausta siihen, miten ja miksi olemme päätyneet tilanteeseen, jossa siementen tuotanto on kaupallistettu. Opinnäytetyössä käsitellään myös globaalin siemenmarkkinan seurauksia ja lopuksi tehdään pieni katsaus siihen, miten nämä asiat vaikuttavat Suomen viljelijöihin ja kuluttajiin. Työn tulokset osoittavat, että historialliset prosessit sekä patenttilakien ja ip-oikeuksien vahvistaminen kasvinjalostajien eduksi on heikentänyt viljelijöiden ja kuluttajien asemaa, sekä vähemmän kehittyneissä että kehittyneissä maissa.

Kieli: Englanti
Avainsanat: Siemen, ip-oikeudet, patentti, geenitekniikka, monimuotoisuuden heikkeneminen, kasvinjalostus

Acronyms

CGIAR	Consultative Group on International Agricultural Research
EPC	European Patent Convention
EU	European Union
FAO	Food and Agriculture Organisation
GATT	General Agreement on Trade and Tariffs
GMO	Genetically Modified Organism
IARCs	International Agricultural Research Centers
IBPGR	International Board for Plant Genetic Resources
IMF	International Monetary Fund
IPR	Intellectual Property Right
NAFTA	North American Free Trade Agreement
NGO	Non-governmental organization
PBRs	Plant breeder's rights
TKUP	Traditional Knowledge of the Uses of Plants
TRIPS	Agreement on Trade-Related Aspects of Intellectual Property
UNCED	United Nations Conference on Environment and Development
UNCTAD	United Nations Conference on Trade and Development
UNDP	United Nations Development Programme
UNESCO	United Nations Educational, Scientific, and Cultural Organisation
UNEP	United Nations Environment Programme
WHO	World Health Organisation
WIPO	World Intellectual Property Organization
WTO	World Trade Organisation

Preface

Studying horticultural production has been a journey for me, the discovery of a new world. It is not only the world of food production but it also encompasses the production of flowers and ornamental plants for our everyday pleasure. This world I was getting to know was new and strange, completely different than I had imagined. I realized that production of plants has become a global enterprise, that agriculture has become agribusiness. And that capitalism, individualism and globalisation, the driving forces of the modern world, have penetrated all the way to the essence of our existence, to the plants that sustain our life on earth.

During the time I studied horticulture the world has been struck by food crisis, and farmers are struggling to survive. There is famine and, at the same time, overproduction and constant discussions about the possibility or impossibility to feed the growing population. I have read about erosion, pollution and reduction of biodiversity caused by farming. Clearly this world I was getting to know was a world in crisis. The interesting thing about this crisis is that it affects us all, rich and poor, regardless of our geographical location. We all eat every day and this brings us together, especially in this globalized world where commodities are shared across borders. The problems might be different depending on circumstances and location, but nonetheless the problems exist. With this crisis and the heated debate that has followed, the public has become increasingly aware of the situation, and alternative, sustainable approaches have gained popularity. The public wants to know what they eat and where their food comes from.

As we all know food production starts with the seed, but at an increasing rate seeds are purchased, not saved, so food production actually does not start at the farm but with the production of the seed. Food production has become a globalized system where seed production has been separated from agriculture. So knowing where the food is grown does not necessarily tell us the whole truth about the origin of the food. This realization led me on the quest to find out more about this scenario, and with this thesis I examine the processes that have made it possible for us to end up in a world where profits are made on the very source of our survival – the seeds.

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1 Introduction

Humans have taken possession over every resource on the planet, even including the source of life on earth, the seed. Market forces determine the path of agricultural development and since patents are available for seeds and plant genetic resources the commoditization of seeds has been facilitated. Seed production and agricultural production are nowadays industrial processes with the production of seeds separated from the production of food.

The purpose of this thesis is to examine the processes behind the situation of the globalized and commercialized seed trade, why and how we ended up in this situation. In addition, I examine how the globalized world of agriculture and the oligopoly in seed trade affect farmers and consumers in my home country, Finland. I chose to investigate the situation in Finland because it is the most easily graspable since I am a member of the Finnish community. I also chose Finland to illustrate how the situation impacts our everyday lives as consumers in an industrialized country. I hope I can reach and sensitize at least some people with this information so that we, through the power of consumer choice, can impact the world we live in and make sensible and sustainable choices.

The literature study was conducted by searching appropriate literature, a lot of reading and finally the writing and assembling of the information I acquired into an easily understandable information packet. The methods of the analysis of the situation in Finland are comprehensively explained in chapter eight.

Personally I feel these issues are of essence if we are to build a sustainable world for future populations. The production of food is the foundation of our civilization and without functioning agricultural practice we would not survive. The issues of commercialized and industrialized agriculture unite us all, rich and poor, since we all need to eat.

2 Humanity and plants entwine

Since the beginning of agriculture seeds have always played an important part, and by practising agriculture and saving seeds farmers have contributed to the agricultural biodiversity for centuries (Kästler 2005, p. 10-11). Farmers simply selected seeds from healthy and productive plants for the following season, and slowly the genetic composition of plant populations changed and different varieties, adapted for a variety of conditions, were created (The Center for Food Safety 2013, p. 3).

Farmers naturally favoured plant individuals with qualities important for successful agricultural practice, and as time passed by domesticated plants lost the qualities needed for survival in the wild. The seeds no longer shattered, ripening and germination became even, toxins were reduced and the lifespan of plants reduced to suit rapid agricultural practice. Humankind and the plants they domesticated became dependent on each other for survival. (Kingsbury 2009, p. 17-29). This transformation of wild plants to domesticated crops enabled people to settle down, and both culture and technology flourished and advanced when artisans, craftsmen, priests and politicians were able to concentrate on their tasks without having to worry about food production (Connoly & Lawn 2004, p. 9).

Our reliance on plants is far greater than one could imagine, plants not only provide us with food, timber and medicine, they also sustain the world we live in by balancing the ecosystem, stabilizing soil and regulating climate. In the less developed countries an approximated 80 % of the population rely on traditional medicine and plants as the basis for their health care, and in the industrialized countries one-quarter of the medicines used derive from plant species. (Mgbeoji 2006, p. 51-52).

2.1 Plant breeding

During the 16th and 17th centuries the attitude to nature started to change as preindustrial capitalism was in advance and Europeans started exploiting nature in a way never seen before. Machines and inventions changed lives and gave humans the feeling of domination over nature; the period of the scientific revolution was at hand. An often-posed question was whether humanity could dominate nature by the combination of scientific knowledge and technological manipulation. (Merchant 2008, p. 735).

These thoughts led to the enlightenment that it is possible to improve plant crops, and in the 17th and 18th centuries educated people started engaging more in agriculture and farming methods. The low status of agriculture was raised, agricultural books were published, subsistence farmers were replaced by commercial agriculture and farming became a firm part of the capitalist economy. (Kingsbury 2009, p. 58-61). The big breakthrough in plant breeding came with Gregor Mendel in the 1850's who by trials growing pea plants came up with the Laws of Inheritance that led to further discoveries in the field of genetics (Marantz 2001, p. 5-7). His discoveries in combination with other scientific findings in heredity, pure-lined breeding and a greater knowledge of genetics made it possible to plan plant breeding and develop pure lines with specific characteristics suited for specific conditions (Kingsbury 2009, p. 165-166 & p. 282).

The production of hybrid seeds that produce high and uniform yields quickly became very popular and during the 19th century yields were increased at a rate never seen before (Kingsbury 2009, p. 240-251 & IFPRI 2002, p. 1). Especially F1 hybrid corn became a great success in the United States, and the higher yields it provided even had a positive effect on the political climate. The US could now concentrate on politics without having to give food production much thought, and the possibility to provide food aid for nations struggling with poverty and malnutrition strengthened their image of a force of good. (Kingsbury 2009, p. 240-251).

In the 1970s genetic engineering, a technology that made it possible to move individual genes from one organism to another was developed. This very precise tool is used in plant breeding to create plant varieties with specific desired qualities. (Paarlberg 2010, p. 162-162). In traditional breeding and hybridization only close relatives can be crossed, but with genetic engineering this has changed and DNA can be mixed and shuffled exactly as desired. With genetic engineering as a tool scientists can go against all rules of natural reproductivity and evolution. (Mbeoji 2006, p. 183-184). This incredible and powerful technology has a lot of potential for both good and bad (Mbeoji 2006, p. 183-184).

Genetically engineered crops have spread quickly, but only in certain areas of the world. In 2008 GMOs were planted at an area of 125 million hectares but only in 25 countries with the United States, Argentina, Brazil, India and Canada in the lead. The United States is in the absolute top when it comes to GMOs; half of the world's GM crops are grown here and 70 % of all commercial foods contain GMOs. (Paarlberg 2010, p. 166).

2.2 The birth of commercial seed trade

In 1943 Columbus brought maize to Europe when he returned from his voyage to America, and later he returned to America with crops originating from Europe and The Middle East (Mgbeoji 2006, p. 96). The European occupation of other nations continued after the time of Columbus and in the 19th century the age of the colonial empires reached its height. The world became globalized, capital economy took over and new crops were spread all over the world. (Kingsbury 2009, p. 98-141). The age of the empire changed agricultural practise in the tropical world from local, small subsistence farms, based on economy of exchange, to agricultural production for export based on capital economy (Kingsbury 2009, p. 98-141).

