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"End Hunger: Including the Wisdom of Women, Traditional People, and Nature in Science" or "Critique of Science" ***Written by Jytte Nhanenge***

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Abstract:
This article argues that science is a knowledge system that dominates women, poor people, and nature. Since science is the foundation in development, also development activities tend to be dominant. Development is therefore not a solution to poverty in the South. Food production is used as an example. The first part of the article explains the methods scientific agriculture use in food production. Since the overall focus is on profit-making, scientific agriculture exploits nature, undermines the ecological knowledge of women and traditional people, and by that fails to end hunger in the South. The first part ends with presenting an ecological method of food production that can end hunger and sustain the environment. The second part of the article clarifies by theoretical discussions and historical facts that science is a reductionist and dualist knowledge system with patriarchal root values that subordinate the needs of women, traditional people, and nature. Applying it to development and expecting it to end hunger and poverty in the South is consequently a paradox. The second part ends with outlining some elements required to make a knowledge system holistic and diverse, including the wisdom and needs of women, traditional people, and nature. The article finally recommends that development studies and development organizations support indigenous knowledges and in that way assist people to end hunger and poverty.

Biographical Details:
Jytte Nhanenge is a Danish woman, who has been working with Third World development in Africa for many years. Being troubled about developmentôs inability to alleviate poverty, she decided to find out what is wrong with development. She then embarked on a lengthy study period at University of South Africa (UNISA.) Her search was for an ethics in development. Using inputs from many insightful authors, Jytte compiled the outcome of her search in a comprehensive dissertation titled, ñEcofeminism: Towards Integrating the Concerns of Women, Poor People, and Nature into Development.ò She rewrote the dissertation into book form, and in 2011 it was published by University Press of America. In this article, Jytte shares some of the insight she gained during her long search for limitations in development. Jytte lives in Chimoio, Mozambique.

End Hunger: Including the Wisdom of Women, Traditional People, and Nature in Science

"Power, in the last analysis, is not about weapons or money or brute strength or feminine wiles, but about having the right to make your definition of reality prevail over all others."
Dorothy Rowe (1994, 356).

Introduction

Our world is home to around 7 billion people; of these 1.02 billion go hungry. In essence, hunger is the most extreme form of poverty. It means that people are not able to grow food enough for their basic needs or they cannot afford to buy adequate food. As a result 947 million people in the South are malnourished. They consume less than the minimum amount of calories essential for a good health. This is almost a doubling compared to 1988 where 500 million people were registered as malnourished. The main sufferers from hunger and malnutrition are women and children. According to the World Health Organisation, poor nutrition causes nearly one in three people to die prematurely or have disabilities. Every day, almost 16,000 children die from hunger-related causes; it is one every five seconds. Most of these deaths are not due to outright starvation, but because diseases attack children whose bodies have been weakened by hunger. In spite of these gruesome data on hunger, average rates of food production are above population growth rate. Food supply increase has during the last 50 years kept ahead of population growth in every region of the world, except Africa. Thus, hunger is escalating, while food production is increasing. Studies indeed confirm that hunger rarely relates to a countryôs food production. Seventy-eight percent of all malnourished children under five years of age live in countries with food surpluses. In addition, many poor countries export more agricultural goods than they import. The causes of food scarcity relates to complex issues. Poverty, inequality, lack of access to food and land are important reasons for starvation. Yet, these are not the real causes of hunger. The root cause of food deprivation is scarcity of democracy. Consequently, hunger derives from political and economic domination. The victims are women, children, traditional people, and nature. (Amiiko 2011; Bread for the World 2009; Capra 2002, 164-65; Dankelman and Davidson 1988, 7-8, 12; EarthSky 2010; Food for the Poor 2011; Lappé and Collins 1986, 4; Shah 2009; UNICEF 2008.)

Part I: Scientific Agriculture's Domination of Women, Traditional People, and Nature in the South

Although women, due to patriarchal traditions, do not own land, they produce more than half of the worldôs food. In areas with food scarcity, they produce more. According to United Nationôs (UN) Food and Agriculture Organisation (FAO), sub-Sahara African women produced 80 percent of the continentôs food in 1985, a figure that was increasing. Thus, when we talk about an African farmer, we talk about a woman. In Asia women produce 50-60 percent of the food. Such data make women the center of food production. Being dependent on natural resources for food production, many women in the South have unique knowledge about their environments. It is an organic relationship aimed at sustainability for both. This knowledge is diverse depending on the context, and it has been transmitted from one generation to the next. With colonialism and development the ecological concept was undermined. Modern economic life broke the traditional relationship between women and nature. In its place governments introduced the Western scientific knowledge system that uses technologies and methods, which undermine women and exploit nature. From then on, the state perceived the work of women and nature as unproductive. Instead, man must produce commodities for profit, using womenôs work as free resources and natureôs wealth as free raw materials. By centraliz-

ing management of the environment, the governments institutionalized the system for the purpose of promoting economic growth. In this economic development model, natureôs wealth and womenôs work are invisible. Yet, when nature is exploited, it dies. When nature dies, women produce less food, and children go hungry. The negative outcomes are systemic, including environmental degradation, hunger, malnutrition, poverty, ill-health, and death. (Dankelman and Davidson 1988, 4, 9; Heyzer 1995, 3; Shiva 1989, xviii, 40-43; Warren 2000, 9.)

Scientific Agriculture: Its Methods and Purpose

Scientific agriculture, which some call the Green Revolution, provides commodities for the formal, private market with the purpose of maximizing individual economic profits. Since economists consider natural processes too slow for this purpose, the yields must be increased by scientific technological intervention. In order to make nature ñproductive,ò scientists have created a high yielding variety (HYV) of crops modified by hybridization 1) and later on also by genetic engineering biotechnology (GE) normally called genetically modified organisms or GMOs 2). The HYV is a dwarf-like plant with heavy grains. Since it uses all its energy to make grains, it is weak to pest, diseases, and drought. The crop therefore needs input of chemical fertilizer, insecticide, and irrigation, otherwise it will fail. Since these agricultural inputs are costly, farmers are forced into cash crop production. In addition, farmers must buy new seeds every season. The HYVôs high output lasts only one season, after which the production decreases. Thus, farmers can no longer select the best seeds from previous harvest for planting in the next season. Instead, they must buy new seeds every year, which means an end to a long tradition of developing new crops. This is devastating in the South, where 80 percent of crops are grown from saved seeds. In this way, agricultural science has displaced seed varieties that were adapted to the context. Thus, reliable, drought resistant, traditional food crops, which were superior in nutrition, are lost. Sri Lanka had 123 varieties of red rice, now only 4 remain. Furthermore, the HYVs are not fulfilling local needs. In Ghana women were reluctant to use the new hybrid maize seeds for various reasons: the crop was hard to prepare, it was less resistant to drought and insects, it required storage methods different from traditional ones, it could not be stored for a long time, and it depended on chemical fertilizers, which changed the taste. Yet, the development agency overlooked their rational objections. Moreover, experiments show that the HYV does not increase crop yields significantly; it may even lower the output. The HYV are vulnerable to severe weather conditions and due to the price of the necessary chemical inputs, farmers may not use enough, thus lowering the output. This is regretful since they need to raise the yields and their income continuously, due to the increasing costs involved in scientific agriculture. By introduction of GE biotechnology the agricultural corporations were also able to take ownership over seed regeneration through patent. This practice is legalized by the World Trade Organisation via its definition of ñintellectual property rights,ò which recognizes knowledge as patentable only if it is expressed in a Western scientific framework. This excludes all other kinds of knowledges. Thus, a few years of scientific research done by agricultural corporations, is considered more important than the contribution made by Third World farmers during ten thousand years in the areas of breeding, conservation, domestication, and development of plant genetic resources. This clearly shows that Western science is dominating traditional people and their knowledges. Hence, scientific agriculture has colonized the food; it has displaced traditional farmersô rights to their genetic resources, and by that sown the seed for famine. Concentrating ownership of food resources in a few hands, and basing food supply on a few crop varieties, is the classical preconditions for hunger. In spite of this, the states are persuading farmers to use the scientific method. They support it by government subsidies and donor aid. Use of the HYV seeds may also be attached to credit access and agricultural inputs. Conclusively, scientific agriculture is promoting economic profit-making while destroying ancient, sustainable, agricultural practices and knowledges. In the process it dominates women and traditional people. (Capra 2002, 164-165, 176; Dankelman and Davidson 1988, 11, 18; Shiva 1989, 96-98, 103, 121-124, 128-130, 155; Shiva 1994b, 132-137.)

Scientific farming considers mono cropping as being efficient although the method increases the cropôs vulnerability and reduces its yields. Since HYV has little straw and is not inter-cropped, it gives too little crop residue for humus to the soils. This reduces the soilôs fertility and hence the yield. To make up for lack of soil nutrition, the HYV needs nutrition intake by chemical fertilizers. Yet, artificial fertilizers cannot strike the nutrient balance in the soils. They either lack trace elements, which exhaust the soils, or deliver them in excess, which toxify the soils. Thus, chemical fertilizers cannot optimally support the crop. The HYV is also vulnerable to pests and requires use of insecticide. Insecticide is, however, a violent way to remove pests. The poison kills indiscriminately. Hence, it also kills the natural pest-predators, which will increase the amount of pests. Since pests mutate quickly, new forms of pests resistant to insecticide develop, which increase crop vulnerability. In this way, the poison creates ecological imbalances that function like drug-addiction. To keep a balance, more and stronger insecticide is needed. Besides, the imbalance caused by pesticide cannot be contained in one field; it destroys the ecology in the whole area. It causes new pest to develop, which also will wipe out traditional crops. Although the poison has been unsuccessful to eradicate pest, it is still sold worldwide. This kind of technology clearly link scientific technology to violence and killing for profit. (Shiva 1989, 114, 121-124, 142-146, 153-159, 164.)

With the introduction of genetically modified organisms (GMOs), the need for chemicals in agriculture has increased. Genetic modification has made the seed ecologically incomplete so that it cannot produce by itself alone. It needs help from specific fertilizer, pesticide, or herbicide. This increases the price, the sale, and the use of that specific chemical product. For example soy beans, engineered by the US agricultural corporation Monsanto, are modified to resist the companyôs herbicide. Thus, farmers can spray the fields with unlimited amounts of herbicides as a weeding exercise. The only plant that will survive is the soy. Yet, the activity creates resistance in plants, and ñsuper weedsò start to grow, forcing farmers to use even more and deadlier toxic chemicals. (Capra 2002, 163; OCA 2010; Shiva 1994b, 133.)

The indiscriminate use of toxic chemicals in nature motivated the American marine biologist Rachel Carson to write her influential book, ñSilent Springò from 1962. The need for toxic chemicals started with introduction of scientific agriculture. When scientists devoted immense land areas to a single crop in order to intensify agricultural output, the stage was set for an explosive increase of specific insect populations. In organic farming, mixed crops limited the habitat for particular insect populations. However, mono cropping means that one insect can build up its population to high levels. The idea to use chemicals against pests derived from the Second World War. When scientists tested chemicals for warfare, they found that some were lethal to insects. These chemicals differ from the simpler insecticides of pre-war days, which derived from naturally occurring minerals and plant products. The synthetic insecticides have immense power to poison plants, animals, and people. They enter the most vital processes of the body and change them in often deadly ways. When these chemicals are used in nature they pollute both soils and water. Chemicals persist for many years in the soil. Thus, ongoing application is merely adding to the quantity remaining from the previous one. In this way, even unsprayed crops may take enough insecticide from the soil to make them unfit for market. Moreover, adding chemicals to soils anywhere will enter our water supply and threaten its purity, everywhere. Nature does not operate in separate, close compartments; everything is connected. All the water on the Earthôs surface was at one time ground water. Thus, polluting water is the deadliest violence of scientific agriculture. Often chemicals may not be detected by routine tests, or they cannot be removed. Chemicals also develop. In the presence of air and sunlight, the water becomes a laboratory for production of new and more dangerous chemicals. In this way, water combines chemicals in ways, which no responsible chemist would think of in his own laboratory. (Carson 1995, 10, 16, 41-44, 58-59.)

Although some of the chemicals Carson wrote about were banned after her book was published, new chemicals are entering the market. According to UNôs Environment Program (UNEP), over the last half century industries have introduced 80,000 chemicals into the market. They believe that governments have not tested many of these for their full range of health and environmental effects, including their potential to disrupt hormonal systems in animals and people. A total of 10 million tons of toxic chemicals are released into our environment by industries each year. Of these, over 2 million tons are recognized carcinogens (causing cancer.) Many of these chemicals are used in scientific agricultural. Thus, paradoxically, the science that should improve our food production promotes dangerous chemicals that destroy our health and the quality of life for society and nature. (UNEP 2002; Worldometers 2009.)