The introduction of the new varieties during the colonial times leads to hysteria in the growing seed trade. Experimenting and improving varieties for gaining wealth and power in the agricultural business turned into a mess since there were no regulations,

no official trials and no growers' associations. (Kingsbury 2009, p. 138). When seed production moved away from local exchange between farmers, based on trust and honesty, the risks of fraud increased since the quality of the seed could not be proved (Kästler 2005, p. 11). As anyone could name new varieties and sell seeds fraud became frequent in the seed trade; old varieties were renamed and sold, seeds of different varieties were mixed and adultery of seeds was common (Kingsbury 2009, p. 138).

Corporate seed producers and the state, therefore, passed seed laws to protect the consumers, and this in turn led to the growing amount of producers specialized in seed production. As time has passed by we have moved from specialized farms to specialized companies taking control over seed production and seed supply. Within a century, seed production has been almost entirely separated from farming. (Kästler 2005, p. 11).

3 The Green Revolution – toward a global world of food production

During the years after World War II most Less Developed Countries (LDCs) were young, independent states experiencing difficulties with malnutrition and both physically and scientifically crippled infrastructure as well as little experience of administration and governance. To address this worrying scenario, plant breeders in the industrialized countries saw the need to develop new varieties of high yielding plant crops suited for the LDCs. Public plant breeding was still dominant so plant genetic resources and the scientific knowledge behind new plant varieties was easily available for adoption in less developed countries. In addition, the improvement of plant varieties was seen as a cheap and easy way to improve the situation in contrast to expensive mechanical and technical improvements. (Murphy 2007, p. 84).

An international agricultural research system with the task to make research and introduce improved varieties suited for the less developed countries (LDCs) was created (IFPRI 2002, p. 1). The Rockefeller and Ford foundations were the investors behind this idea, and new wheat and rice varieties were developed mainly for use in Latin America and Asia by plant breeders in Mexico and the Philippines (Paarlberg 2010, p. 56-57). The International Maize and Wheat Improvement Center (CIMMYT) was established in

Mexico and the International Rice Research Institute (IRRI) in the Philippines. These two institutes together with other public sector breeders were the main contributors to the new high-yielding varieties (HYVs) of wheat and rice that quickly increased yields and saved millions of people from starvation after World War II. (Murphy 2007, p. 86-90).

In the 1960s hunger and malnutrition grew stronger in the less developed countries and, in addition, their populations were growing at an increasing rate (IFPRI 2002, p. 1). It was realized that international agricultural research had to expand as CIMMYT and IRRI mostly had concentrated their efforts to Asia and Latin America. With the combined efforts of CIMMYT, IRRI, the Food and Agriculture Organisation (FAO) and the World Bank, the Consultative Group on International Agricultural Research (CGIAR) was established in 1971. The objective of CGIAR was to reduce hunger and food scarcity in regions where it was most needed, and today 15 agricultural research institutions and 8,500 scientists in over one hundred countries are under the wings of CGIAR. (Murphy 2007, p. 95-97).

The high yielding varieties were produced by crossing dwarfing varieties, resulting in new varieties that produced short stiff straws, consequently concentrating more energy on grain production than on leaf or straw. But for these varieties to be successful they required more external inputs, such as fertilizer and irrigation. (Paarlberg 2010, p. 56). Therefore this so-called Green Revolution involved not only the production of high-yield varieties, but also the spread and increased use of irrigation, fertilizer and pesticides. In addition to this, the availability of credit was improved for farmers in the less developed countries making it possible for a higher percentage of farmers to try the new technology. (IFPRI 2002, p. 1). High-yield varieties became very popular and by 1990 the area of rice and wheat planted with HYVs were as high as 70 %. (IFPRI 2002, p. 1). By 1998 the increase of the new varieties reached 82 percent in Asia and 52 percent in Latin America (Paarlberg 2010, p. 64). And by the 1980s more than 8,000 new high-yield varieties had been developed for at least 11 different crops (Paarlberg 2010, p. 56-57).

The solid package that the Green Revolution came as had many positive effects. The introduction of high-yield varieties, fertilizers and irrigation increased yields in both Asia and Latin America at the end of the 1960s. (IFPRI 2002, p. 1). The wheat harvests in India

grew steadily every year from 1967 onward, and in 1974 India was self-sufficient in cereals. In Pakistan wheat production increased by 60 percent from 1967 to 1969 and the Philippines started to export rice for the first time in a century. (Kingsbury 2009, p. 285).

It is estimated that annual crops would have been 16-19 percent lower in the year 2000 if it had not been for the Green Revolution (Paarlberg 2010, p. 57). And as farmers had the chance to finance their business, through improved availability of credit, and invest in seeds, fertilizers and technology, they were able to produce higher yields and rise from poverty (Kingsbury 2009, p. 284-287). Because of the great impacts of the Green Revolution on world food production, Norman Borlaug, who was the man behind many of the new wheat varieties, was awarded the Nobel Peace Prize in 1970 (Paarlberg 2010, p. 57). The Green Revolution also made a big contribution to the transition to capital based economies all over the world making agriculture more globalized than ever before (Kingsbury 2009, p. 284-287).

3.1 Criticism of the Green Revolution

The seeds of the Green Revolution have, however, provoked controversy and several negative impacts have also occurred. Investing in fertilizer, irrigation and pesticides is expensive and a lot of small farmers could not afford it, thus large landowners were the ones who benefitted the most from the new technology. (Kingsbury 2009, p. 310-311). The Green Revolution has also provoked political debate since the beginning because of the feared negative side effects of the new technology. The growth of income inequality, dependence on fertilizer and irrigation, environmental damage and reduction of biodiversity were the greatest concerns among critics. (Paarlberg 2010, p. 58).

Since the plant breeders behind the Green Revolution mostly had higher yields on their mind, they did not take into account that for small farmers in less developed countries security might be of higher value than a potentially high yield (Kingsbury 2009, p. 310-311). The high-yielding varieties were based on an agricultural model of high inputs of synthetic fertilizers to produce as high yields as possible. What the Green Revolution

failed to take into consideration was the ecological impact that the high inputs of synthetic fertilizers and reduced input of organic matter had on soil fertility and soil structure. Agricultural systems function, just as natural ecosystems, on co-operation and mutual creation of beneficial biological products for the plants and the soil. (Shiva 1997, p. 48-49).

The increased use of synthetic fertilizers, especially nitrogen, chemical pesticides and irrigation combined with the subsidies farmers were offered for the use of the new technology led to fertilizer and chemical use of hazardous proportions. Because of the high amounts of pesticides used, a lot of beneficial insects have died while pests have evolved resistance to the pesticides, resulting in an ever increasing use of even more toxic chemicals. (Paarlberg 2010, p. 61-63). In many parts of the world the consequences were seen as a drop in the groundwater tables, increased nitrates in drinking water and high amounts of fertilizers in streams (Paarlberg 2010, p. 61-63).

Because of the great success of high-yielding varieties, other crops were abandoned and rice and wheat were cultivated at larger areas (IFPRI 2002, p. 1). The high-yield varieties were mostly hybrid varieties that do not reproduce a stable offspring so farmers continually returned to commercial breeders to purchase new seeds and the fertilizers required. This commercialization and commoditization of naturally regenerative seeds to a non-renewable resource, produced through technical processes, has led to the reduction of agricultural diversity. (Shiva 1997, p. 50-51).

3.2 The Green Revolution and Africa

The Green Revolution never properly reached Africa and only 27 % of agricultural land was covered with the new seeds (Paarlberg 2010, p. 64). The poor soils, abscence of irrigated land and the large scale of climate zones and diverse soils put a lot of pressure on plant breeding. The varieties developed for the Green Revolution did not fit for introduction in Africa. (Kingsbury 2009, p. 311-312). Varieties from Asia and Latin America, not suitable for the climate and culture in Africa, were introduced but the

farmers did not like them. High transport costs combined with a poor infrastructure made the Green Revolution too expensive for Africa. (IFPRI 2002, p. 2).

Now a new Green Revolution, the Alliance for a Green Revolution in Africa (AGRA), is planned especially for Sub-Saharan Africa with the aim to bring new farm technology to the reach of African farmers. The Rockefeller Foundation and the Bill and Melinda Gates Foundation have been working together since 2006 with this project. However, critics and activist groups were immediately concerned about the true motives of AGRA arguing that a few stakeholders, like the seed and fertilizer industries, would be the ones profiting and that poor farmers and food production would be negatively affected. (Paarlberg 2010, p. 58-59).

4 Intellectual property rights on plants

It is clear that plants have had a huge impact on the history of humankind and that plants are vital for the survival of humans. But what is not as clear is the legal ownership and control of plants and plant resources. (Mgbeoji 2006, p. 9-11).