Scientific agriculture also has a problem with the quantity in its production. In spite of all the efforts and promises to the opposite, GE crops do not produce higher yields. After 20 years of research and 13 years of commercialization, GE has failed to significantly increase crop yields in USA. This is the finding of a 2009 report, ñFailure to Yield: Evaluating the Performance of Genetically Engineered Crops,ò made by the Union of Concerned Scientists. Scientific agriculture does therefore not give food security. It provides less value to people and nature than traditional agricultural methods did. Nevertheless, the method has generated wealth to the agricultural corporations. (UCS 2009.)

Scientific agriculture can also lead to debt. Due to low yields, high prices on implements, dependency on corporations, and low crop prices in the global market, many small-scale farmers end up with huge debts. Thus, farmers may lose their land and face a life of destitute. Out of despair, the farmers drink the toxic chemicals. In 2011, the Center for Human Rights and Global Justice in USA compiled a report called ñEvery Thirty Minutes: Farmer Suicides, Human Rights, and the Agrarian Crisis in India.ò The report quotes statistics compiled by the Indian government stating that 241,679 farmers in India have committed suicide between 1995 and 2009. In 2009 alone, 17,638 farmers committed suicide; that is one every 30 minutes. Although it is the largest wave of recorded suicides in human history the estimates are still low. For example, women are often not included in farmer suicide statistics since most do not have land titles, which is a prerequisite for being recognized as a farmer in official statistics. The majority of those affected are cash crop farmers, specifically cotton growers who rely on GE seeds. The report connects the suicide crisis to a violation of the universal human rights to life, water, food, and adequate standard of living. (CHRGJ 2011; CNN 2010.)

In sum, development supports a shift from ecological productivity and renewability, to an artificial scientific process of non-renewable production. This has reduced biological diversity in agriculture and increased farmersô dependency on expensive patented products. It has subordinated indigenous agricultural knowledge and created non-sustainability in food production. Conclusively, scientific agriculture, or the Green Revolution, and its technologies cannot end hunger for women, children, and traditional people. It has conversely increased the calamities of starvation, malnutrition, ill-health, poverty, and death. (Shiva 1989, 1994b.)

Scientific Water Management

Scientific agriculture has a high demand for water, and the HYV has low water conservation. Thus, irrigation is required all through the year. In order to direct water to agricultural uses scientists propose construction of large water dams. However, this type of water management is highly doubtful for several reasons: due to its size, the construction of a water dam automatically disrupts large natural areas, destroying essential ecosystems like forests and fertile agricultural land. Removing vegetation will reduce both rainfall and food production. Building of dams is also displacing thousands of indigenous people, with deeply negative social consequences. In 1990, some 70 ongoing projects of

the World Bank were forcibly displacing 1.5 million people. In almost all the cases, the dispossessed will end up impoverished. Besides, in order to increase economic growth, dams normally redirect water away from the use of traditional farmers, towards the elitesô economic activities. This diminishes food security for subsistence farmers and increases hunger and poverty. And paradoxically, the damming in itself reduces the availability of water. Due to the interruption of the natural water flows and the inundation of virgin forests for catchments area, there will be less river water and less rains. Moreover, the dams will siltate. The water in the dam will be filled with mud and clay due to erosion from the degrading catchments areas. This will limit the damôs performance and life. Irrigation is also not an optimal way of supporting crop production. It introduces more water into the ecosystem than it can handle, which results in rise of water table and logging of water. Water logging reduces soil aeration and restricts root development, negatively affecting plant growth. Another problem is salinisation. Soils in arid areas contain unleashed salts. By irrigation, salt is brought to the surface, which poisons the soils resulting in crop failure. Water logging and salinisation have caused fertile areas to degrade, loosing land to grow food. Already in 1989, it was estimated that India had lost 7 million hectares crop land due to salinisation and 6 million hectares are waterlogged. India is the country in the world with most salinisation (1994-1996 figures.) In 1992, Ekins estimated that 24 percent of the worldôs irrigated land has been damaged by the build-up of salt. Moreover, scientific agriculture is over-using water. The Earth has a finite stock of water. There is the same amount of water on the planet now as there was in the age of the dinosaurs. However, population growth and modern standards of living has increased water demands. During the 20th century, the world population increased fourfold, while the amount of freshwater used increased nine times over. The high level of water use relates to scientific agriculture, which accounts for 2/3 of global water use due to its method of irrigation. Furthermore, only 20-30 percent of the water gets to its destination, thus the water waste is huge. Finally, irrigation has a low efficiency in increasing crop yields. (Dankelman and Davidson 1988, xii, 10-11, 14, 31-32; Ekins, Hillman, and Hutchison 1992, 17, 22-23; NationMaster.com 2011; Shiva 1989, xvi, 142-149, 183.)

Penalty from redirecting and overusing of water ï together with the systemic web-like effects from climate change, like higher temperatures, sea level rise, increased droughts and floods, deforestation, desertification ï means in sum that water is becoming scarce. In March 2009 two reports about the global water situation was published. The World Economic Forum issued one, while the other, called the World Water Development Report, was compiled by 24 UN agencies under the auspices of UNESCO, United Nations Educational, Scientific, and Cultural Organization. Both reports perceive the current water situation as being extremely serious. Already 2.8 billion people live in areas of high water stress. By 2030 this number will rise to 3.9 billion, more than half the expected world population. By that time, water scarcity could diminish world harvests by 30 percent, equivalent to all the grains grown in the USA and India. That happens in a world where the number of people and thus appetite is increasing. An added cause of water scarcity is pollution. The World Commission on Environment and Development found in 1987 that sewage, chemical, and industrial wastes have polluted 70 percent of all surface water in India. Conclusively, the domination of scientific agriculture is decreasing availability of food and water for women and poor people, and it is poisoning and drying up nature. (Lean 2009; Shandilya 2007.)

Elites' Farmland Grab

Apart from the environmental destruction scientific agriculture is causing directly, it also promotes environmental degradation indirectly. The technology involved in scientific agriculture demands high input of capital investments. Scientific agriculture therefore automatically involves large-scale, mechanized, high-technology, industrial farming. This has concentrated the best quality and the biggest quantity of farmland in the hands of the elites, leaving poor people with little and marginal lands. In order to survive, poor people must use their land to the fullest. This may be causing addi-

tional environmental destruction in the form of over-cultivation, over-grazing, and deforestation, that is turning millions of hectares of land into desert annually. When vegetation is removed, soils are exposed to solar radiation and rains, which contributes to desertification and erosion, resulting in less land for poor peopleøs food production. (Dankelman and Davidson 1988, 10-11, 31.)

Scientific agricultureøs focus on high capital investments also limits availability of land for poor people in another way. Farmland in the South is increasingly used for the growing of cash crops intended for export to the North. For example, the Netherlands uses a land area in the South that is 5 times the size of its own cultivated land. This land supplies fodder for the Dutch cattle and raw materials for Dutch food products. Japan is believed to hold three times the amount of its own farm-able land outside of its borders. Thus, people from the rich part of the world, are taking fertile land away from people and their food production in the poor part of the world. (Business Insider 2011; Dankelman and Davidson 1988, 10-11, 31.)

This phenomenon is expanding and has become known as ñfarmland grab.ò Investment into foreign farmland began with countries, which have food challenges, such as Saudi Arabia, United Arab Emirates, Abu Dhabi, Qatar, South Korea, and China. The latter is by far the largest investor, buying or leasing twice as much land as anyone else. The trend became pronounced after the 2008 increase in food and fuel prices. Thus, countries dependent on food imports want to secure their domestic food supply, raw commodities, and bio-fuels. In addition, speculation in land and commodity prices has become attractive. Western investors, including Wall Street banks, hedge funds, and pension funds are now viewing direct investments in land as being safe in an otherwise turbulent financial climate. Reuters estimates the value of global investment in agricultural lands to be between 15 and 20 billion USD. According to the World Bank, 463 projects covering 116 million acres, mostly in sub-Saharan Africa, were acquired during a period of only eight months in 2008. In 2009 alone nearly 148 million acres (60 million hectares) of land ï an area the size of France ï was purchased or leased. These land investments develop into mega-agricultural farms based on mechanized, scientific agriculture. Some farms are as big as Denmark. (BusinessInsider 2011; ColorLines 2011.)

Poor nations may perceive this land investment as an opportunity to benefit from connected infrastructure, like the necessary building of rails, roads, and ports. Moreover, many Southern governments want to earn income from selling or renting out their land in order to end dependency on development aid, under the headline ñtrade not aid.ò Yet, it is rare that grand scale investments benefit a country. There is also no guarantee that corporate farming will pay. Successful attempts to farm across borders have a poor history. Many large farming ventures attempted in the past have failed. Sometimes mistaken beliefs in economies of scale in agricultural production have created subsidy-dependent large farm sectors that provided few economic or social benefits. (BusinessInsider 2011; ColorLines 2011.)

There are conversely considerable social and environmental risks involved in large farmland investments: it displaces indigenous people, who are losing their customary land rights and their livelihoods, leading to food insecurity, hunger, and poverty. Moreover, farmland grab often involves corruption, which is increasing social inequality and political instability. Environmentally it may be a disaster. Governments in the South often do not have adequate capacity to control pollution of the air, soils, and waters done by the toxic chemicals from increased agricultural activities. Hence, applying aggressive industrial farming methods, overusing of water, and planting of GE crops will undermine rural communities further, adding more to the heavy burdens already carried by women, poor people, and nature. Farmland grab is also a ticking bomb. Many conflicts have their roots in land issues, especially where division of land is unequal. In Africa, ownership of land is complex, with historical, political, emotional, and survival elements. It is therefore highly sensitive. Thus,

large land investments could very well destabilize Southern nations. Large-scale agricultural ventures will also destroy sustainable small-scale food production, thus foreign financial groups will end up controlling the food chain and the food market. This will lead to high food prices, perhaps causing food riots similar to those that preceded the Tunisian and Egyptian revolutions. In many ways, the situation parallels colonialism, it is only more complex, involving social, environmental, political, and economic issues. (BusinessInsider 2011; ColorLines 2011; Oakland Institute 2011.)

As a result of its magnitude, the Oakland Institute began a research into transnational land grabs in Africa. The Institute released a series of investigative reports in June 2011. The reports, ñUnderstanding Land Investment Deals in Africaò examine the consequences from farmland grabbing in Ethiopia, Mali, Sierra Leone, Mozambique, Tanzania, and South Sudan. The reports reveal that these largely unregulated land purchases or leases are resulting in virtually none of the promised benefits for the local populations. They are instead forcing millions of small farmers off their ancestral lands in order to make room for large-scale production of export crops. The reports also reveal that investors include not only speculators, but also universities like Harvard, Spellman, and Vanderbilt. (Oakland Institute 2011.)

The issue of farmland grabbing gained importance in UN after the South Korean corporation Daewoo Logistics attempted to secure a huge trunk of farmland in Madagascar, contributing to the collapse of Madagascarôs government. Due to the risks involved the World Bank, FAO, the International Fund for Agricultural Development (IFAD), and the UN Conference on Trade and Development (UNCTAD) presented in 2009 seven principles for ñResponsible Agricultural Investment.ò The principles are meant to ensure that large-scale land investments are positively benefiting both the investors and the affected communities. The principles include the following recommendations: agreements must guarantee that existing rights to land and natural resources are recognized and respected; that investments will strengthen local food security; that agreements are transparent, making all stakeholders accountable; that all affected are consulted in the process; that contracts are recorded and enforced; that the rule of law is respected; that investments generate positive and desirable social impacts locally; that local environmental impacts are quantified and sustainable resource use is encouraged. (DEVEX November 2009; RAI 2011.)

These principles are well-intended but inadequate, according to UN Special Rapporteur on The Right to Food, Professor Olivier De Schutter. First, they are voluntary. It is therefore not required that governments comply with their human rights obligations, including the right to food and the right not to be deprived of means of subsistence. Ignoring human rights means that the principles lack accountability. Secondly, experience shows that large-scale land investment does not end hunger and poverty, it increases inequality. It is small-scale farmers who feed local, rural communities, where 75 percent of the worldôs poor reside. Smallholders are often very productive by hectare, since they maximize the use of soil and achieve the best combined utility of plants and animals. The form of agriculture smallholders practice relies less on chemical inputs and mechanization, while it is highly labor-intensive. Small-scale farmers also give invaluable services to society and nature by preserving biodiversity, conserving the environment, and increasing local communitiesô resilience to shocks in food prices or weather-related events. Yet, if smallholders must compete in the same markets as the large farms, they will lose. Thus, the focus on large-scale agriculture will exacerbate a highly unequal competition. It is therefore not the solution to food insecurity, it will only intensify it. When we support the economic elitesô large-scale scientific agriculture ï which currently also is responsible for one-third of man-made greenhouse-gas emissions ï then we will increase not only climate change and natural degradation, but also social inequality, hunger, and poverty. Consequently, Professor De Schutter sees no ñresponsibleò way to support large-scale scientific agriculture. It can only destroy

the global peasantry. Instead we must develop agriculture in a way that is socially and naturally sustainable. (Project Syndicate 2010.)