According to the WTO website intellectual property rights (IPRs) are: “rights given to persons over the creations of their minds”. IPRs can protect authors and artists through copyrights and industrial property through e.g. patents. (World Trade Organization, 2013). Intellectual property rights (IPRs) and patents on products of nature were not allowed for a long time, but with the emergence of the pharmaceutical and chemical industries the patent laws have been changed, and gradually the definition of patentable subject matter has been expanded to include artificially modified life forms and DNA sequences (Mgbeoji 2006, p. 122-123 & 130).

In the 1980s and 1990s changes in legislation made it possible to apply for utility patents on genetically modified organisms, which significantly alleviated the patenting of plant genetic resources, and strengthened the rights of plant breeders to obtain intellectual property rights on plants (Murphy 2007, p. 104). It is considered that genetically

engineered crops are eligible for patents, and that they are products of human invention since external output is needed in the creation process (Shiva 1997, p. 19-20).

There are two main philosophical approaches that lie as the foundation for national laws and international agreements relating to intellectual property rights. Article 27 of the Universal Declaration of Human Rights states that everyone has "the right to the protection of the moral and material interests resulting from any scientific, literary or artistic production of which he is the author". The protection of intellectual property can, therefore, be seen as a human right and makes IPR protection a necessity. (Helfer 2004, p. 1-2).

The other approach that underlies intellectual property right laws and the granting of IPR protection is the view of these products as important and enriching for the cultural life and welfare of a society (Helfer 2004, p. 1-2). Since plants are easy to reproduce, intellectual property protection for plant varieties are granted to encourage commercial plant breeders to innovate and improve plant varieties safely without the fear of third parties replicating their innovations. Intellectual property right protection of plant varieties is also meant to encourage private research and alleviate the need of public funding. (Helfer 2004, p. 2-3).

4.1 International agreements concerning plant patents

Internationally there are two major treaties that are the most important in the issue of intellectual property right protection of plant varieties, the International Union for the Protection of New Varieties of Plants (UPOV) and the Agreement on Trade Related Aspects of Intellectual Property Rights (TRIPS) (Helfer 2004, p. 20).

The UPOV convention, established in 1961, set out to protect plant breeders and encourage the development of new varieties by providing plant breeders with intellectual property rights for their products. The Convention came to force in 1968 and has been revised in 1972, 1978 and 1991. There are four criteria that have to be fulfilled

for a new variety to be granted protection under the UPOV. (UPOV 2013, p. 1).

> "Varieties have to be (i) distinct from existing, commonly known varieties, (ii) sufficiently uniform, (iii) stable and (iv) new in the sense that they must not have been commercialized prior to certain dates established by reference to the date of the application for protection." (UPOV 2013, p. 1)

The UPOV conventions were created as an alternative, sui generis system for the protection of plants, and UPOV 1991 provides industrial plant breeders with exclusive rights of the protected variety (Mbeoji 2006, p. 176-177). As of January 5, 2013, a total of 71 countries are members of the UPOV (UPOV 2013, p. 1).

The Agreement on Trade-Related Aspects of Intellectual Property Rights (TRIPS) is an agreement under the WTO and it was a result of the Uruguay Round of GATT in 1986-94. The achievement of the TRIPS Agreement was that it offered an international and unified approach to intellectual property rights to alleviate international trade. Each member of the WTO and TRIPS agreement has to offer a minimum level of protection for intellectual property. (World Trade Organization, 2013b). Plant variety protection is only mentioned briefly in the TRIPS agreement, but it has had a big impact on plant variety protection and plant breeders' rights since it requires all members to establish a patent regime or similar system for plants (Mgbeoji 2006, p. 128-129 & Helfer 2004, p. 33).

To be eligible for patenting under the TRIPS agreement the invention must be new, involve an inventive step and be capable of industrial application (Helfer 2004, p. 38). WTO members do not have to protect plant varieties through patents, a sui generis system like, e.g. UPOV, is also accepted or a combination of both patents and a sui generis sytem (Helfer 2004, p. 39).

Because the TRIPS agreement not only deals with intellectual property rights, but is a part of other trade-related WTO agreements as well, nations across the world have seen it as very appealing to implement the TRIPS agreement (Helfer 2004, p. 34). Corporate driven standardization of patent laws has definitely progressed with the implementation

of the TRIPS agreement even if it does not have the power of an international patent system (Mgbeoji 2006, p. 48-49). According to the WTO website, 159 nations were members of the WTO on 2 march 2013, more than double the amount of the 71 UPOV members.

Article 27 (1) of the TRIPS agreement states:

"…patents shall be available for any inventions, whether products or processes, in all fields of technology, provided that they are new, involve an inventive step and are capable of industrial application.

The exceptions in paragraphs 2 and 3 are:

2. Members may exclude from patentability inventions, the prevention within their territory of the commercial exploitation of which is necessary to protect ordre public or morality, including to protect human, animal or plant life or health or to avoid serious prejudice to the environment, provided that such exclusion is not made merely because the exploitation is prohibited by their law.

3. Members may also exclude from patentability:
(a) diagnostic, therapeutic and surgical methods for the treatment of humans or animals;
(b) plants and animals other than micro-organisms, and essentially biological processes for the production of plants or animals other than non-biological and microbiological processes. However, Members shall provide for the protection of plant varieties either by patents or by an effective sui generis system or by any combination thereof. The provisions of this subparagraph shall be reviewed four years after the date of entry into force of the WTO Agreement." (World Trade Organization, 1994).

With the TRIPS agreement the patent system has become globalized and patents on life forms have been made available (Shiva, 2001). However, without a precise definition of a novelty and a patent the member states are allowed to quite freely interpret and utilise the TRIPS agreement as they wish and in the biological field this has great implications since the line between patentable discoveries and inventions remain fuzzy (Mgbeoji 2006, p. 130).

In addition to the UPOV and the TRIPS there are several other international agreements and institutions that are relevant to IPR issues and the creation of rules and standards relating to intellectual property and patent law, the following being the most important: the World Intellectual Property Organization (WIPO), the World Trade Organization (WTO), the Convention on Biological Diversity (CBD), The Consultative Group on

International Agricultural Research (CGIAR), the International Plant Genetic Resources Institute (IPGRI), The International Undertaking on Plant Genetic Resources and, The International Treaty on Plant Genetic Resources for Food and Agriculture (ITPGR). (Helfer 2004, p. 15-16).

4.2 Patents on plants in the United States

In the US patents were first made available for asexually reproducing plants when the US congress passed the Plant Patent Act in 1930. But since the most important food crops reproduce sexually with seeds, they were excluded from patentability. (Murphy 2007, p. 106). After the implementation of the UPOV the US Congress approved the Plant Variety Protection Act (PVPA) in 1970 (Murphy 2007, p. 107). With the PVPA legal protection was made available for sexually reproducing plants as well (Mbeoji 2006, p. 176-177), and in 1985 utility patent protection was made available for genetically engineered plants (Murphy 2007, p. 108).

4.3 The creation of a community patent system in Europe

In Europe a lot of work has been done regarding the internationalization and harmonization of the patent system that is mainly based on two agreements; the 1973 European Patent Convention (EPC) and the 1975 Luxembourg Community Patent Convention (CPC) (Mgbeoji 2006, p. 40).

The EPC led to the implementation of the European Patent Office (EPO), a stand-alone body with its headquarters in Munich. Through the EPO it is possible to file for a European Patent Application or a so-called “bundle of patents” that, when granted, has the same effect as a national patent in each designated country. This system facilitates the granting of patents within Europe while at the same time maintaining the sovereignty of the member states over patent enforcement. In the 1990s the EPO Board of Appeal established that genetic material is patentable and could be considered an invention once isolated from the body. (LaFlame 2010, p. 619-620). Article five of the

directive states that “an element isolated from the human body or otherwise produced by means of a technical process, including the sequence or partial sequence of a gene, may constitute a patentable invention, even if the structure of that element is identical to that of a natural element.” (Eur-lex, 1998).

Even though the patent procedure was made significantly easier through the EPC, it is still criticized for being expensive and complicated. That is why the Community Patent Convention (CPC) followed suit only two years after the EPC. The idea of the community patent is to establish a unitary system of enforcement to further facilitate and reduce the costs of patents in Europe. Ever since the Community Patent Convention in 1975 this has been discussed and attempted at several occasions. (LaFlame 2010, p. 614-615).

In December, 2012, the European Parliament and all member states, except Italy and Spain, eventually agreed upon the “patent package”. Two regulations and an International Agreement were adopted and after each member state has signed and ratified these, a single patent jurisdiction will be set up that will lower the costs and administrative work of obtaining patents within the European Union. (European Commission, 2013a). With the community patent the bundle of patents would be brought together to form a single European patent valid in the European Union (Mgbeoji 2006, p. 40).

In addition to the renewing and unifying of the patent system the EU legislation on the marketing of seed and plant propagating material is being reviewed as well (European Commission, 2013b). It is argued that this new seed law; the Regulation on Marketing of Plant Reproductive Material, if passed would prohibit farmers from saving heritage seeds, many which are rare. The EU directorate for Sanitary and Consumer affairs (DG SANCO) together with multinational seed corporations are the driving forces behind the new seed law, while both EU directorates for agricultural affairs (DG AGRI) and environmental affairs (DG ENVI) oppose the proposal. (Open source seeds, 2013).