In June 2011, hundreds of civil society groups and movements called on G20 governments to halt all farmland grabbing and return lands to communities with immediate effect. They demand a central role for the UN Committee on World Food Security (CFS) to ñdevelop effective mandatory guidelines for land tenure that respect and protect peoplesô rights especially the right to food.ò They have requested the CFS to reject the ñResponsible Agricultural Investmentò guidelines developed by the World Bank, which they perceive as being both illegitimate and inadequate to address the phenomenon of land grabbing. The civil society groups also demand an inclusive process launched by CFS about what kinds of investments are needed to support small-scale food producers. (Friends of the Earth International 2011.)

Domination of Women

The trend in development towards scientific agriculture, cash crops, and capitalist economies has given Southern women more work and a lower social status. Commercialization of agriculture means constraints on land. Due to patriarchal perceptions cash crop is mainly under male control, while food production is a female responsibility, thus the best family land is used for cash crops, resulting in less food for the household. The profit from cash crops belongs to the husband, who rarely spends it on buying food for the family. Scientific agriculture has consequently pushed womenôs food production on to marginal lands. Moreover, men expect women to carry out their traditional tasks of weeding and crop maintenance also in menôs cash-crop fields, while at the same time cultivating their own food crops. This work is normally extensive, since men have expanded the cash crop area by use of machinery. Research shows that introduction of modern tractor and ploughs in Sierra Leone resulted in decrease of menôs working day in the fields, while womenôs manual tasks increased. Another burden to women is the increase of female headed households. Capitalism and industrialization has drawn men away from rural areas removing their labor from farming, leaving the responsibility for the entire family with women. With the focus on profit, society increasingly considers womenôs subsistence economy inferior. Thus, as scientific agriculture penetrates the rural areas, the status and power of women is downgraded. Men increasingly see women as being available for domination. In India it has caused domestic violence and ñfemicide.ò Women can be dispensed with, and it is done in various ways from dowry death to abortion of female fetuses. (Dankelman and Davidson 1988, 13, 16; Shiva 1989, 113-120.)

Women in subsistence agriculture are also undermined by development experts. In spite of their amazing achievement in food production women do not have access to agricultural credit, training, extension, and other productive resources. Hence, the main food producers in Africa receive less than 10 percent of the credit to small farmers, and only 1 percent of the credit to agriculture in general. Access to credit is limited, since women do not own land or other assets. Without assets, they cannot become members of farmersô unions or cooperatives through which credit is available. Similarly, extension services are often only available for members of farmersô clubs. Besides, only a small percentage of the extension workers in Africa are women. Since religion and culture often hinder a close man-women relationship in learning, female farmers get little assistance. Scientific technologies from Northern countries only exacerbate the problem of resource shortage for women. In spite of womenôs huge contribution to food security, men are the main recipients of agricultural machinery and irrigation systems. Thus, development technology excludes women. According to Western patriarchal values a peasant farmer is considered to be male who grows cash crops. Thus, scientifically educated development experts undermine traditional, ecologically sound agricultural knowledge. Womenôs food production depends on a healthy environment. Due to this, rural women have important knowledge about nature. Womenôs methods are old and adapted to their environ-

ment; they are sustainable and make no long-term damage to the land. This knowledge gives women food security. However, scientific experts consider it non-scientific and therefore irrational. There is also an economic pressure against traditional knowledge. Indigenous methods do not need financial investment and scientific innovation; they therefore do not profit agribusinesses. Since it is not recognized, womenôs environmental knowledge disappears. This has negative consequences for womenôs food production, and it is causing hunger and malnutrition for women and children and degradation of nature. (Dankelman and Davidson 1988, 17-19; Heyzer 1995, 3; Tadria 1997, 171-72; Warren 1997, 9; Warren 2000, 8-10.)

The Cash Crop Paradox

Finally, in spite of promises to the opposite, scientific agriculture and its cash crops produce less cash over time. Increased output of cash crops will cause world prices on unprocessed products to fall, resulting in declining returns. The price for imported agricultural technology and chemicals conversely increases. This gives a deficit, meaning that more cash crops must be produced to create a balance. Thus, the South must use more land for cash crops, causing even less production of food for local people. This could lead to food scarcity and the need for food import. Governments must then obtain high-interest World Bank loans to get foreign exchange for payment of imported food. Since food is bought from the commodity market, it has now become expensive. Hence, poor people cannot afford it and must therefore decrease their nutrition intake. Consequently, scientific agriculture has increased dependency upon a global economic order that excludes poor and hungry people. In sum, scientific agriculture and its focus on cash crop degrades the environment; it exploits natural resources; it increases food scarcity; it lowers rural diet leading to poor nutrition and decreased health; it escalates debt, inflation, and prices; it promotes financial and economic colonization, and it intensifies the domination of women and poor people. Consequently, cash crops magnify poverty of women, traditional people, and nature. Africaôs economies have since the 1960s been depending on export-oriented cash crops. That is largely the reason for Africaôs ecological, economic, and human crisis. (Dankelman and Davidson 1988, 11, 14; Shiva 1989, 137-138.)

Conclusion on Scientific Agriculture

Conclusively, scientific agriculture is unsustainable. It involves violent and life-threatening methods. It has shifted control of food production from local people to international agricultural corporations. It has violated natureôs balance, womenôs productivity, societyôs food security, peopleôs right to food, and created hunger and poverty. Hence, scientific food production was not meant to feed people; it is a tool to produce profit to the elites. In order for food production to become sustainable, scientific agriculture must retreat and give room for re-integration of traditional farming. (Shiva 1989, 96-98, 105, 111; Shiva 1994b, 131-132.)

An Alternative: Agroecology

In December 2010, the UN Special Rapporteur on the Right to Food, Professor Olivier De Schutter submitted his annual report to the UN Human Rights Council. The report is based on extensive inputs from global experts. Before submission, it was also discussed by specialists in an international two-day seminar. The report advises that governments change their agricultural systems towards modes of production that can satisfy the following three objectives: it must *ensure that food is available for everyone*; it must *be productive and increase the incomes of small-scale farmers*; it must *be sustainable, and not compromise nature's ability to satisfy future needs*. ñAgroecologyò can satisfy these aims and it is therefore recommended. (SRFood 2010.)

Agroecology is both a science and a set of practices. It was created by combining two scientific disciplines: agronomy and ecology. As a science, agroecology applies ecology to the study of ecological

sustainable agricultural systems. As a practice, agroecology aims to enhance agricultural systems by imitating natural processes. The goal is to provide the most favorable soil conditions for plant growth by managing organic matter and increasing soil biotic activity. It includes: recycling of available nutrients and energy, rather than using external inputs; integration of crops, trees, and livestock; diversifying species and genetic resources; and prioritizing overall farm productivity rather than focusing on maximizing individual species. Agroecology is knowledge-intensive, based on techniques that are developed on the basis of farmersô knowledge, experience, and experimentation. (SRFood 2010.)

To *increase productivity and sustainability*, agroecology embraces biodiversity by combining different crops, agro-forestry, livestock, fish, pollinators, insects, soil biota, water harvesting, and other components. The system has been developed and tested in various regions with success. The most systematic research done on agroecology compared the impacts of 286 projects, in 57 poor countries, covering 37 million hectares of land, on 12.6 million farms. The outcome showed that agroecology interventions resulted in an average crop increase of 79 percent. In Africa the average crop yield increase was 116 percent, thus higher than the global average. By use of *agro-forestry* 350,000 hectares of land was rehabilitated in Tanzania. Similar large scale projects are being developed in Malawi, Mozambique, and Zambia. *Water harvesting* in drylands allows cultivation of once degraded lands. In West Africa, farmers built stone barriers alongside their fields, slowing water runoff during the rainy season. This improved soil moisture, replenished water tables, and reduced soil erosion. It resulted in 5-10 folds increase in water retention, while biomass production multiplied 10-15 times. Besides, livestock could feed on the grass that grows along the stone barriers after the rains. Integrating *livestock*, such as dairy cattle, pigs, and poultry, into farming systems provides protein to the family and fertilizer for soils; so does incorporation of fish, shrimps, and other aquatic resources. Agroecology also offers a variety of techniques to control *parasitic weeds and insects* that damage crops. In Kenya, researchers and farmers developed the ñpush-pullò strategy. They ñpushò away pests from corn by inter-planting them with insect-repellent crops like Desmodium. They ñpullò them towards small plots of Napier grass, a plant that excretes a sticky gum, which attracts and traps pests. Apart from controlling pests, Desmodium can be used as fodder for livestock. The push-pull strategy doubled maize yields and milk production, while improving the soil. (SRFood 2010.)

Agroecology *reduces rural poverty and increases incomes* by enhancing agricultural production and diminishing farmersô reliance on expensive external inputs. This makes vulnerable smallholders less dependent on local retailers and moneylenders. Moreover, agroecological approaches are labor-intensive, especially during their launching period, creating employment in rural areas, where underemployment is massive and population growth remains high. (SRFood 2010.)

With its diversity, agroecology contributes to *improved nutrition*. Scientific agriculture focuses primarily on boosting cereal crops. Yet, rice, wheat, and maize are sources of carbohydrates; they contain few other nutrients essential for adequate diets. The shift from traditional diversified cropping systems to cereal-based monoculture has contributed to malnutrition in the South. Since human beings have over 80,000 plant species available for their use, nutritionists insist on the need for more diverse agro-ecosystems in order to ensure a varied nutrient output from the farming systems. (SRFood 2010.)

Agroecology improves environmental resilience to *climate change*. Climate change means more extreme weather-related events. Using agroecological techniques can notably soften the possible negative impacts. Following Hurricane Mitch in 1998, a study on 180 smallholder communities in Nicaragua showed that plots cropped with simple agroecological methods had higher field moisture, less soil erosion, and lower economic losses than plots on conventional farms. Climate change may also lead to more frequent and severe droughts and floods. Agroecological modes of farming are better

equipped to support such shocks. An agro-forestry program in Malawi protected farmers from crop failure after droughts due to its improved soil filtration. Experiments from Ethiopia, India, and the Netherlands demonstrated that soils on organic farms improved drought resistance in crops. Moreover, agroecologyôs diversity of species and mixture of crops can diminish risks from new pests, weeds, and diseases, which will come along with a warmer weather. In Chinaôs Yunnan Province, after disease-susceptible rice varieties were planted in mixtures with resistant varieties, yields improved by 89 percent and rice blast disease was 94 percent less severe than when the varieties were grown in mono culture. Crop breeding is vital in agroecology. It can provide varieties with shorter growing cycles and improve drought or pest resistance in crops. However, agroecology is holistic, aiming to build drought resistant agricultural systems, not only individual drought resistant plants. Agroecology will also lessen climate change: by delinking food production from fossil energy, it reduces emission of carbon dioxide and other greenhouse gases. In addition, when soil is cultivated organically, its carbon content increases and it contributes to reducing global warming. American physicist Amory Lovins estimates that increasing the carbon content of the worldôs depleted soils at plausible rates would absorb about as much carbon as all human activity emits. (Capra 2002, 166-167; SRFood 2010.)

Farmersô participation in and sharing of knowledge is vital for the success of best agroecological practices. Agroecology was developed by grassroots organizations and NGOs, and it has spread via farmer field schools and farmersô movements. Agroecology is empowering farmers because the system improves yields, increases incomes, and gives people control over their livelihoods and futures. Governments can build on these efforts by initiating agrarian reform towards agroecology and establishing supportive extension services. This will enable rapid horizontal dissemination of best agroecological practices, with farmers in the center as active participants. When we disseminate knowledge horizontally it transforms the nature of knowledge itself. From being handed down as a single, universal truth from above, it becomes the assorted, context-related products of a diverse network. The intention is to encourage farmers to develop innovative solutions by working with specialists towards a ñco-construction of knowledgeò that will benefit them. This co-construction of knowledge is the key for reaching the goal of the right to food for all: it makes small-scale farmers experts with knowledge complementary to formal expertise; it ensures that policies are responsive to the needs of vulnerable groups; it empowers poor farmers due to their participation in knowledge creation and policy making; and it is a vital step towards poverty alleviation. Food insecure groups must participate in all policies that affect them; including policy design, assessment of results, and decision on research priorities. Improving the situation of a billion food-insecure people cannot be done without them. (SRFood 2010.)

Schemes must ensure that women are empowered to participate equally to men in the co-construction of agroecological knowledge. Women are the poorest of the poor, the hungriest of the hungry, and the main producers of food. They are faced with the biggest social, economic, and political obstacles due to patriarchal domination. Women have limited access to land, capital, and decision making, while they must carry the heaviest work load in productive and reproductive duties. Since women encounter most difficulties in accessing external agricultural support they can benefit the most from agroecology. However, successful involvement requires affirmative action, directed specifically towards women. (SRFood 2010.)