5 The rise of private sector plant breeding - the oligopoly in seed trade

As previously mentioned agriculture and plant breeding was globalised thanks to the work of the public sector and the International Research Centers CIMMYT, IRRI and CGIAR. At the same time, however, the private sector was active as well but in a smaller scale. The availability of utility patents on genetically engineered organisms in combination with the strengthening of plant breeders' rights with the UPOV and TRIPS agreements, made profit making on seeds and plant varieties possible, and the spark needed for the private sector to rise as the dominant force in plant breeding was ignited. (Murphy 2007, p. 104).

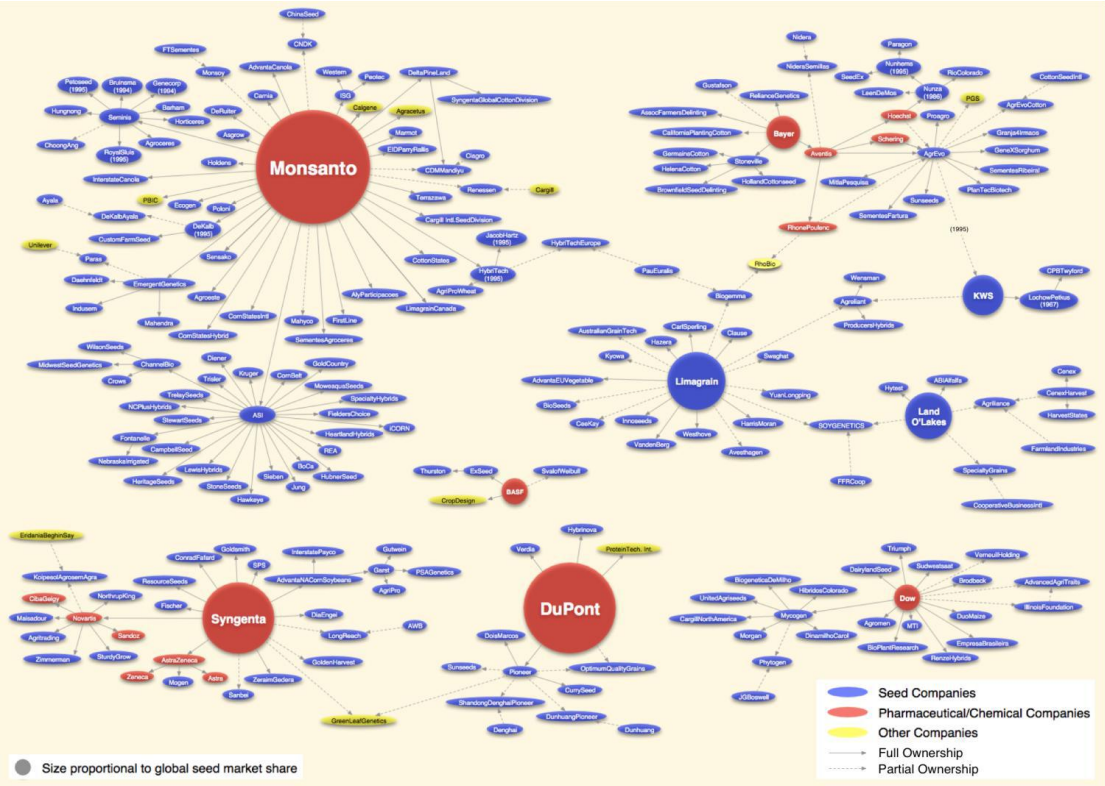

Figure1. Visualization of the market concentration, 1996-1998. (Howard 2009, p. 1274)

The growth of the private sector as a major player in plant breeding has given us a world where food production aims at profit making for the survival and maximum profit of the seed industry (Murphy 2007, p. 168-169). The privatisation of the seed market has led to market concentration and the fallout of numerous small seed producers (Then&Tippe 2009). Figure 1 visualizes the market concentration in seed trade from 1996-2008 and clearly illustrates how the largest firms fully or partially have taken over smaller firms

(Howard 2009, p. 1274). The ten largest seed companies control one-quarter to one-third of the annual seed trade, reaching a value of around $30 billion (Mbeoji 2006, p. 182). And in 2008 the proprietary seed market covered 82 % of the commercial seed trade (ETC Group 2008, p. 11).

To give a picture of the market concentration seed production has gone through the top 10 seed companies, their annual sale (2007), and their percentage of the global proprietary seed market is presented in table 1. Monsanto is the largest seed company with 23% of the global proprietary seed market in its hands. (ETC Group 2008, p. 11). In 2008 Monsanto had over 400 plant technology patents covering 96% of the GE cotton, 90% of GE soybeans and 90% of GE corn planted in the United States (Navdanya 2012). DuPont and Syngenta are the two biggest companies after Monsanto and together they stand for almost half of the global seed production (ETC Group 2008, p. 11-12).

Company	**2007 seed sales (US $ Million)**	**% of global proprietary seed market**
1. Monsanto (US)	$ 4694	23%
2. DuPont (US)	$ 3300	15%
3. Syngenta (Switzerland)	$ 2018	9%
4. Groupe Limagrain (France)	$ 1226	6%
5. Land O' Lakes (US)	$ 917	4%
6. KWS AG (Germany)	$ 702	3%
7. Bayer Crop Science (Germany)	$ 524	2%
8. Sakata (Japan)	$ 396	<2%
9. DLF-Trifolium (Denmark)	$ 391	<2%
10. Takii (Japan)	$ 347	<2%
Top 10 Total	**$ 14, 785**	**67%**

Table1. Top ten seed companies. (ETC Group 2008, p. 11-12)

5.1 The firm grip of Agbiotech companies

To maximize their profits private sector plant breeders and agbiotech companies concentrate their efforts in research and plant breeding on traits like herbicide tolerance and other qualities that fit together with the chemical products they produce (Mbeoji 2006, p. 181). To further maximize their profits agbiotech companies only concentrate their production of seeds on a few crops making it possible to produce uniform products at low cost (Kästler, 2005).

As a result private sector breeding has led to research on relatively few crops and a narrow focus on the development of input traits (Murphy 2007, p. 168-169). The three most known and widely spread GE crops are Bt corn, Bt cotton and Roundup Ready soybean. In the Bt crops the soil bacterium *Bacillus Thuringiensis*, Bt, with the capacity of insect resistance being genetically engineered into the plant. And the Roundup Ready soybean has been engineered to resist Monsanto's glyphosate herbicide called Roundup. (Paarlberg 2010, p. 162-162). These two traits, herbicide tolerance and insect resistance, are the only traits the biotech industry has provided the market with. Crop varieties with two and even up to three different genes for herbicide and insect resistance are being developed to add value to the seeds and maximize profits. (ETC Group 2008, p. 13).

To get an even firmer grip over global food production seed companies collaborate and make cross-licensing agreements with agrochemical firms (ETC Group 2008, p. 11-12). This Results in the fact that 91 % of the annual $31 billion trade in agrochemicals is also controlled by seed producers (Mbeoji 2006, p. 182). According to Navdanya's report *The GMO Emperor Has No Clothes* (2012, p. 24-25), Monsanto collaborates with BASF, the world's largest chemical producer; Bayer;

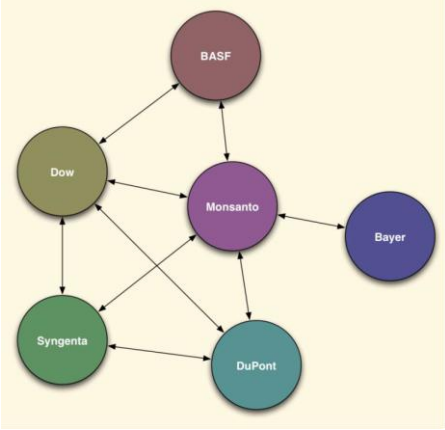

Figure 2. Cross-licensing agreements. (Howard 2009, p. 1274)

DuPont; Syngenta and Dow. The report further states that these multinationals are not competing with each other, but they are together taking control over the seed supply. The phenomenon of cross-licensing can be seen in figure 2, which clearly illustrates the central part Monsanto has in this cartel. Monsanto is the only company collaborating with all of the other firms because of the near monopoly it has on transgenic traits (Howard 2009, p. 1279).

The legal obstacles in the ownership of plants have been relatively easy to overcome, but the biological barriers of reproduction are more difficult to control. The fact that plants reproduce is a negative quality for seed enterprises making it difficult for them to protect their products. It is not possible to produce sterile hybrids of all crops, and other sterility technologies have been difficult to develop. Because of this, private seed enterprises make written contracts with farmers compelling them to repurchase seeds every year. (Murphy 2007, p. 107). These contracts, in combination with seeds and agrochemicals being sold as packages, have effectively locked farmers to return to the same seed companies year after year (ETC Group 2008, p. 11-13). Ironically the creation of a world of global, free trade has aggravated the existence of a multitude of small producers giving big companies assets to grow (ETC Group 2008, p. 6).