In order to end hunger and poverty we must combine the best of what scientists can offer and the valuable experience of smallholder farmers and develop participatory modes of learning. Thus, research and extension services as well as ministries, educational, and financial institutions should change into learning organizations. Farmersô networks have collected valuable experience on agroecological practices. These movements are functioning as learning organizations; they must now be

officially sustained. Agroecology is supported by an increasingly wide range of experts within the scientific community and by international agencies such as FAO, UNEP, and Biodiversity International. It is also gaining ground in countries as diverse as the United States, Brazil, Germany, and France. Conclusively, agroecology is a holistic approach to food production, which can include the wisdom of women, poor people, and nature. (SRFood 2010.)

Having such negative effects on society and nature and with alternatives available, one may wonder why governments are promoting scientific agriculture. To understand this, it is necessary to examine the underlying values in science. Part II is meant to do that:

Part II: Science's Inherent Domination of Women, Traditional People, and Nature

The Dualised Values in Science

Modern science is described as a universal and objective knowledge system. It is believed to pursuit truth, valuable for all. Hence, it has displaced all other knowledge systems. However, feminist scholars have studied various scientific disciplines and found that what is assumed to be humanly inclusive theories, methodologies, concepts, and truths is less than that. Rather, the products bear the mark of the creators, who are colored by gender, class, race, and culture. Thus, one can best describe creation of scientific knowledge as a social activity embedded in a specific culture and worldview founded on a historical ideology. From this, it follows that the modern Western culture favors knowledge that does not reflect the world as it is. Instead, scientific facts come from a collection of human perceptions, values, and actions ï a paradigm ï from which they cannot be separated. According to feminists, this paradigm is based on white, male, hegemonic thinking. Therefore, science is not universal or objective. It is a subjective tool used to dominate all that is not white, Western, and masculine. (Braidotti et al 1994, 30; Capra 1997, 11; Harding 1986, 10, 15-16; Shiva 1989, 15.)

Science is determined by political, economic, and social issues according to a patriarchal regime that is dualized, hierarchical, and dominant. Dualism has sharply divided reality into two different categories. It separates male from female, culture from nature, mind from body, reason from emotion, quantity from quality, and the public from the private. This order of reality has also been valued hierarchical. The first mentioned are masculine and considered the best or the right ones. Thus, male is placed above female, mind above body, culture above nature, reason above emotion, etc. In this way, male, mind, culture, and reason exercise hierarchical control and domination over female, body, nature, and emotion. Hence, the Western experience of reality and its resulting knowledge system, is framed in relations of dualism, hierarchy, domination, and control; all being masculine-feminine oppositions. These bias principles are deeply inscribed in the modern pattern of thinking and knowing, but they are argued to be neutral and true. (Braidotti et al 1994, 30-31; Keller 1985, 7.)

The dualized worldview defines women as part of the private realm, which is synonymous with nature, emotion, cooperation, and caring for others. Men are conversely defined as the user of reason and therefore fit for civic life. Hence, patriarchal ideology relates womenôs social situation to the domestic sphere, while men are placed in the public sphere. Since science belongs to the public sphere and the realm of reason, knowledge generation is automatically a masculine activity. Women are therefore considered unfit for use of reasons and excluded from science. In fact, all feminine issues, including emotion, cooperation, quality, and nature, are regarded as subordinate and disqualified in science. Thus, by the use of dualism, patriarchy has marginalized all it perceives as different from the masculine archetype. Science therefore relates to rationality, competition, quantity, and culture, virtues that relate to the Western, white, middle-class male. What does not belong to this group

relates to the ñotherò, the non-scientists. These others include women, foreign cultures, lower classes, people of color, and nature. (Braidotti et al 1994, 30-31; Des Jardins 2001, 255; Keller 1985, 8.)

Inspired by Capra 1982, Loy 1987, Palmer 1997, Plumwood 1993, Veith 2002, and Wilhelm and Wilhelm 1995 some of the dualist pairs are lined up below. The first mentioned relates to the masculine realm and is therefore the superior self, while the second mentioned is the inferior other, the feminine:

Masculine-feminine; male-female; Ups-Downs; reason-emotion; culture-nature; human-nature; public-private; production-reproduction; subject-object; self-other; individual-social; mind-body; domination-subordination; universal-particular; rationality-intuition; mental-manual; quantity-quality; theory-practice; universal-particular; strength-weakness; white-black; master-slave; civilized-primitive; colonizer-colonized; modern-traditional; North-South; competition-cooperation; aggressive-responsive; active-passive; creative-receptive; parts-whole; analytic-synthetic; linear-cyclical; reductionist-holist; exploitation-conservation; self-assertive-integrative; mechanistic-ecological; hard-soft; large-small; day-night; summer-winter; fire-water; growth-decay; life-death; form-matter/energy.

Since the dualized pairs form a network, it is difficult to escape from a dualized relationship. If one avoids being defined as *the other* in one incident, one may be trapped inside such a definition in another. Thus, domination is interwoven to the extent that most people are at times oppressors and at other times oppressed. This complexity makes it difficult to call the dominator for a man. It is therefore more correct to use the concept master or Ups for the superior group and slave or Downs for the inferior one. Besides, the Downs can come to belong to the Ups. The condition is that they take on the characteristics of the Ups. Thus, to be masculine one must exclude emotions and other qualitative issues including cooperation, care, and ethics, and become a competitive individual, focusing on maximizing quantities, willing to use aggression in order to dominate others and exploit nature. (Plumwood 1993, 10, 42.)

Consequently, knowledge is made by men. Scientific theory is written from the point of view and the sociopolitical experience of white, West-European, middle-class men. They have universalized a worldview that is masculine. Hence, in masculine science the first mentioned category of the dualized pairs is permitted to dominate the second mentioned, which is excluded from science: the feminine. This masculine supremacy over the feminine has through history been internalized as part of a normal order of things. Conclusively, science is founded on masculine domination over all that is feminine. This masculine domination has been normalized to the extent that nobody questions it. (Braidotti et al 1994, 34-35.)

The Scientific Revolution

In order to understand the inherent, masculine domination in science, a brief summary of modern scienceôs history is presented below. It is based on the works of Capra 1982, 1989, 1997, 2002; Honderich 1995; Keller 1985; Merchant 1980; Plumwood 1993; Shiva 1989.

The present worldview and its value system, which is the foundation of the Western modern culture, were formulated in the 16th and 17th century, when it replaced an organic worldview. Modern science started in the time of the Polish astronomer **Nicolaus Copernicus** (1473-1543.) He deposed of Ptolemyôs *geocentric view*, which found that the Earth was the center of the Universe. This view had been an accepted dogma for more than a thousand years. Copernicus replaced it with a *heliocentric view*. This view finds that the Earth conversely circles around the sun together with many other planets. It was difficult for scientists to accept the new heliocentric view at first, but finally the Italian

Galileo Galilei (1564-1642) managed to discredit the old cosmology, establishing the Copernican hypothesis as a valid scientific theory. In his further work Galileo combined scientific experimentation with mathematical language to describe nature. However, he had a methodological problem. Since, only phenomena like shape, number, and movement can be quantified, Galileo decided that only these should be included in science. Other properties should be disqualified. Hence, excluded from science were color, sight, sound, taste, touch, and smell. Along with them has since gone aesthetic, ethics, value, quality, feeling, motive, intention, need, consciousness, belief, soul, and spirit. As a result, human experience and quality of life are excluded from scientific discourse, which from then on became obsessed with rational measurement and quantification.

Francis Bacon (1561-1626) is considered the father of modern science. He was a lawyer, politician, and philosopher at the Courts of Elizabeth Tudor and her successor James Stuart in England. He also originated modern research by formulating the inductive 3) theory in scientific experimentation. Baconôs aim was a patriarchal science that promoted control over and manipulation of nature by technology for economic profit. His philosophy included a patriarchal structure of family and state. Thus, privileged and productive knowledge was masculine. Baconôs vision of science was also aggressive. Science should lead to the sovereignty, domination, and mastery of man over nature. It is a science where knowledge and power meet in one. Bacon called one of his works, ñMasculine Birth of Time.ò It saw science as a power, a force, virile enough to penetrate and subdue nature. His root image was to *enslave nature*. This provided an image that still pervades science. Baconôs highest vision was domination. His ideal was to create, ña blessed race of Heroes and Supermenò to dominate both women and nature. With the social transformation that already had changed women into reproductive resources, Bacon reduced women further into a resource for manôs economic production. Thus, gender ideology was important in the social, political, and intellectual origins of modern science. Baconôs program ultimately benefited the middle-class male entrepreneur, while his science was less favorable towards women, the lower orders of society, and nature.

Bacon was a misogynist, he hated women. Thus, he perceived reality in a dualist form where mind and matter, man and nature, man and woman were separate and the first mentioned superior. In adapting scientific knowledge and methods to manôs power over nature, Bacon used the female image to describe nature. He saw nature as women, being tortured through mechanical inventions. This image paralleled the witch trials and the torture used, of which Bacon was well aware as a lawyer. He commonly formulated the testing of hypothesis in sexual metaphors that sanctioned rape. Baconôs way of formulation meant that nature should be seen as a degraded female, available for exploitation. Thus, the interrogation of witches was for Bacon a symbol for interrogation of nature. The courtroom became the scientific laboratory where inquisition and torture took place through mechanical devices. Baconôs aim was to force the secrets out of nature and use it for economic advance. By this method, Bacon believed man could recover power over nature that was lost when Eva and Adam were expelled from paradise. In his opinion, it was female inquisitiveness, which caused manôs fall from God-given domination. Interrogation of the witches and nature could be used to regain it.

Already early on it was decided that witchcraft comes from lust, in which women are insatiable. Women consort the devil with their lust. In the 17th century, the witch mania reached its high, as did the fear of female sexuality. Social disintegration was linked to female sexuality. Women were seen as an error of nature and all women were potentially witches. Thus, by power and domination Baconôs masculine science provided an antidote to the threats men felt about women and sexuality. In the ideological system that emerged, science was a purely male and chaste venture, seeking domination over the female nature. It promised to defeat nature and the uncontrolled female. By the 16th century, women were totally excluded from the practice of medicine and healing, and natureôs regenerative capacities were reduced to a passive and fragmented matter to be manipulated. Thus sexual

politics helped to structure the empirical method that was to produce a new form of knowledge and a new ideology of objectivity seemingly devoid of cultural and political assumptions.

The emerging market economy had already at Baconôs time widened the gap between upper and lower social classes. Bacon clearly identified with the interests of capitalists, merchants, mine owners, farmers, and the state. His idea was to concentrate ever more wealth in the hands of the rich through exploitation of nature for the sake of progress. Hence, in Baconôs scientific scheme of progress the public good excluded the good of the peasant, the cottager, and the worker. Scientific progress was therefore from the beginning associated with the rise of technology and a capitalist economy. In Baconôs ideal society there was no political process. Politics was replaced by scientific administration. Decisions were made by the scientists for the good of the whole. Their judgment was to be trusted implicitly, for they alone possessed the secrets of nature. Hence, scientists were the ultimate authority. They decided which secrets to be revealed and which not. Baconôs utopia became reality after his death in 1660 with the establishment of the Royal Society. Henry Oldenburg, Secretary of the Royal Society, announced that the intention of the society was *"to raise a Masculine Philosophy... whereby the Mind of Man may be ennobled with the knowledge of Solid Truths."* Oldenburg also warned against the power of affection in understanding, *"The women in us still prosecute a deceit, like that begun in the Garden."* Thus, he finds that truth has no chance when affections reign and the female rules.

Baconôs program included manipulation of environments and organic life including creation of artificial species of plants and animals. Experimentation on animals and creation of new species was ultimately done for the benefit of man. Technology was used to force nature into new forms. In this way, reproduction was controlled for the sake of production and profit. Baconôs ideal was an entirely artificial environment created by and for man. He paid little attention to the whole ecosystem of which human beings are only a part. Thus, Bacon made a clear connection between scientific mechanics, commercial interests of the elites, and domination of nature. However, to fulfill his ideal Bacon had to remove any ethical limitations against manipulation of nature. The philosophy of Descartes helped him to do just that.

René Descartes (1596-1650) decided that knowledge with certainty can be reached by mathematical thinking and the hypothetical deductive method 4). It is analytic thinking. It breaks up complex problems into pieces and arranges them in a logical order. In this way, the properties of the parts help to understand the behavior of the whole. It is called *reductionism*. It has been a useful method in development of science and technology, but it contributed to a fragmented way of thinking. It gives the false belief that we can understand complex phenomena by reducing them to their constituent parts. This is, however, impossible since the method excludes qualities. Descartes also changed the idea of rationality. He saw mind and thought as superior. The mind relates to consciousness only. Hence, the rational way nature works was excluded. Since animals lack the ability to think, they became body without mind. From then on, rationality related to human minds only. Thus, rationality was used to have power over dualized qualitative issues including nature and women. Descartes consequently divided mind and body, humans and nature. Body and nature are the dualized others. The thinking self has a mind and it is masculine. The body is feminine and associated with oppressed groups like slaves, traditional people, women, animals, and all others who labor with their bodies. This resulted in the theory known as *Cartesian dualism*. It taught people to see themselves as being minds inside bodies and to value rationality and thinking higher than emotions and the physical. In this way, academics became superior to workers. Bodies were merely mechanical things comparable to the works of a clock. Accordingly, Descartesô model presented a dead world. It was a perfect machine, governed by exact mathematical laws over which man can have control. This mechanical framework of

nature became the dominant paradigm of science. It provided the sanction for scientific exploitation of nature.