6 Controversies beyond comprehension

Globalisation of agriculture that spread across the world with the introduction of high yield varieties during the Green Revolution has continued (Navdanya, 2012), and the strengthening of intellectual property rights for plant breeders and the emergence of genetic engineering has simplified the commodification, commercialization and patenting of products of nature (Shiva 1997, p. 23-24).

Further, the market concentration and reliance on private sector plant breeding has changed agricultural practice, and capital economy and market forces now determine the course of agriculture (Mgbeoji 2006, p. 73&168-169). The choice to focus on the development of hybrids in the 1920s and transgenesis in the 1990s was not made because these technologies were better than other technologies, but rather because

these technologies were easy to make a profit on and easy to implement in the market economy. Both technologies disable farmers to save seed and are, therefore, favoured by seed enterprises. (Murphy 2007, p. 123-124). The values of multinational seed companies might have been profitable on a short term for both farmers and the corporations behind the products, but in the long term the products are not sustainable (Murphy 2007, p. 123).

Agriculture has moved from being a self- organized, complex and diverse living system that grows from within and has the capacity to self-heal and adapt into becoming a uniform system that is mechanically controlled (Shiva 1997, p. 31-32). The narrow approach of research and the focus on transgenesis that the agbiotech industry is favouring are feared to have many negative unintended side effects. The consequences of the use of GM crops for our ecosystems and our health is uncertain, and the fact that the main goal of the agbiotech companies behind this technology is profit, not consumer safety, has added volume to the fear against the technology. (Murphy 2007, p. 168-169).

6.1 Concerns caused by genetic engineering

When genetic engineering emerged the world was struck with awe and the technology was said to be the solution to all future agricultural problems (Navdanya 2012, p. 18). However, genes form networks that are not entirely understood by humans, and isolating genes from these networks might have unintended consequences that cannot be predicted (Mbeoji 2006, p. 185).

The purchase of transgenic seeds and herbicides brings benefits like yield increase, simpler management and less labour for the farmer (Murphy 2007, p. 106). But the end of the supply chain, the food processors, wholesalers, retailers and last, but not least, the consumers do not benefit from the technology (Murphy 2007, p. 106). The most acute issues that worry the consumers concerning trangenesis are antibiotic resistance markers, transgene insertion, e.g. random insertion of genes into a plant genome, and

the risks of gene flow or genetic contamination as the phenomenon has been dubbed among activists (Murphy 2007, p. 179-180).

When engineering transgenic crops selection methods are needed to eliminate cells that have not been transformed in the process. The most common and effective technique used is the insertion of antibiotic resistance genes to the transgenic cells in addition to the trait the breeder desires. After the transformation process the cells are treated with an antibiotic that kills all cells except the resistant transgenic ones. (Murphy 2007, p. 180). This process of inserting antibiotic resistance into agricultural crops has raised much concern among the public because of the possibility of the transfer of the resistant genes to bacteria in the digestive system. According to scientists the risk of gene transfer is small and so far the scepticism of the public has been ignored, even though other methods for selection are available. (Murphy 2007, p. 180-181).

Selectable markers are also used to accomplish herbicide tolerance, and concerns about these genes escaping and contaminating wild relatives are also widespread among the public and anti-GM activists. The exchange of genes has been important in the evolution of domesticated plants but an unwanted gene flow can cause unexpected consequences. (Murphy 2007, p. 181-184). Genetic contamination means the spread of genetically engineered traits, like herbicide or insect tolerance, from agricultural crops to weeds and insects. Growing herbicide tolerant crops has led to increased use of the pesticide glyphosate, and consequently, weeds are evolving resistance and similarly Bt-resistant insects are emerging. (Navdanya International 2012, p. 29-30). The concerns of these so called superweeds and superpests can clearly be seen in the US where genetically engineered crops have been grown for the past 20 years (Navdanya International 2012, p. 49).

6.2 Biopiracy in a neo-colonial world

The age of empire and traces of colonialism can still be seen today; the less developed countries of the south still supply the industrialized countries with plant raw materials and foodstuffs. We are living in a postcolonial era where the industrialized North still controls the South through global trade structures. (Mgbeoji 2006, p. 68). The industrialized countries effectively utilise the patent system to protect their intellectual property, while less developed countries do not have the same access to intellectual property rights. This inequality, and the appropriation of the diversity in the South to the advantage of the North has led to the heated debate of biopiracy that can be defined as follows (Ikechi 2006, p. 12):

> "…the unauthorized commercial use of biological resources and/or associated traditional knowledge, or the patenting of spurious inventions based on such knowledge, without compensation … biopiracy also refers to the asymmetrical and unrequited movement of plants and traditional knowledge of the uses of plants (TKUP) from the south to the North through the processes of international institutions and the patent system". (Mgbeoji 2006, p. 12-13)

Allthough the colonial times are far behind, the industrialized countries continue to have a firm grip on the less developed countries through the biopiracy of genetic resources (Shiva 1997, p. 4-5). The tropical regions and less developed countries are home to the majority of plant species on earth, and the monetary rich but genetically poor industrialized countries are highly dependent on these regions (Mgbeoji 2006, p. 61). The appropriation of plant biodiversity has brought a great advantage to the industrialized countries that with technological superiority have been able to make quantum leaps in agriculture, biotechnology and pharmaceuticals (Mgbeoji 2006, p. 87).

6.3 Patents facilitating biopiracy

Patents on plant genetic resources make it possible for corporations to own seeds as intellectual property (Paarlberg 2010, p. 129-130). And large agbiotech companies with economic self-interest in mind can use the patent system as a tool to gain high profits (Mgbeoji 2006, p. 42-43). It is argued that the measures taken are positive for farmers and agriculture allowing them the same opportunities as industry has been allowed

through the patent system, but the patent system is of European origin with cultural values and a philosophy and ideology that make it un-neutral in a global concept (Mgbeoji 2006, p. 135&16-17). In addition, the uncertainties surrounding the patent system makes it possible for people with knowledge of it to use it for selfish purposes and biopiracy (Mgbeoji 2006, p. 31-33).

Who benefits from the TRIPS agreement and the standardization of patent laws is a much debated issue strongly related to biopiracy and the power of control over biodiversity resources (Mgbeoji 2006, p. 48-49). By only recognizing intellectual rights as private rights the TRIPS agreement has privatized intellectual property and excluded communal innovations from patentability. This has implications for people in less developed countries where innovation and creativity most often is a common source shared among people. The TRIPS agreement further strengthens the growth of corporate power by restricting patentability to products capable of industrial application. This leaves innovations for social good outside the scope of patentability and encourages innovation for profit. (Shiva 1997, p. 23-24).

It is argued that IPR systems are vital for creativity in science since it provides economic security for plant breeders through the protection patents provide (Mbeoji 2006, p. 180). But humans have been innovating since the dawn of time, intellectual property protection has just failed to take these different methods of creativity into account and as a result conservation of biodiversity and intellectual diversity is difficult (Shiva 1997, p. 8-9).

6.4 Biodiversity loss and the abandoning of landraces

The plant varieties humans have produced through centuries of selection are called landraces. These landraces produce a population of plants with high variety, which leads to an uneven harvest, but the strength is that diverse fields of plants are more resistant to changes in climate. Landraces may not have the high yields of uniform varieties, but the risk of total failure is inexistant and the need of input is also smaller. (Connoly & Lawn 2004, p. 13).

As seeds of landraces are collected each year their characteristics change slightly every time, which makes them highly adaptable and prone to evolution. When landraces are exposed to bad conditions they adapt and gradually the gene pool might change, but the genetic resources will still remain wide-ranged and prepared for new problems. (Kingsbury 2009, p. 41).

The introduction of modern high yield varieties and the transition to a capital based global economy (Kingsbury 2009, p. 48), in combination with the growth of cultural homogeneity that globalization has brought (Mgbeoji 2006, p. 65) has led to a lot of farmers around the world abandoning landraces. The loss of landraces has resulted in a great loss of genetic diversity of plant crops and genes that might carry the solution for future problems. (Kingsbury 2009, p. 48).

Since the beginning of the 20th century the focus on only a few commercial varieties has led to a 95 % loss of varieties of our most important agricultural crops especially increasing after the 1970s (Murphy 2007, p. 120).

Agribusiness, patents and plant breeders' rights also drive a lot of species into extinction since the strong intellectual property rights regimes make it very difficult for traditional varieties and landraces to survive. As a result 40 % of all potatoes cultivated in the US are of the variety Russel Burbank since it perfectly matches the requirements McDonald's has on its French fries, and in Indonesia 1,500 varieties of rice have disappeared during the past fifteen years because of the introduction of high yield varieties. Before over 8,000 varieties of apples were grown throughout the world, but now 95 % of all commercially grown apples rely on only twelve to fifteen varieties. (Mgbeoji 2006, p. 65&71).

The narrow approach in plant breeding and agriculture has led to the fact that humanity relies on only four crops, wheat, rice, maize and barley for 90 % of the annual grain production. This monoculture has so far been able to feed the growing population of earth, but the importance of biodiversity should not be forgotten. (Mgbeoji 2006, p. 51).