Isaac Newton (1642-1727) developed a complete mathematical formulation of the mechanistic view of nature. This was the grand synthesis of the works of Copernicus, Galileo, Bacon, and Descartes, which completed the Scientific Revolution. Newton formulated the general universal laws that were governing all objects in the solar system. They confirmed that the universe was a huge mechanical system, operating according to exact mathematical laws. Newton combined Baconôs empirical inductive method with Descartesô rational deductive method and developed the methodology upon which natural science has been based ever since. Newton only had one problem: he could not explain life itself. Nevertheless, in spite of such a minor discrepancy scientists saw mechanism as a successful tool to make order and gain power over the universe. Order came from the idea that change was subject to mathematical laws and therefore predictable. Power was achieved through experiment, technology, and manipulation. It became known as the ñAge of Enlightenment.ò It took hold with the rise of capitalism, which needed to turn nature into resources with no moral or social constraint.

Since then, mechanical science has been invalidated by the quantum and the relativity theory, together with the Santiago theory of cognition. These perspectives show that all biological and social phenomena must be seen as systemic frameworks. Life has three interconnected perspectives: *form*, *matter*, and *process*. Only *matter* is quantifiable, the others are non-material qualities. If meaning is added, one can extend the framework to the social domain. Thus, understanding of social phenomena integrates *form*, *matter*, *process*, and *meaning*. Three of these perspectives are non-quantifiable. Apart from the fact that the four cannot be separated, excluding qualitative elements would give a false picture of social reality. Hence, qualitative and all other feminine elements cannot be excluded in science. We must therefore reject reductionist science. Nevertheless, the mechanical worldview is still the philosophical ideology of modern culture. It supports exploitation of natural resources and excludes quality of life in the name of economic profit-making. It dominates all dualized others and sees reductionism as the only valid scientific method. This view has transformed complex pluralistic traditions of knowledge into one monolith, gender-based, class-based thought, which modern patriarchy has forced all classes, genders, and cultures to adopt. (Capra 2002, 61-64, 70.)

Masculine Science

In spite of its domineering origin, one may still argue that science is a true description of reality and therefore the best possible knowledge system. As evidence, one may point to the many improvements science has generated in medicine, transport, and information systems from which, at least the elites have benefited. However, such an argument is not valid. In his book, ñThe Structure of Scientific Revolutionò from 1962, Thomas Kuhn argues that there are no simple criteria to demonstrate the superiority of one scientific paradigm over another. Two rival knowledge systems are ñincommensurableò and cannot be compared. In reality scientists choose a knowledge system because it fulfills pressing social needs and solves specific problems. Only much later, after they have developed the paradigm, are they decisively arguing for their choice. Consequently, no means can show that any one knowledge system is the best available. There is also no procedure for arriving at an adequate knowledge system. Thus, worldviews are not determined by internal logic, other factors enter into the choice of a ñbest theory.ò This implies that different perceptions of the world are both possible and consistent with what we call science. Kuhnôs work consequently provides a welcome alternative to the view that science is universal, autonomous, and an accurate description of reality. (Braidotti et al 1994, 31-32; Chalmers 1982, 89, 95-97, 99; Keller 1985, 4-6.)

Researchers have since examined, which factors affect the choice of the scientific paradigm and the growth of knowledge. They found that science relates to ideology rather than truth. The concept ide-

ology means here to be lying on behalf of an idea or an interest. Michel Foucault pointed out that science was not used to explain reality, but to produce, control, and normalize it. This connects power to knowledge and truth. Thus, science is not a search for truth. It is rather the outcome of power relations and structures that determine what can be called a scientific truth and what not. Therefore, politics legitimize what is permitted to be called scientifically valid and true. Hence, political and economic pressure not only directs scientific research, it also controls the outcome. Foucault conclusively found that science is influenced by special interests. According to Sandra Harding, those special interests are androcentric (male-centered.) However, to call scientific rationality for androcentric is perceived as blasphemy rather than social criticism, because science has become more holy than religion. Nevertheless, she finds it necessary to critique science. By that, she does not suggest us to throw out the baby with the bath water. We should not abandon to describe, explain, and understand regularities, causal tendencies, and meanings of our world, just because science is androcentric. Harding wants an end to androcentrism, not to systematic inquiry. Nevertheless, ending androcentrism will include far reaching changes in meanings and practices of that inquiry. (Braidotti et al 1994, 31-34; Harding 1986, 10, 15-16; Keller 1985, 4-6.)

Quantitative Science

Hazel Henderson agrees that science is a religion for many. However, it is a dualist religion. The academic world rewards reductionist, quantitative studies with less significance, while human values and ethical concerns are overlooked because they are non-quantifiable. Famous scholars have called attention to this. They include Kenneth Boulding, Nicholas Georgescu-Roegen, Kurt Gödel, Werner Heisenberg, R. D. Laing, Oskar Morgenstern, Theodore Roszak, E. F. Schumacher, and William Irwin Thompson. They force us to remember that the normative nature of science is revealed in the first decision of any scientist: what phenomena to study. This choice influences the view of reality. (Henderson 1978, 307.)

According to Vandana Shiva, it was the Western, middle class, patriarchal attitude that made these choices early in history. Since these people perceived nature as a dead resource for profit maximization, this became the focus of science. A political choice backs this up, thus the scientific perception of reality prevails, while excluding other ways of knowing. Hence, science is based on power. It is a system of political values, rather than facts. In spite of these clearly value laden choices, scientists still call science objective and the universal law of nature. However, it is a fact that science generates knowledge with economic aims in mind. Therefore, when science was applied to economic development it created the domination of nature by man, of poor by rich, of the South by the North, of traditional man by modern man, and of women by men. Thus, knowledge, power, and economic development are linked and they are generating inequalities and domination. (Shiva 1989, 26-29.)

Quantification of all statements is a crucial criterion in the scientific approach. E. F. Schumacher finds such science inadequate. It cannot deal with any qualities or values, including ethics and metaphysics (knowledge beyond the physical.) If science cannot clarify our basic convictions, it cannot educate people to be of any real value to society. Lack of studying metaphysical and ethical problems involved in science render its educational value doubtful. The center of our being, our most basic beliefs or values, transcend the world of quantitative facts. Scientific facts can therefore not prove or disprove our values. We need to be in touch with this basic center within us. If we were, we would not be in doubt about our purpose in life. Thus, the whole notion of having a mathematical model as our universal knowledge system must be questioned. The price of this kind of science means loss of quality, the very thing that matters the most for people. (Capra 1989, 145, 227; Schumacher 1993, 72-74.)

The focus on quantitative and rational theories conforms to scientistsô personal desires, commitments, and expectations. Scientists are motivated by social, political, and emotional issues, be they conscious or not. To avoid this subjectivity, scientists appeal to *objectivity*, which imposes a veil over the ideology in science. Apparent self-evidence makes the subjective scientific practices invisible and inaccessible to criticism. *Universality* completes the picture, and protects the privileges of science. Thus, the claim that science is objective and universal is misconceived. Ideological science belies its own aims by undermining the meaning of objective inquiry. Feminists therefore reject scienceôs claims to objectivity and universalism. Both are created by dualism. Such concepts suggest that the masculine standpoint is objective and universally valid, while the feminine is subjective and particular. Thus, the masculine is the norm, while the feminine is the difference, *the other*. Claiming objectivity and universality makes scientists and their knowledge system detached, disembodied, transcendent, and eternal. Women and their knowledge conversely become confined to the body, the physical, and related to change and nature. That is bias knowledge making. It overlooks diversity and ñsituatedness,ò which would give space for various knowledges related to differences of race, class, sex, culture, and nationality. Nevertheless, diversity cannot be permitted by the universal mode of knowledge. (Braidotti et al 1994, 37; Keller 1985, 7-12; Reitzes 1993, 45.)

In order to end the purely quantitative approach in science and its androcentrism, one must reject the dualist separation. In reality the private bears on the public, feelings are interacting with reason, quality and quantity cannot be kept separate, and women and men are inter-dependent. Dualism is not real. It is created to secure the autonomy of science. It blurs the fact that science has been produced almost entirely by white, Western, middle-class men; that it evolved from a particular ideal of masculinity; that it is based on domination; and that it is a deeply subjective, personal, and social activity. Without dualism, science will collapse. It becomes both public and personal, and scientists will be not only rational but also emotional human actors. (Braidotti et al 1994, 37; Keller 1985, 7-12; Reitzes 1993, 45.)

Scientific Violence

The androcentric values of science lead the Ups to seek power over women, traditional people, people of color (Downs), and nature. Since the Downs are passive and lack rationality they deserve unequal treatment. When science constructs women and emotions as *the other*, it confirms that the masculine position and rationality are superior and the standard. In this way, rationality is used as an instrument for masculine domination over women and all dualized others. It has become a tool to undermine differences. However, lack of ability to find diversity positive, and trying to make all one, leads to fundamentalism. Thus, forcing through a single definition of reality becomes violent. Consequently, there is a close link between masculinity, rationality, and violence in science. These oppressive features inhere therefore also in the various scientific disciplines, in scientific technology, and in economic development. (Braidotti et al 1994, 32, 34; Des Jardins 2001, 255.)

The androcentric premises also have political consequences. When humanôs inherent nature is masculine, which includes being individual, competitive, and aggressive, then coercion and hierarchical structures are necessary to manage conflicts and maintain social order. In this way, the ideological basis of exploitative relationships is protected. Hence, militarism, colonialism, racism, sexism, capitalism, and other modern pathological ñismsò become an inevitable part of society. Thus, power relations are created by universal scientific ñtruthsò about human nature, rather than by political and social debate. The state declares it a scientific truth, which cannot be otherwise, thus people cannot challenge the power structure. This permits the state to implement laws and policies that are controlling and coercive. These are assumed correct, because they are based on scientific facts. One result is the stateôs eternal pursuit of economic growth, without public consultation. The state supports the capitalist ideology, including scientific agriculture, scientific water management, and industrializa-

tion, which benefit the Ups, while degrading nature and increasing poverty for the Downs. Thus the state does not consider a possible conflict between its goal of social control and economic profits and the welfare needs of various social groups. Not being able to suggest alternatives to the existing order, people become dis-empowered, which leads to public apathy and an excuse to establish authoritarian governments. In this way, the ideology of science affirms the prevailing social, political, and economic order. (Birkeland 1995, 59; Reitzes 1993, 36-39, 41-42.)

In reality it is a contradiction to apply the scientific method to politics. Politics relates to values. Since values and facts are different categories, one cannot apply empirical facts to social values. It is therefore impossible to legitimize political decisions based on scientific knowledge. Social decision-making is a political process. When we apply science to political and moral questions, it becomes an ideology that supports the dominant interests. Thus, the state creates the conditions for domination. If people challenge the stateôs power, it becomes violent resulting in totalitarianism. It is a situation where the state sets limits to what is allowed to think and teach ï if necessary by coercion. Consequently, the Ups use science to serve their interests. The result is a violent ideology masked as science. The outcome is increased hunger, poverty, and misery for women, other Downs, and nature. (Reitzes 1993, 32, 34, 42-45.)

Vandana Shiva confirms that science is violent. Eighty percent of scientific research is devoted to the war industry. War is violence against a perceived enemy, sometimes a countryôs own population. Science also relates to violence in peaceful spheres. Scienceôs dualist view permits its proponents to exploit nature for economic profit. Dualist science can only include quantifiable, profit generating properties of a natural resource system. The qualitative and stabilizing ecological processes are therefore seen as *the other*, which can be destroyed. The priority on power, domination, and control for profit-making means that scientists cannot choose what is important for nature and society. For that reason they prefer nuclear energy and spreading deadly pesticide in our environment, while excluding the less profitable, but sustainable organic farming and solar energy. In this way, science is used to prioritize violence and profit, while excluding issues that would improve the quality of life for women, poor people, and nature. (Des Jardins 2001, 255; Shiva 1989, 23.)

According to Susan Griffin, the destructive tendency of science comes from its reductionist worldview. With its priority on rationality, science has separated intellectual knowledge from intuition and eliminated the latter. The consequence is that scientists only see the world in fragments. Since the reductionist method gives detailed and in depth knowledge about the parts, it creates the illusion of having knowledge of the whole. However, without intuition science cannot have any idea about, neither any feeling for the whole. Having knowledge of fragments means that science can only produce fragmented knowledge. This has serious consequences. When scientists see the world in pieces, they believe it is dead. This permits exploitation of nature. Conversely, if scientists would view the world as a whole, they would be able to see that nature is alive. Therefore, when we distance ourselves from the whole, we distance ourselves from the issue of life and death. The reductionist approach consequently promotes decisions for actions to the parts, which becomes destructive and are causing the death of the whole. (Griffin 1990, 87-88.)