The narrow genetic diversity of world food crops exposes them, and makes them vulnerable to possible outbreaks of diseases and pest invasions (Mbeoji 2006, p. 181). As an example the southern corn leaf blight *Helminthosporium maydis* that struck maize crops in the US in the 1970s can be mentioned. The uniform maize varieties grown in the US did not have any resistance to the fungus, and a huge quantity of maize across the US was lost due to the outbreak of the disease. (Murphy 2007, p. 120).

Supposedly unimportant plants can carry important genes to resist future diseases and pests (Mbeoji, 2006. p. 181). Species that have not been of importance in food production have several times saved agricultural production from huge declines because of valuable traits they carry. A good example of this is the potato blight attack in Europe 1845-46 that would not have ended well if new potato genes had not been introduced from South America. (Mgbeoji 2006, p. 51). Industrial plant breeders have recognized the problem of biodiversity loss, and seed banks have, therefore, been established all over the world to secure future research (Kingsbury 2009, p. 48).

Today's cash economy puts a lot of pressure on farmers to produce yields as high and uniform as possible, something that is not possible with landraces. Therefore, it is argued that the high variety that landraces offer is a weakness rather than strength in modern agriculture. Modern varieties are predictable and produce a high and uniform yield, which undoubtedly is a relief for many farmers. (Kingsbury 2009, p. 40-41).

Opposed to this view, however, there are people who think landraces are vital and important, especially for communities in less developed countries, where the adaption to modern agriculture is too expensive and risky (Kingsbury 2009, p. 48). The adaptability and variability of landraces is an advantage especially for subsistence farmers, for whom reliability exceeds high yields in importance. Taking the current environmental problems and climate change into consideration landraces can provide valuable genes needed to adapt agriculture to a future of sustainable and sufficient food production. (Connoly&Lawn 2004, p. 10).

Food is still strongly tied to culture and history and therefore landraces are still of value for consumers, and in the past few years consumers have started to demand food diversity, and trends like the slow food movement have occurred (Kingsbury 2009, p. 51-53). Yields have been boosted through industrial methods of agriculture and plant breeding that cannot be denied, but in the long term it is not sustainable, and industrialized agriculture cannot survive without the genetic diversity that is vital for plant breeding and the creation of new varieties (Mbeoji 2006, p. 181).

7 It affects us all – rich and poor

The creation of norms is a gradual process and as history shows us we have gradually ended up in the current situation that allows appropriation of traditional knowledge and patents on genetic resources (Mbeoji 2006, p. 197). Agriculture has become a global enterprise, a solid part of the business world, and the word agriculture has been joined by the word agribusiness (Paarlberg 2010, p. 127-128). Essential as trade is, it has become the major driving force in the world forgetting that without a sustainable and stable environment trade would not be possible. “Only the living can pursue trade, and they can do so only if there is something to buy, sell, or barter within a sustainable environment.” (Mbeoji 2006, p. 197).

The increased use and reliance on technological solutions for emerging agricultural problems have given us a world where corporate powers have control over food production. Agbiotech companies are co-operating and converging to develop new technologies to secure food production and commodify plants. But as has been learned in the previous chapters the oligopoly in seed trade has not been able to build a world of secured food production. The higher yields that technology has been able to offer have come with the cost of severe ecological, social and financial implications, and the world is still facing the problems of food crisis with an increasing amount of starvation. Despite this, governments all over the world are still embracing agbiotech companies and the solutions they seem to be offering for every problem from climate change to Peak Oil. (ETC Group. 2008. p. 5).

The public has been waiting for more consumer friendly products since the emergence of the biotech industry in the 1990s, but so far only a few genetically engineered products are available with only a few companies producing them (Murphy 2007, p. 186). Clearly agbiotech companies are not interested in consumer safety and food security, the technology they offer just introduces new potential problems, makes the food system vulnerable and makes people globally dependent on industry by pushing small farmers aside (ETC Group 2008, p. 6).

The concentration of seed production to a few multinational corporations affects people all over the world, rich and poor. The growing use of the patent system to protect plant genetic resources, especially by commercial plant breeders, not only harm indigenous people, but also aggravates research as legal barriers created to protect plant varieties might cripple research by shutting off access to plant genetic resources. (Mbeoji 2006, p. 182).

Globalisation of industrial agriculture has set the global society on the same foundation when it comes to agriculture, and the ecological, social, financial and political consequences can be seen all over the world. Transgenic crops are infesting organic and non-biotech crops, weeds and insects are evolving resistance to herbicides creating a spiral of ever increasing pesticide use. In USA and Canada Monsanto and other biotech giants are suing farmers for patent infringements and forcing them to pay high royalties. (Navdanya 2012, p. 239-241). And in India suicide rates among farmers has grown drastically after the introduction of Bt cotton that has left many farmers in debt after crop failures (Navdanya International 2012, p. 31). In Europe the consequences of market concentration can be seen as escalating seed prices, less choice of varieties and the restricted possibilities for farmers to save seeds and develop varieties on farm (Navdanya 2012, p. 246-247).

To take a step away from this mess small decisions have to be made to gradually create new norms and lines of action (Mbeoji 2006, p. 197). Some wrong turns have been made during the history of plant breeding and profit driven motives have become dominant in the process of industrializing agriculture. Modern technology and

knowledge can, however, be used to improve plant species and plant diversity if used right. (Mgbeoji 2006, p. 62-63). A transparent system with a good foundation of basic principles has to be built in order to achieve the much needed change in the patent system and the attitudes to it (Mbeoji 2006, p. 192-193).

8 The effects of market concentration on seed purchase in Finland

As can be concluded from the previous chapters the globalisation of agriculture and seed production as well as the market concentration in seed trade have multiple consequences on a social, ecological and economical scale. In the previous chapter it also became clear that the effects reach all over the world – from less developed countries to the industrialized world. But is that really the case? Can the effects be seen in my home country, Finland? And does this situation even concern farmers and consumers here? To find the answers to these questions I decided to find out which seed enterprises are on the market in Finland.

I chose to concentrate on the most common agricultural vegetable crops in Finland that, according to the Ministry of Agriculture and Forestry are cabbage, carrot and garden pea. In addition, I also chose ridged cucumber that also is a commonly grown crop in Finland. As for green house cultivation the Ministry of Agriculture and Forestry informs that cucumber and tomato are the most important crops, and I chose to include salad as well, because of the popularity among consumers. I set out to investigate, which the most commonly grown varieties of these vegetables are, which the companies behind them are, where they are produced and how much each variety is sold in Finland.

8.1 Methods and realization

First I contacted Tike, a service providing statistical information on Finnish agriculture, functioning under the Ministry of Agriculture and Forestry. But it turned out they could only provide me with statistics of the area grown per crop. I was encouraged to contact

the wholesale dealers of seeds; Helle Oy, HL-Vihannes and Schetelig for the information I needed to acquire.

I contacted the personnel at Helle Oy, HL-Vihannes and Schetelig, who are responsible for seed purchase, by telephone and told them about my degree thesis and the information I needed. The companies seemed positive to answering my inquiries so I decided to simply contact them by sending an email, where I stated the questions I needed answered concerning the vegetables I had chosen to investigate (cabbage, carrot, garden pea, ridged cucumber, greenhouse tomato, greenhouse cucumber and greenhouse salad). The questions were as follows; *Which are your most sold varieties and which seed enterprises produce them? Where are the seeds produced? And how much did you sell of each variety during the season 2012?*

As it turned out only Schetelig answered all the questions. Helle Oy and HL-vihannes only answered the two first questions and stated that the two last questions they would not answer because of competition reasons. I contacted Helle Oy and HL-Vihannes again clarifying that the information they provide is confidential and that each company's market share would not be visible in the end result because I would sum the results to get a picture of which seed producers are on the market in Finland. But they were still reluctant to answer my questions, and from Helle Oy they informed me that I would have to contact an impartial party to acquire statistical information concerning the market share of different seed enterprises. In addition, Helle Oy stated that the exact place of production is not informed on the seed packages they receive and that the seed enterprises keep it as their secret. According to Helle Oy the European Union does not require information about place of production since the seeds are marketed through the seed enterprises' European departments.

I contacted the customs to find out if they had any statistical information concerning seed varieties, but they could not help me and redirected me to contact the Finnish Food Safety Authority Evira that manages and controls the food chain in Finland. However, a senior officer at the seed certification and seed control unit at Evira informed me that no control is conducted on the imports of vegetable seeds. The seed

producers have departments in Europe and, therefore, the seed market on vegetable seeds is seen as EU's internal market and no control is conducted. Unfortunately Evira does not have any information about the origin of the vegetable seeds entering the market in Finland since the movement of seeds is free in the EU. (Personal communication, Apr. 9, 2013).

8.2 Results

Since the information I received from the wholesale dealers was insufficient it is not suitable for proper scientific research, but the results give an indication of the situation in Finland. Schetelig gave me the most comprehensive answers, and since they only sell seeds for greenhouse production the results I got were best for the seeds of greenhouse tomato, greenhouse cucumber and greenhouse salad.