Already after the First World War did the British philosopher, civil-rights activist, and Nobel Prize-winner Bertrand Russell (1872-1970) contemplate on the effects of modern science. In his 1923 book, ñThe Prospects of Industrial Civilizationò Russell concluded that the application of science has been ñin the main immeasurably harmful,ò and it would only cease to be so ñwhen men have a less strenuous outlook on life.ò Russell found that science has been used for three purposes: to increase the production of commodities; to make wars more destructive; and to substitute trivial amusement for those that had some artistic or hygiene values. Production increase had its importance 100 years

ago, now it is more important to direct production wisely. Instead, science increased production and created natural degeneration; it made wars more destructive, which increased global violence and human suffering; and it trivialized cultural activities, hence destroying the quality of life. (Ullrich 1993, 276-277.)

Scientific Development

Development was meant to alleviate poverty and bring a good life to the people in the former Southern colonies. By establishing nation-states and promoting economic growth, the North assumed the Southern countries would change into modern societies. The main pillars in this evolution were Western science, its discipline of economics, and application of modern technology. Thus, development in the South was built on the Western scientific framework. However, what happens when an inherently dualist and dominative science is applied to development? Since reductionist, individual, quantitative, modern, rational, masculine, and technical issues are considered superior, scientific development automatically subordinates holistic, social, qualitative, traditional, emotional, feminine, and environmental issues. Consequently, the scientific development program exploits nature, dominates women and traditional people, and overlooks their quality of life. The outcome from such an ideology is hunger, poverty, violence, destruction, and death of women, poor people, and nature. (Nhanenge 2011, 301.)

The development program began on 20 January 1949, when US President Harry Truman held his Inaugural Address. His ñPoint Fourò claimed that some countries were ñunderdevelopedò needing assistance to become developed. Truman suggested, *"...making the benefits of our scientific advances and industrial progress available for the improvement and growth of underdeveloped areas"... "The United States is pre-eminent among nations in the development of industrial and scientific techniques. The material resources which we can afford to use for assistance of other peoples is limited. But our imponderable resources in technical knowledge are constantly growing and are inexhaustible. I believe that we should make available to peace-loving peoples the benefits of our store of technical knowledge in order to help them realize their aspirations for a better life. And in cooperation with other nations, we should foster capital investment in areas needing development."..."Greater production is the key to prosperity and peace. And the key to greater production is a wider and more vigorous application of modern scientific and technical knowledge."* Consequently, in a brief speech development assistance to the South was founded on transfer of Western scientific and technical knowledge together with capital investment. The purpose was to increase Southern productivity, assumed to give economic prosperity and lead to global peace and happiness. (Braidotti et al 1994, 21; Rist 1997, 71-72.)

Thus, development is a purely scientific, technical, and quantitative issue. However, when one applies an inherently violent and fragmented knowledge system to development, it must logically follow that also development will become dominant. Wolfgang Sachs confirms that science, supported by the institution of the nation-state, are indeed the immensely powerful forces behind development. Combined, scientism, statism, and developmentalism have managed to divide society into three groups: the beneficiaries, the servants, and the dispossessed. It has also created an explosion of commodities, technologies, and material expectations. These forces have increased global wars, caused human repression, poverty, and environmental collapse of a potentially terminal nature. (Ekins 1992, 202-203, 207; Ekins, Hillman, and Hutchison 1992, 164.)

Rosemary Radford Ruether has a similar opinion. She points out that the application of science to technological control over nature and economic development took place in the North simultaneously with their colonialization of the South. From the 16th to the 20th centuries Western Europe appropriated lands of the Americas, Asia, and Africa and reduced their population to servitude. The wealth

accrued by this vast expropriation, increased scientific revolution and economic growth in Europe. The means were confiscation of natural resources from other continents and exploitation of the labor of their indigenous peoples. Thus, scientific and economic developments are built on injustice. They combine their forces to exploit nature and people. It is a system that benefits the few, while being harmful to the many. It has created poverty of huge proportions, including an ever-widening gap between rich and poor, while also degrading the global environment. (Radford Ruether 1993, 20.)

Michel Foucault adds that science exploits people and nature, because science is intimately linked with power relations. Western political and economic institutions are based on scientific discourse, thus its centers of truth is identical with its centers of power. Therefore, by producing truth claims about development, the North has the power to shape reality into a picture that benefits their own economic interests; with some profit to the Southern elites. Globally, they have created images of progress as being an urban life style with white-collar jobs and high consumption. Although the poor can never hope to gain this life style, because natural resources are too limited, the North misleadingly suggests that the modern way of life is possible for all. Such false claims have assisted the centers of power to displace traditional people, appropriate their lands, and exploit their natural resources for scientific and economic progress benefiting the elites. (Braidotti et al 1994, 10.)

According to Braidotti et al (1994, 9) the problem with science is its priority on economic goals. This is also implied in development of the South. Southern people have consequently experienced a ruthless application of scientific technology in the form of big-scale development projects, like dams and cash crops plantations, which has served only urban, industrial, and foreign economic interests. It has displaced thousands of indigenous peoples from their land and appropriated their means of livelihood. Such dominant development practices are important reasons for destruction of nature; but the real force behind the global environmental crisis is Western science. Vandana Shiva (1989, xviii) draws the same conclusion, science and its technology is responsible for the current economic and ecological crises.

There is consequently a profound relationship between science and development. One cannot understand them in isolation from each other. Claude Alvares compares them to the horse and the carriage. Development was desired by non-Western societies because it was associated with science, and science was desired because it made development possible. Thus, they interrelate in a circular form of, ñI scratch your back, and you scratch mine.ò If development did not have any special relationship with science, there would have been no need to displace the subsistence living of traditional peoples and replace it with a modern standard of living that science proposes. (Alvares 1993, 221-222.)

The close relationship between science and development and their joint domination of society and nature can be seen in India. The modern Indian state is in its constitution committed to science. Thus, in the hands of the national elites it is the primary force for the destruction of the environment. India has become a regional super power with massive government spending on militarization, rather than on social services. Western educated Indian elites have adopted affluent consumerist life styles, while huge parts of the population are marginalized. Large-scale projects like dams and nuclear power plants have displaced people from their land with devastating effects. All of this has been done in the name of scientific development. Indian society is extremely exploitative of its poor population and their natural resource base. As a consequence of this, the development model has been criticized by many Indian scholars. They are questioning its foundation ï the framework of Western science ï as the only valid way of knowing, and its claim to universal truth. The Indian state presents science as the only knowledge base of development, but it overlooks that science is the product of white, Western, male thinking. However, this is convenient, since science has become the means of control for the Indian state and a justification for its institutionalized violence. Vandana Shiva and

Shiv Visvanathan perceive the scientific mode of development as violence and terrorism in theory and in practice. Visvanathan calls it ña slow genocideò while Shiva names it ñMal-development.ò (Braidotti et al 1994, 109; Carmen 1991, 70; Shiva 1989, 4.)

According to Shiva and Visvanathan the root of the problem is that science with its quantitative focus is serving the interest of the global market economy, overlooking the interests of nature and people, which relate to a quality of life. The economic priority means that scientists exploit those parts of a natural resource system that can generate profits. Properties that are commercially non-profitable but conserve natureôs ecological processes and support peopleôs subsistence living are destroyed. Hence, scientists reduce a forest into a single component: commercial wood; with a single function: profit-making. By scientific technology forests are manipulated to produce even more commercial wood. Scientists see such actions as increasing productivity, although it decreases the output of water, derived from natural forests, and reduces the diversity of species. Thus, the living, diverse ecosystem is violated and finally destroyed by scientific forestry. In this way, science is the root of the ecological crises. It alters nature to fit its own purpose and destroys organic processes and regenerative capacities. The women and traditional peoples who live in the sustenance economy and produce wealth together with nature have holistic knowledge about the environment. However, since such alternative knowledge is directed towards social and ecological well-being rather than profit, it is not included in the scientific paradigm. Reductionist science has established a monopoly on knowledge, which it uses only in the interest of economic pursuit. It serves an economic structure based on exploitation, profit, maximization, and capital accumulation for the Northern and Southern elites. Nobody evaluates the true outcome from applying reductionist science. Since the state supports the myth of science, it is assumed superior. Development agencies also support scientific development financially, materially, and ideologically so it can appropriate nature for profits. Indigenous peoples and nature must bear the costs of such scientific development, while not reaping the benefits. They are persuaded to see it as ña minor sacrifice for the national interest.ò Since the state, the elites, and Northern development organizations support science it becomes powerful. Without this support science is weak and ineffective in its knowledge about nature. Yet, as a knowledge system to gain profit at the market, it is strong. Consequently, modern science and its development project support and are supported by Western capitalist patriarchy. Both dominate and exploit nature, women, and poor people in the South. (Braidotti et al 1994, 9, 109-110; Shiva 1989, 23-25.)

Some may argue that the problem is not science per se, but the political and economic elites misuse of science, which leads to violence. However, Shiva finds that incorrect. With its economic focus, science is intrinsically violent and destructive to society and nature. Science creates ecological disasters, it supports militarism, and its technologies are meant to control and dominate others. That is not misuse of science; that is science. When water projects decrease water availability; when fertilizers rob the soil of its fertility; when pesticide increase pests, then it is not a discussion of use or misuse of scientific technology. The problem is rooted in the modern scienceôs knowledge creation process. Science is now busier in solving problems created by scientific development than occupied with solving problems, posed by nature itself. A majority of poor people in the South are threatened by starvation due to environmental degradation. The reason for these disasters is the eliteôs chase for economic growth supported by science. Its technologies have become a major source of genocide. The killing of people by the murder of nature is an invisible form of violence, which today is the biggest threat to justice and peace. (Shiva 1989, 31, 34, 36.)

A development, which is directing natural resources to the market economy, away from peopleôs survival economy, generates conflicts and instability. In response, local people have increasingly staged protest actions against development projects. These protests are due to the destruction of local cultures and lifestyles, and the displacement of people leading to physical, psychological, and cultur-

al poverty. The struggle of peoples is not only about limited natural resources. The issue at stake is also that the modern way of life is not desirable for all. Apart from being unable to alleviate poverty and bring people a quality of life, the greatest criticism of scientific development is its universal model, which allows for no alternatives. According to Herman Max-Neef, the imposition of a single development model on a global scale has resulted in the disruption and transformation of age-old diverse cultural heritages and knowledge systems, and often in their destruction. (Braidotti et al 1994, 9-10, 109-110; Carmen 1994, 18; Radford Ruether 1993, 20; Seabrook 1993, 9.)

Foucault points out that resistance to power start from the margins. Part of the political protest is peopleôs demand for a renewal of their subordinate, traditional knowledge and culture. Thus, definition of how to live a good life depends on a participatory democratic process involving all actors, not only the norm-setting elite. Moreover, what a good change means in a particular social and cultural context may vary from society to society. Thus, a reconstruction of Southern life styles will have to include multiple development modes. There are already thousands of alternative development activities in the world. These give hope to the people who are either not assisted by the mainstream model or who are dominated by it. (Braidotti et al 1994, 10, 107; Seabrook 1993, 9.)

Consequently hunger, poverty, and environmental destruction stem from the modern perception of reality; it is the reality of scientific reductionism. The antithesis to scientism is the knowledge, experience, and wisdom of common people. The world of scientific experiments and beliefs needs to be extended to those experts who have been excluded from it: women, peasants, and traditional people. In this way, a scientific system can be validated in practice as a real-life activity in society and nature. Traditional knowledge is increasingly seen as a cultural resource that is both valid and valuable in its own context. Such knowledge is the only possible basis for anything that may be called development. It is a development that can enhance peopleôs capability to increase the control over their daily lives while maintaining a healthy relationship with the natural processes, which sustains it. Such development needs to start from what people know already. This knowledge may be combined with science, but it will only be effective if it is rooted in the culture and experience of those who are developing. (Ekins 1992, 204, 207-208; Shiva 1989, 36.)

Holistic Knowledge

Philosophical theories on human knowledge have historically included the experience of only one group of humanity, as being the experience of all: the white, Western, middle-class men. Hence, understanding of life was done without women, traditional people, and nature. What was left for them was the so-called experimental knowledge. That is knowledge based on everyday experiences, which the Ups did not recognize as real science but associated with the lowest levels of knowing. From this it follows that knowledge is based on exclusion of the majority of people. Science is meant to benefit the Ups who also monopolize political and economic power. This domination and exclusion in knowing is manifested in most global societies. However, such a knowledge system is a paradox. By excluding the experience of women and traditional people, and by exploiting nature on which human survival is founded, science lays the ground for environmental and social crises, which eventually will lead to destruction of both. We consequently need alternative ways of knowing, which can dismantle the patriarchal domination of women, traditional people, and nature, and generate a holistic knowledge system. (Braidotti et al 1994, 47; Gebara 1999, 21-22, 25-27; Warren 1996, xiv.)