Helle Oy imports their most sold varieties of ridged cucumber from Nunhems and their cabbage and carrot from Bejo Zaden. HL-Vihannes imports ridged cucumber from Rijk Zwaan and cabbage and carrot from Rijk Zwaan, Clause, Syngenta and Monsanto. Not much can be concluded from this information other than the fact that six seed enterprises, i.e. Nunhems, Bejo Zaden, Rijk Zwaan, Clause, Syngenta and Monsanto seem to be dominating the seed market for the most popular Finnish agricultural crops.

Nunhems, a subsidiary of Bayer CropScience, is a global enterprise concentrating on research and production of vegetable seeds (Nunhems the global specialist, 2013). Just like Nunhems Bejo Zaden is also a company originally founded in the Netherlands. And just like Nunhems it has grown into one of the leading global seed enterprises for vegetable seeds. (Bejo specialist in vegetable seeds, 2013). Rijk Zwaan is also a European enterprise first founded in the Netherlands that focuses on the production of vegetable seeds on a global scale (Rijk Zwaan seeds and services, 2013). Clause is a subsidiary of Limagrain Group, a global French company producing vegetable seeds (Clause vegetable seeds, 2013). As concluded in chapter five Monsanto is the number one seed producer, Syngenta is number three, Limagrain Group is number four and Bayer CropScience is

number seven on the top ten seed companies in the world. All of the six companies providing Finnish agriculture with seeds collaborate and are united under the Anti-Infringement Bureau for Intellectual Property Rights in Plant Material with the task to prevent patent infringements of the member companies. (AIB Anti Infringement Bureau, 2013).

The information I acquired concerning the seed market for greenhouse crops in Finland was far more interesting, partly because of the more detailed information Schetelig was able to provide the study with. The competition in the market of open field seeds seems to be more competitive than the seed market for greenhouse production where fewer companies control the market for different vegetable seeds.

Helle Oy purchases their cucumber and tomato seeds from Monsanto, and as for salad they rely on Monsanto and Nunhems. HL-Vihannes imports cucumber and tomato seeds from Syngenta and the salad seeds come from Monsanto, Syngenta and Rijk Zwaan. Schetelig purchases tomato and cucumber seeds from Enza Zaden and Rijk Zwaan and seeds for salad from Monsanto and Rijk Zwaan.

	Cucumber	**Tomato**	**Salad**
Helle Oy	Monsanto	Monsanto	Monsanto, Nunhems
HL-Vihannes	Syngenta	Syngenta	Monsanto, Syngenta, Rjk Zwaan
Schetelig	Enza Zaden, Rijk Zwaan	Enza Zaden Rijk Zwaan	Monsanto, Rijk Zwaan

Table 2. The import of seeds for greenhouse production

As can be concluded Helle Oy mainly represents Monsanto, HL-Vihannes represents Syngenta and Schetelig represents Enza Zaden and Rijk Zwaan. This is illustrated in table 2 below. The competition in the market of seeds for greenhouse production in Finland is mainly between the four companies Monsanto, Syngenta, Enza Zaden and Rijk Zwaan. Helle Oy, HL-Vihannes and Schetelig are the main delegates of these seed companies and they compete for customers. This tight fight for purchasing farmers was one of the reasons Helle Oy and HL-Vihannes chose not to answer all the questions they were asked.

The interesting fact is that all three companies import seeds for salad from Monsanto and, in addition, all three companies informed me that Monsanto's green lettuce Frillice is the most sold of all their varieties of salad. According to Schetelig they sold 26 million pieces of Frilice seeds during the season of 2012, as can be seen in table 3. This is a huge amount considering that the combined amount of the five next most sold varieties was 15.4 million pieces in 2012. Since Helle Oy and HL-Vihannes also stated that Frillice is their most sold variety of salad, and assuming that their sales returns are prominently bigger for Frillice compared to other varieties of salad as they are in Schetelig, it seems that Monsanto has a dominant market share in the production of salad in Finland. As has become clear in the previous chapters Monsanto is the largest seed producer on the global market of seeds. Conclusively, Monsanto has been able to find a niche in the market in Finland as well as in the rest of the world.

Variety	Producer	Amount sold (pieces of seed)
Frillice	Monsanto	26 million
Grand Rapids Aficion	Rijk Zwaan	7,5 million
Salanova Exact	Rijk Zwaan	7 million
SV3035LF	Monsanto	400 000
Salanova Triplex	Rijk Zwaan	300 000
Rex	Rijk Zwaan	200 000

Table 3. The sales of salad seeds at Schetelig 2012.

8.3 Conclusions

Even though the information acquired was insufficient to be able to make comprehensive conclusions one interesting result was discovered, namely that the biggest seed producer in the world, Monsanto, seems to have a dominant position in the market of salad seeds in Finland. The most sold variety of salad in Finland is Frillice, which is a product of Monsanto. This can also clearly be seen in the grocery store where the shelves are filled with this popular salad that seems to be loved by consumers. Monsanto has found a way to the plates of Finnish consumers and has been able to dominate the market in this field of agricultural production in Finland.

Farmers in Finland are affected by the market concentration in seed production by a narrowed supply of seed varieties and as a result a poor choice of vegetables for consumers. It can also be concluded that the seven main companies importing vegetable seeds to Finland, i.e. Nunhems, Bejo Zaden, Enza Zaden, Rijk Zwaan, Clause, Syngenta and Monsanto all are global seed enterprises collaborating to protect the intellectual property rights on their products. It can be concluded that Finland, just like the rest of the world is in the same boat of globalized and commercialized seed production dominated by a few companies.

9 Critical examination and discussion

I started out with a simple task; I wanted to know more about seeds. But as it turned out this was more easily said than done, and I found out that the processes behind the seeds before they reach the farmer are complicated and very difficult to understand. To even begin to understand the web of global seed trade an understanding of the historical processes as well as international law and politics has to be acquired.

The process of writing this thesis has been longer and harder than I had imagined mainly because I did not have much background information about the subject before I plunged into it. As a result the literature study expanded and became much more dominant than originally planned and not much time was left for the practical study about the effects of market concentration on seed purchase in Finland. Because of this the study became quite shallow and more interesting results might have emerged if I had had more time to continue the research. However, it does seem that information about the origin of the seeds is difficult to acquire. And apparently the amounts of seeds imported from the seed enterprises are impossible to obtain without the collaboration of all the wholesale dealers. So even though I would have had more time this specific information might not have been possible to get through any of the available sources.

The oligopoly in seed trade has set up a dangerous scenario where farmers and consumers at an increasing rate rely on just a few agricultural traits and crops. These

monocultures make agriculture very vulnerable, since the outbreak of a disease or an attack of pests could wipe out large areas of the agricultural crops we rely on for survival. The reliance on only a few seed enterprises for the production of seed also gives farmers a narrow choice of seeds to purchase. As crop plants with the right qualities might not be available for each farmer the risks of crop failure because of external factors such as climate becomes more evident.

The high yielding varieties might have had a positive effect on the halting of starvation after World War II and in the 1960s. But in the long term this technology in combination with the high inputs of fertilizer, pesticides and irrigation is not sustainable and other approaches ought to be researched. It is a pity that the world only seems to be reaching for higher profits, building a world where capitalism and individualism are seen as the optimal way of being. So much good could be done with the available technology and resources we have at our disposal. Unfortunately, as long as market forces are allowed to determine the path of agriculture sustainability is difficult to reach since profit is what is attained, not ecological, social and economical sustainability.

Personally I have seen the effects industrialized agriculture can have in a developed country, namely my home country Finland. Farmers in Finland are limited to using certified commercial seed varieties if they want to obtain the subsidies that are crucial for most of them to be able to live on their farming. I have seen what the world of farmers in Finland can be, and I have realized that we slowly are taking the steps towards increasingly industrialized methods of agricultural production making us dependent on multinational companies providing seeds, fertilizers and herbicides. This can be seen especially in greenhouse cultivation, which in some cases seems more like factory production than agriculture. Since my childhood I have also been witnessing the gradual deterioration of the beautiful Baltic Sea. That partly is caused by the excessive use of agricultural inputs like chemical fertilizers that easily reach our streams because of the monoculture our fields are managed in.

I have also experienced the consequences monoculture of a single crop might cause in a less developed country, when I worked as a volunteer in Madagascar during two and a

half months. In Madagascar rice is the main commodity and it is grown in vast areas in the valleys between what used to be magnificent rainforests with a unique biodiversity with plants and animal species that could not be found anywhere else. However, erosion has taken most of the forests and the only remaining vegetation in some places is the fields of rice. If nothing is done it is only a matter of time before the rice stops growing as well and the people will be left with nothing but eroded hills. I have felt the impacts of monoculture not only by seeing the landscapes, but I also experienced how it feels and what health issues become apparent when eating nothing but rice and beans three times a day. And I can say that it is not beautiful and it is not glorious.

These are just the two cases I have seen first-hand, effects can be seen in every country all over the world. The globalization, commoditization and industrialization of seed production are clearly affecting every single one of us. Everyone who eats is part of this issue, it is a fact that cannot be denied. Seeds bring us together and seeds give us a reason to fight for a better and more sustainable world together.

Sources

AIB Anti Infringement Bureau. (2013). http://www.aib-seeds.com/en/aib%E2%80%99s-mission/48.aib (retrieved: 13.05.2013)

Bejo specialist in vegetable seeds. (2013). http://www.bejo.com/ww/about-us/quick-profile.aspx (retrieved: 14.05.2013)

The Center for Food Safety. (2013). Seed Giants vs. U.S. Farmers. http://www.centerforfoodsafety.org/files/seed-giants_final_04424.pdf (retrieved: 13.2.2013)

Clause vegetable seeds. (2013). http://www.clause.fr/uk/entreprise/groupe_limagrain/index.php (retrieved 14.05.2013)

Connoly Bryan & Lawn C.R. (2004). *Organic Seed Production and Saving The wisdom of Plant Heritage.* White River Junction, Vermont: Chelsea Green Publishing.

ETC Group. (2008). *Who Owns Nature? Corporate Power and the Final Frontier in the Commodification of Life.* http://www.etcgroup.org/sites/www.etcgroup.org/files/publication/707/01/etc_won_report_final_color.pdf (retrieved: 14.11.2012)

Eur-lex. (1998). *Directive 98/44/EC of the European Parliament and of the Council of 6 July 1998 on the legal protection of biotechnological inventions.* http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=CELEX:31998L0044:EN:HTML (retrieved: 12.1.2013)

European Commission 1. (2013). *Patents.* http://ec.europa.eu/internal_market/indprop/patent/ (retrieved: 5.5.2013)

European Parliament. (2012). *The new EU unitary patent – Q&A.* Press Service, Directorate for the Media. http://www.europarl.europa.eu/pdfs/news/expert/background/20121205BKG57397/20121205BKG57397_en.pdf retrieved: (14.4.2013)

European Commission 2. (2013). *Review of EU rules.* http://ec.europa.eu/food/plant/plant_propagation_material/review_eu_rules/index_en.htm (Retrieved 5.5.2013)

Freese Bill. (2012). *Going Backwards: Dow's 2,4-D-Resistant Crops and a More Toxic Future.* Washington: The Center of Food Safety

Fukuoka Masanobu & Korn Larry (ed.). (2012) *Sowing Seeds In The Desert.* White River Junction, Vermont: Chelsea Green Publishing.

Grain Briefing. (2008). *Whose harvest? The politics of orgnic seed certification.* http://www.grain.org/article/entries/141-whose-harvest-the-politics-of-organic-seed-certification (retrieved: 16.6.2012)

Helfer Laurence R. (2004). For the Development Law Service FAO Legal Office. Intellectual property rights in plant varieties. International legal regimes and policy options for national governments. ftp://ftp.fao.org/docrep/fao/007/y5714e/y5714e00.pdf (retrieved: 10.3.2013)

Howard Philip H. (2009). *Visualizing Consolidation in the Global Seed Industry: 1996-2008.* Michigan State University: Department of Community, Agriculture, Recreation and Resource Studies. http://www.mdpi.com/2071-1050/1/4/1266 (retrieved: 5.5.2013)

IFPRI – International Food Policy Research Institute. (2002). *Green Revolution – Curse or Blessing?.* http://www.ifpri.org/sites/default/files/pubs/pubs/ib/ib11.pdf (retrieved: 25.11.2012)

Kingsbury Noel. (2009). *Hybrid.* Chicago & London: The University of Chicago Press.

Kästler Guy. (2005). *Europe's seed laws: locking out farmers.* GRAIN. http://www.grain.org/article/entries/541-seed-laws-in-europe-locking-farmers-out (retrieved: 16.6.2012)

LaFlame Jr. Michael. (2010). *The European Patent System: An Overview and Critique.* http://www.hjil.org/ArticleFiles/LaFlame.pdf (retrieved: 3.11.2012)

Marantz Henig Robin. (2001). *The lost and found genius of Gregor Mendel, the father of genetics, the Monk in the Garden.* New York: First Mariner Books.

Merchant Carolyn. (2008). *Qritiques and Contentions."The violence of Impediments" Francis Bacon and the Origins of Experimentation.* The History of Science Society. http://leopold.asu.edu/sustainability/sites/default/files/Warren,%20Violence%20of%20Impediments,%20Merchant_2.pdf (retrieved: 8.12.2012)

Mgbeoji Ikechi. (2006). *Global Biopiracy Patents, Plants, and Indigenous Knowledge.* Itacha, New York: Cornell University Press.

Murphy Denis. (2007). *Plant Breeding and Biotechnology - Societal Context and the Future of Agriculture.* Cambridge: Cambridge University Press.

Navdanya. (2012). *Seed Freedom A Global Citizens' Report.* New Delhi: Navdanya

Nunhems the global specialist. (2013). http://www.nunhems.com/www/NunhemsInternet.nsf/id/CW_EN_About_Us-_Overview?open (retrieved: 15.05.2013)

Open source seeds. (2013). *Bad Seed Law.* http://open-seeds.org/bad-seed-law/ (retrieved: 10.12.2012)

Navdanya International. (2012). *The GMO Emperor Has No Clothes A Global Citizens Report on the State of GMOs.* http://www.navdanya.org/attachments/Latest_Publications5.pdf (retrieved: 22.10.2012).

Neate J.H. Paul & Guei G. Robert. (2010). *Promoting the Growth and Development of Smallholder Seed Enterprises for Food Security Crops – Best practices and options for decision making.* FAO. http://www.fao.org/docrep/013/i1839e/i1839e00.pdf (retrieved: 15.5.2012)

Paarlberg Robert. (2010). *Food Politics What Everyone Needs To Know.* New York: Oxford university Press.

Patentti- ja Rekisterihallitus. (2008). *Kansainvälinen patenttihakemus(PCT-hakemus).* http://www.prh.fi/fi/patentit/hakuulkom/kvhakemus.html (retrieved: 15.12.2012)

Phillips Peter W.B. & Onwuekwe C.B. (eds.). (2007). *Accessing and Sharing the Benefits of the Genomics Revolution.* Springer: 2007.

Ray Janisse. (2012). *The Seed Underground A Growing Revolution to Save Food.* White River Junction, Vermont: Chelsea Green Publishing.

Rijk Zwaan seeds and services. (2013). http://www.rijkzwaan.com/wps/wcm/connect/RZ+Corporate/Rijk+Zwaan/Company/About+us/General+Information (retrieved 15.05.2013)

Shiva Vandana. (2001). *Protect or Plunder? Understanding Intellectual Property Rights.* London: Zed Books Ltd.

Shiva Vandana. (1997). *Biopiracy The Plunder of Nature and Knowledge.* USA: South End Press.

Shiva Vandana. (2001). *Protect or Plunder?.* London: Zed Books.

Then Cristoph & Tippe Ruth. (2009). *The future of seeds and food – under the growing threat of patents and market concentration.*

http://www.misereor.org/fileadmin/redaktion/2009_e_report_future_of_seed.pdf (retrieved: 10.9.2012)

United Nations Educational, Scientific and cultural Organization. (2005). *The Precautionary Principle World Commission on the Ethics of Scientific Knowledge and Technology (COMTEST).* Paris: UNESCO. http://unesdoc.unesco.org/images/0013/001395/139578e.pdf (retrieved: 20.1.2013)

UPOV Publication NO. 437(EN). (2013). International Union for the Protection of New Varieties of Plants, What It Is, What It Does. http://www.upov.int/export/sites/upov/about/en/pdf/pub437.pdf (retrieved: 12.3.2013)

Williams Blair, Clough Michael P., Stanley Matthew, Colbert James T. *Creativity and Discovery The Work of Gregor Mendel.* National Science Foundation. http://www.storybehindthescience.org/pdf/mendel.pdf (retrieved: 1.11.2012)

World Intellectual Property Organization. (2013). *Summary of the Paris Convention for the Protection of Industrial Property (1883).* http://www.wipo.int/treaties/en/ip/paris/summary_paris.html (retrieved: 29.1.2013)

World Intellectual Property Organization. (2013). *Contracting Parties.* http://www.wipo.int/treaties/en/ShowResults.jsp?country_id=ALL&start_year=ANY&end_year=ANY&search_what=C&treaty_id=2 (retrieved: 29.1.2013)

World Trade Organization. (1994). *Agreement Establishing the World Trade Organization, Annex 1C Agreement On Trade-Related Aspects of Intellectual Property Rights.* http://www.wto.org/english/docs_e/legal_e/27-trips.pdf (retrieved: 12.1.2013)

World Trade Organizatio. (2013a). *TRIPS: What are intellectual property rights?.* http://www.wto.org/english/tratop_e/trips_e/intel1_e.htm (retrieved: 10.4.2013)

World Trade Organization. (2013b). Understanding the WTO: The Agreements. Intellectual property:protection and enforcement. http://www.wto.org/english/thewto_e/whatis_e/tif_e/agrm7_e.htm (retrieved 10.4.2013)