Human knowing is called epistemology. It is an invitation to think, feel, and contemplate about how one can know oneself, other people, nature, and things in oneôs everyday surroundings. Thus, ordinary people can take part in epistemology. It is therefore not an activity that belongs only to experts, although it is considered so. Knowing is an action, which includes a chosen understanding of the world and human beings. Value is a part of this choice. Neutrality is not possible. Ethical judgments

are therefore implicit in knowing, meaning that knowing has consequences. Hence, ethics of knowing is relevant. It means that society cannot propose unrestricted scientific research without asking questions about which and whoôs interests is prioritized. Thus, ethics can force us to redirect or limit our knowledge. Ethics will also demand that gender and ecology become constitutive parts of knowing. By such inclusion humanity can overcome its dualist way of knowing, seeking new relationship with all beings. (Gebara 1999, 20-25.)

Holistic epistemology consequently introduces the issues of gender and ecology as ways of understanding the world and human beings. Both are part of human reality, although they were excluded from human history. However, when knowledge is reconstructed both the masculine and the feminine need to express their particular ways of being in the world. Hence, universalization of masculine knowing must end. This will help us understand that the masculine is not a synonym of the human, and nature is not an object to be manipulated and exploited for profit. Including gender and ecology in science creates new frames of reference for knowing. It put knowing in the context of menôs and womenôs daily and concrete experiences seen in relation to each other and their ecosystem. That would increase knowledge, change the underlying values and the concrete expression of knowing. Bringing in gender and ecology will challenge traditional processes of knowing; it will make earlier truth relative; and it will correct mistaken facts about the cognitive abilities of women and traditional people. Based on this, one can mention some, few, interconnected characteristics of a holistic non-dualized epistemology that is in the process of developing: (Gebara 1999, 57-59.)

A central feature in knowledge generation is *experience.* Thus experience is the first step in knowledge. It includes getting a feeling about what is happening. The second step is expressing this in words. However, this process of knowing is normally not followed. People are often faced with absolute truths that exist beyond their own experience. When these truths are repeated, people accept them without questions. This develops an authoritarian knowledge system that promotes manipulation and fear. It also builds dominant institutions with control and power over people. We must reject such truths. We must also deny the existence of a unitary human consciousness. This kind of knowledge comes from imposing form on the world, rather than allowing it to develop by discovery. It makes power implicit in the production of knowledge. Raising questions based on experience about these absolute truths will democratize such powers. Hence, we must recover the human experience as the guiding principle of science. (Braidotti et al 1994, 45; Gebara 1999, 48-50.)

Experience does not provide immediate knowledge. It provides a particular perspective giving room for more kinds of experiences and the means to evaluate the state of affairs. Hence, there is no universal human experience, although we tend to believe so. However, that is only because some privileged people receive a platform to speak, while others are relegated to the sidelines. Holistic knowledge cannot privilege some experience over others. Knowledge claims must develop from an equal community dialogue, providing a forum for all experiences. Human experience must not be limited by authoritarian, unequal systems. It must instead be complemented with a wider inclusion of all life forms, because humans do not exist in isolation. Human beings have kinship with all other beings. Knowing is therefore *interdependent*; it relates to all elements in the world. When we have a headache it affects not only the head, but the whole body, including our family. Thus, interdependence goes beyond ourselves, to other human beings, to nature, including the universe. This cosmic interdependence raises our awareness of being part of a greater body, without which individual life would be impossible. By this awareness, people will be able to care for the whole as well as its parts, rather than dominate and exploit them. This higher level of consciousness would help people to cooperate and diminish competition, to appreciate qualities rather than only quantities. It would increase the understanding of feminine issues that have been forgotten in the dualized, masculine, domineering, modern system. This kind of knowledge would eventually modify economic and politi-

cal systems, which fail to respect that life of people, cultures, and nature is sacred. (Braidotti et al 1994, 45; Gebara 1999, 48-52, 54; Gruen 1994, 129-133.)

This would make knowing *holistic*. When we live in a model that prioritizes mind over body and men over women, we come to think and act as if the universe contains these dualisms. When we perceive reality holistic these separations disappear. Mind and body are united, all is made up of both matter and energy, thus everything is one whole. There is beauty in unity. When we comprehend unity of all things, we may also understand and welcome our own mortality, together with that of the birds and the flowers. (Gebara 1999, 57, 62.)

Situated Knowledges

Knowing is a process that differs according to changing circumstances and contexts. There is therefore not one best way of knowing, being a paradigm to other ways of knowing. Knowing relates to the world where it is carried out, and it is relevant to the context where it is developed. Knowledge is therefore a product of historical experiences in a specific cultural context. This makes knowledge situated and contextual. Donna Haraway created the term ñsituated knowledges.ò It has provided feminism, post-modernism, and post-colonialism with correctives to current epistemological limitations. The concept recognizes that knowledge is context bound, partial, particular, diverse, and culturally bias. We are all laying under for these values. The culture, history, and society in which we grew up shape our beliefs, opinions, hopes, and desires. The questions we prioritize to ask, the methods we choose to answer them, and the way we interpret the answers, all include our subjective perspectives. Thus, how people interpret the world depends on their context. Holistic knowledge must therefore include the way context determines human understanding, explanation, and interpretations of the world. A holistic account of knowledge is based on peopleôs social, cultural, and sexual reality related to a process of participation that emerges historically over time. Apart from including womenôs experiences also nature is part of such knowledge construction. Thus, knowledge develops from local contexts, long before it is open to a more global perspective. Hence, universal truth does not exist in knowledge. It is not possible to take criteria from one place and apply it to another place without problems. Given that people are situated in various and diverse contexts, any claim to a universal outcome must be rejected. Instead concrete, contextual, interdependent affirmations are stressed. The only universal part of knowing is the fact that people learn in a local way. This universality marks everyone. Knowledge is neither objective. The observer is not a rational, detached, neutral mind observing a passive natural object. According to Haraway, such claims are based on patriarchal ideologies of control and domination. It makes the male knower invisible, preventing him from taking responsibility for what he sees. She calls it the ñgod-trick.ò The knower must be replaced by an embodied subject that discloses his position. It is a shift from neutral to situated knowledges. Furthermore, nature is not a resource for manôs exploitation. Nature is an active subject with whom one can converse and who contributes to what humans know about ñit.ò Hence, subject and object engage in ñconversationsò on an equal footing. In this perspective, science becomes a socially and politically charged conversation with nature. Consequently, Haraway argues that knowledge is pluralistic, subjective, and situated. A scientist can only provide knowledge claims grounded in specific contexts, according to his perception. Harding agrees and adds that since the social location of the knower is crucial in order to understand and address knowledge claims, it makes local knowledge important. Only by listening to the perspectives of indigenous people can outsiders understand environmental issues and solutions can be reached. Local people have relevant technical knowledge, because it is based on their daily, lived experience as users and managers of their environment. Such information is not readily available for outsiders. Much of the problems human beings have with nature stems from their distance from it. However, when all community members participate in a dialogue and all voices are heard, and all ideas are tested, it may end in becoming valuable knowledge. In this way, community knowledge confirms the value of nature. Nevertheless, not any community

will do. Holistic knowledge comes from a community that is opposed to any oppressive, domineering conceptual frameworks and institutions. Such a setting plays a crucial role in creating better knowledge and value claims. With the features of experience, community, and situatedness, holistic knowledge provides justification for human knowledge of and obligations to the natural world. (Braidotti et al. 1994, 51-52; Gebara 1999, 54-56, 60-62; Gruen 1994, 124, 126-129; Murphy 1997, 53; Well and Wirth 1997, 301, 306; Warren 2000, 33-35.)

Knowing also involves an affectionate approach to the things and people one wants to know about. Affection relates to emotions and senses that allow us to discover things that would otherwise pass unobserved in the act of knowing. It is therefore impossible to divide objectivity and subjectivity. The researcher sees other peopleôs reality from within, not pretending to be the other. It becomes a research approach of compassionate conversation between agents. Since the parties are equal, it prevents re-construction of dualism. Equality also means that although one agent was dominated in earlier knowledge generation, it is not ground for a privileged access to superior vision. Suppression might give better clues to the problem, but it does not give a more objective idea. Affection opens up emotions as a source of knowing rather than being the dark side of reason. Anyway, we cannot separate reason from emotion; reason has no autonomous existence. That would alienate reason from creativity and exclude it from the reality on which it depends to nourish itself. Human beings are reason, emotion, sentiment, and passion wrapped up in one. People are an extraordinary blend, able to emphasize one aspect of themselves at one time and another at a different time. Thus, the dualist distinction between male rationality and female emotion is unacceptable. It is an unnatural division. Emotion and rationality are manifested in all men and women according to their individual characters, life situations, and cultures. (Braidotti et al 1994, 52; Gebara 1999, 63-64.)

Moreover, there is no singular worldview that can provide the same meaning to all people. Such an outlook ignores diversity, complexity, and richness of peopleôs lives. This has ethical consequences. It means that peopleôs diverse ways of life, cultures, religions, and sexual orientations must be acknowledged. Such inclusive knowledge influences the various ñindependentò disciplines. In reality, one study opens up to other fields and is to some degree dependent upon them. Thus, a specific discipline has some autonomy, but it is also related to and dependent on other areas of knowledge. All aspects of knowledge making are interdependent. In this way, we can overcome reductionist and mechanical theories of knowledge, which sees parts as being independent of the whole. (Gebara 1999, 64; Gruen 1994, 123-124.)

Thus, holistic knowledge is interdependent with science, society, nature, reason, emotion, facts, and values. Recognizing such interdependence is the first step to legitimate knowledge. It assures that all voices, and the environment in which they are expressed, are included. One unified view of the world excludes the experiences of many people; it will create fragmented knowledge that contributes to the global crises of hunger and poverty. Nevertheless, being committed to context, pluralism, and diversity does not lead to abandonment of truth and values. Instead, we must realize that truth and values are constructed. Since, we have different backgrounds, we have alternative true and right world-versions too. It does not mean that there is no objective, external reality, but those are both materially given and socially constructed. Thus, how we conceive natural objects, must be understood in the broader social context. This must play a central role in deliberation about moral obligations to nature. We therefore need more than only objective, quantitative facts. Knowledge claims are influenced by the values of the culture in which they are generated. Hence, facts are theory-laden, theories are value-laden, and values are molded by historical and philosophical beliefs, social norms, and individual processes of categorization. However, Gruen warns that generating this kind of relevant knowledge requires humility. One must have deep respect for differences and assume that one cannot immediately understand concepts or events. That will encourage people to withhold early

judgment, to learn to listen to others, and to see themselves relationally. (Gruen 1994, 124-126, 133-134; Warren 2000, 34.)

Conclusion and Recommendation

Conclusively, dualized, modern science is based on power, control, domination, and profit-making. Such hugely important vested interests will die hard. It may consequently take a long time before a holistic way of viewing reality will be fully implemented. In the meantime, science will continuously push humanity towards artificial environments, technological control over humans, and a loss of quality of life. Science will also continue to guide development, with devastating effects for nature, women, children, and poor people in the South. (Merchant 1980, 290-291; Capra 1989, 51-53.)

This is where development studies and development organizations come into the picture. In order to end hunger and poverty and regenerate natural health, it is necessary to embrace indigenous knowledges. Hence, they need support. Such support may include promoting research into and documentation of how indigenous knowledges can improve the quality of life for women, traditional people, and nature. If studies would show indigenous knowledges effectiveness in hunger and poverty alleviation, it may increase awareness of the importance of indigenous knowledges. This may convince agencies about their relevance, and persuade development workers to take local peopleôs experiences and knowledge seriously. Such awareness will develop slowly, but it is a step further towards the aim of including in science reality as perceived from the perspectives of women, traditional people, and nature. Or said differently: being aware of the importance indigenous knowledges play in ending hunger and alleviating poverty means that any development activity that would overlook the experiences of gender, culture, and ecology must be considered a reductionist, masculine, and dominant enterprise, the outcome of which will only reinforce global hunger and poverty.

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Bibliography

Alvares, C. 1993. Science. In *The Development Dictionary*, ed. W. Sachs. Johannesburg: Witwatersrand.

Amiiko. 2011. *World Environmental Facts.* http://www.amiiko.com/ (accessed August 17, 2011.)

Birkeland, J. 1995. The Relevance of Ecofeminism to the Environmental Professions. *Environmental Professional* 17 (1.)

Braidotti, R., E. Charkiewicz, S. Häusler, and S. Wieringa. 1994. *Women, the Environment, and Sustainable Development: Towards a Theoretical Synthesis.* London: Zed Books.

Bread for the World. 2010. *Hunger Facts.* http://www.bread.org/hunger/global/ http://www.bread.org/hunger/global/facts.html (accessed February 20, 2010.)

BusinessInsider. 2011. *Why investing in international farmland can be perilous.* http://farmlandgrab.org/post/view/18810 (accessed August 22, 2011.)

Capra, F. 1982. *The Turning Point: Science, Society, and the Rising Culture*. London: Flamingo, Fontana Paperbacks.

Capra, F. 1989. *Uncommon Wisdom: Conversation with Remarkable People*. London: Flamingo.

Capra, F. 1997. *The Web of Life: A New Synthesis of Mind and Matter*. London: Flamingo.

Capra, F. 2002. *The Hidden Connections: A Science for Sustainable Living*. London: Harper Collins.

Carmen, R. 1991. Paradigm Lost, Paradigm Gained, Self-reliance in the Post-developmentalist Nineties. *Development* 3-4.

Carmen, R. 1994. Development Ethics or the Rediscovery and Reclamation of Meaning. *Development* 4.

Carson, R. 1962. *Silent Spring*. Greenwich: Fawcett Publications.

Chalmers, A. F. 1982. *What Is This Thing Called Science?* Buckingham: Open University Press.

CHRGJ. 2011. Center for Human Rights and Global Justice. *Every Thirty Minutes: Farmer Suicides, Human Rights, and the Agrarian Crisis in India* http://www.chrgj.org/publications/docs/every30min.pdf (New York: NYU School of Law, 2011).

CNN. 2010. *Activist: Farmer suicides in India linked to debt, globalization*. http://edition.cnn.com/2010/WORLD/asiapcf/01/05/india.farmer.suicides/index.html (accessed January 6, 2011.)

ColorLines. 2011. *Who's Grabbing Africa's Land? U.S. Speculators, Including Universities.* http://colorlines.com/archives/2011/07/us_investors_and_universities_join_the_land_rush_in_africa.html?utm_source=feedburner&utm_medium=feed&utm_campaign=Feed%3A+racewireblog+%28ColorLines%29 (accessed August 22, 2011.)

Dankelman, I. and J. Davidson. 1988. *Women and Environment in the Third World: Alliance for the Future*. London: Earthscan.

Des Jardins, J. R. 2001. *Environmental Ethics: An Introduction to Environmental Philosophy*. Ontario: Wadsworth.

DEVEX. 2009. *Global Development Briefing*. https://www.devex.com/en/.

EarthSky. 2010. *How many people in the world today are hungry?* http://earthsky.org/human-world/how-many-people-in-the-world-today-are-hungry (accessed August 17, 2011.)

Ekins, P. 1992. *A New World Order: Grassroots Movements for Global Change*. London: Routledge.

Ekins, P., M. Hillman, and R. Hutchison. 1992. *Wealth beyond Measure: An Atlas of New Economics*. London: Gaia Books Ltd.

Food for the Poor. 2011. *Starvation*. http://www.foodforthepoor.org/about/topics/starvation.html (accessed August 17, 2011.)

Friends of the Earth International. 2011. *Stop Farm Land Grabbing – Hundreds of Civil Society Groups call on the G20.* http://www.foei.org/en/media/archive/2011/stop-farm-land-grabbing-2013-hundreds-of-civil-society-groups-call-on-the-g20 (accessed August 22, 2011.)

Gebara, I. 1999. *Longing for Running Water: Ecofeminism and Liberation*. Minneapolis: Fortress Press.

Griffin, S. 1990. Curves along the Road. In *Reweaving the World: The Emergence of Ecofeminism*, eds. I. Diamond and G. Orenstein. San Francisco: Sierra Club Books.

Gruen, K. 1994. Toward an Ecofeminist Moral Epistemology. In *Ecological Feminism*, ed. K. J. Warren. London and New York: Routledge.

Harding, S. 1986. *The Science Question in Feminism*. London: Cornell University Press.

Henderson, H. 1978. *Creating Alternative Futures: The End of Economics*. New York: Berkeley Publishing Corporation.

Heyzer, N. 1995. The Womenôs Development Agenda for the 21st Century. In *A Commitment to the World's Women: Perspectives on Development for Beijing and beyond*, ed. N. Heyzer with S. Kapoor and J. Sandler. New York: United Nations Development Fund for Women.

Ho, Mae-Wan, 1998. *Genetic Engineering: Dream or Nightmare? The Brave New World of Bad Science and Big Business.* Bath: Gateway Books.

Honderich, T., ed. 1995. *The Oxford Companion to Philosophy*. Oxford and New York: Oxford University Press.

Keller, E. F. 1985. *Reflections on Gender and Science*. New Haven: Yale University Press.

Lappé, F.M. and J. Collins. 1988. *World Hunger: Twelve Myths*. New York: Grove Press.

Lean, G. 2009. *Water Scarcity "Now Bigger Threat than Financial Crisis".* http://www.independent.co.uk/environment/climate-change/water-scarcity-now-bigger-threat-than-financial-crisis-1645358.html (accessed December 30, 2009.)

Loy, D. 1987. On the Meaning of the I Ching. *Journal of Chinese Philosophy* 14.

Merchant, C. 1980. *The Death of Nature: Women, Ecology, and the Scientific Revolution*. New York: Harper and Row.

Murphy, P. D. 1997. Ecofeminism and Postmodernism: Agency, Transformation, and Future Possibilities. *NWSA journal* 9, 3, fall.

NationMaster.com. 2011. *Water Salinisation (most recent) by Country 1994-1996* http://www.nationmaster.com/graph/env_wat_sal-environment-water-salinisation (accessed January, 3, 2011.)

Oakland Institute. 2011. *Press Release: Understanding Land Investment Deals in Africa* http://media.oaklandinstitute.org/press-release-understanding-land-investment-deals-africa and http://media.oaklandinstitute.org/ (accessed August 22, 2011.)

OCA. 2010. *Organic Consumer's Association: The Escalating Chemical War on Weeds - Profit Drive Of Monsanto And Other Chemical Companies Backfires.* http://www.organicconsumers.org/articles/article_21225.cfm (accesses July 13, 2010.)

Palmer, M. 1997. *Yin and Yang: Understanding the Chinese Philosophy of Opposites and How to apply it to Your Everyday Life*. London: Judy Piatkus (Publishers) Ltd.

Plumwood, V. 1993. *Feminism and the Mastery of Nature*. London: Routledge.

Pringle, P. 2003. *Food, Inc.* New York: Simon & Schuster.

Project Syndicate. 2010. *Responsibly Destroying the World's Peasantry* http://www.project-syndicate.org/commentary/responsibly-destroying-the-world-s-peasantry (accessed August 22, 2011.)

Radford Ruether, R. 1993. Ecofeminism: Symbolic and Social Connections of the Oppression of Women and the Domination of Nature. In *Ecofeminism and the Sacred*, ed. C. J. Adams. New York: Continuum.

Reitzes, M. 1993. Ideology as Science: Some Methodological Considerations Concerning Positivism and Policy Options in South Africa. *Politikon* vol. 20, nr. 1, June.

RAI. 2011. *Responsible Agro-Investment, Principles for Responsible Agricultural Investment that Respects Rights, Livelihoods and Resources* https://www.responsibleagroinvestment.org/node/256 (accessed, August 22, 2011.)

Rist, G. 1997. *The History of Development: From Western Origins to Global Faith*. London and New York: Zed Books.

Rowe, D. 1994. *Breaking the Bonds: Understanding Depression, Finding Freedom*. London: Harper Collins.

Schumacher, E. F. 1993. *Small Is Beautiful: A Study of Economics as if People Mattered*. London: Vintage.

Seabrook, J. 1993. *Pioneers of Change: Experiments in Creating a Humane Society*. Philadelphia: New World Publishers.

Shah, A. 2009b. *Today, Over 25,000 Children Died Around the World*. http://www.globalissues.org/article/715/today-21000-children-died-around-the-world (accessed December 26, 2009.)

Shandilya, R. 2007. *Facts about Water Pollution.* http://www.buzzle.com/articles/facts-about-water-pollution.html (accessed December 30, 2009.)

Shiva, V. 1989. *Staying Alive: Women, Ecology, and Development*. London: Zed Books.

Shiva, V. 1994b. The Seed and the Earth: Biotechnology and the Colonisation of Regeneration. In *Close to Home: Women Reconnect Ecology, Health, and Development Worldwide,* ed. V. Shiva. Philadelphia: New Society Publishers.

SRFood. 2010. *Report submitted by the Special Rapporteur on the right to food, Olivier De Schutter*. http://www.srfood.org/ or http://www2.ohchr.org/english/issues/food/docs/A-HRC-16-49.pdf (accessed August 11, 2011.)

Tadria, H. M. 1997. Poverty and Gender in Africa. In *A New Partnership for African Development*, eds. H. Kifle, A. O. Olukoshi, and L. Wohlgemuth. Uppsala: Nordiska Africainstitutet.

Triple Pundit. 2010. *Profit Trends in Organic Food Markets*. http://www.triplepundit.com/2010/09/profit-trends-in-organic-food-markets/ (accessed February 28, 2011.)

UCS. 2009. *Genetic Engineering Has Failed to Significantly Boost U.S. Crop Yields despite Biotech Industry Claims.* http://www.ucsusa.org/news/press_release/ge-fails-to-increase-yields-0219.html (accessed April 14, 2009.)

Ullrich, O. 1993. Technology. In *The Development Dictionary*, ed. W. Sachs. Johannesburg: Witwatersrand.

UNEP see United Nations Environmental Programme.

UNICEF see United Nations Childrenôs Fund.

United Nations Childrenôs Fund. 2008. *Annual Report.* http://www.unicef.org/publications/ index.html (accessed December 25, 2009.)

United Nations Environmental Programme. 2002. *Chemicals, Strengthening UNEP, and Modernizing the World's Environmental Machinery, Key Issues at Global Environment Talks.* http://www.unep.org/Documents.multilingual/Default.asp?DocumentID=233&ArticleID=2997&l=en (accessed December 30, 2009.)

Veith, I. 2002. *The Yellow Emperor's Classic of Internal Medicine*. Huang ti nei ching su wên. Translated from Chinese by I. Veith. Berkeley: University of California Press.

Warren, K. J. ed. 1996. *Ecological Feminist Philosophies*. Bloomington: Indiana University Press.

Warren, K. J. 1997. Taking Empirical Data Seriously: An Ecofeminist Philosophical Perspective. In *Ecofeminism: Women, Culture, Nature*, ed. K. J. Warren. Bloomington and Indianapolis: Indiana University Press.

Warren, K. J. 2000. *Ecofeminist Philosophy: A Western Perspective on What It Is and Why It Matters*. Lanham: Rowman and Littlefield.

Wells, B. and D. Wirth. 1997. Re-mediating Development through an Ecofeminist Lens. In *Ecofeminism: Women, Culture, Nature*, ed. K. J. Warren. Bloomington and Indianapolis: Indiana University Press.

Wilhelm, H. and R. Wilhelm. 1995. *Understanding the I Ching: The Wilhelm Lectures on the Book of Change*. Princeton: Princeton University Press.
Worldometers. 2009. *Toxic Chemicals Released by Industries this Year* http://www.worldometers.info/view/toxchem/ (accessed December 30, 2009.)

Observe: some figures used here have been changed and updated over time; new figures may therefore differ from those stated in this article. However, those stated were the figures at the time of writing this article.

Explanations of Concepts

1) Hybridization (or hybrid plants) refers to a cross between a wild plant and a cultivated variety, done in order to improve a quality in the cultivated plant, resulting in what is called ñhybrid vigor.ò This has been done by traditional breeders for thousands of years. However, by introduction of scientific agriculture, hybridization became more sophisticated. Hybrids are made by artificial cross breeding between two plant varieties that has been inbred and fertilized with their own pollen for three or four generations. This gives a high vigor, increasing yields up to 50 percent. Yet, this hybrid vigor only lasts for one generation. Thus, when the hybrid plant is naturally fertilized in a farmerôs field, the gene pool is again mixed up and the vigor of the hybrid progressively declines in successive generations. Hence, in order to maintain bigger yields, farmers must buy hybrid seeds for every planting season. This means that plant breeding and seed selection has changed from being a traditional activity of the farmer, to become an industrial activity, done for profit making. Moreover, it decreased the number of varieties of plants to only a few hybrids, a uniformity that has made the plants vulnerable. (Pringle 2003, 45-46, 174.)

2) Genetic engineering (GE) or bio-technology, which is producing genetic modified organisms (GMO) or plants, is an even more sophisticated plant breeding method. GE includes a set of techniques for isolating, modifying, multiplying, and recombining genes from different organisms. It enables geneticists to transfer genes between species belonging to different kingdoms that would have no probability of interbreeding in nature. Thus, they can transfer a fish gene to a tomato or a human gene to a sheep. The transfer of the alien gene is done by a complex process using promoters or vectors, normally in the form of bacteria or virus. (Ho 1998, 19.)

3) Induction is a process of reasoning by which a general conclusion is drawn from a set of particular premises, based mainly on experience or on experimental evidence. It is an inference from specific premises to a general conclusion. Inductive inference is characterized as one, whose conclusion, while not following deductively from its premises, in some way is supported by them or rendered plausible. (Honderich 1995, 405.)

4) Deduction is a process of reasoning by which a particular conclusion necessarily follows from a given set of premises; it is deduction when one goes from general premises to a specific conclusion. (Honderich 1995, 181.)