DOWNLOAD PDF GENETIC RESOURCES AND SUSTAINABLE AGRICULTURE

Chapter 1 : Genetic resources | FAO | Food and Agriculture Organization of the United Nations

Genetic resources for food and agriculture are the raw materials upon which the world relies to improve the productivity and quality of crops, livestock, forestry and fisheries, as well as to maintain healthy populations of wild species. The conservation and sustainable use of genetic resources for.

Dung used as fertilizer Draught Power Diversity also allows the flexibility to change breeding goals if needed and emphasize alternative traits in response to changes in markets or other conditions. For example the Holstein Friesian Cow which is widely used for its whole milk production. Changes in cereal feed availability or demand for low-solid content milk may decrease the advantage of breeding Holstein cows. Different breeds produce specific wool , hairs and leather for clothing, carpets and furniture and are often the basis for traditional garments. Local breeds that were developed by a given community often have a huge cultural significance for that community. Livestock are often a source of wealth and are critical for its maintenance. They appear frequently in art and often play key roles in traditional customs, such as religious ceremonies, sporting events and weddings. Cultural ecosystem services also create significant economic opportunities in fields such as tourism including, in the context of food and agriculture, farm holidays and visits to areas with historical or scenic farming or forest landscapes and recreational hunting. Breeds that have been developed primarily through natural selection have effectively evolved with their environments and usually provide ecosystem services , such as landscape management, vegetation control, and promotion of biodiversity, that are critical for maintaining those landscapes. Having access to a range of diverse livestock traits may allow for greater ability to cope with harsh climates and emerging diseases. Animals with unique adaptive abilities, such as resistance or tolerance to diseases and pests, or ability to thrive on poor feed and cope with dry or hot climates can help humans be more resilient to changes in climate. Within breeds, greater genetic diversity allows for continued selection for improving a given trait, such as disease resistance. Values of animal genetic resources[edit] "From a formal economic perspective, AnGR can have various different types of value for conservation. These values can be categorized as follows Direct use value â€" results from benefits obtained from the utilization of animal genetic resources, such as the production of milk or meat. Indirect use value â€" results from the provision of support or protection to other activities that produce benefits, such as through the provision of regulating and supporting ecosystem services e. Option value â€" results from the potential benefits of having a given resource available for the future; for example, having genetic variability available that can be used to respond to market and environmental changes. Bequest value â€" results from benefits that might be obtained from the knowledge that others may derive benefits from the animal genetic resource in the future. Existence value â€" results only from the satisfaction of knowing that a given animal genetic resource exists, even if no other type of value can be derived from it. Increasing the direct use value will contribute to the economic sustainability of a breed and therefore to the potential for successful conservation activities. Changes in climate will affect livestock and food production in many ways. For example, parts of Madagascar and Mozambique are predicted to have a drier than average rainy season, while just north in parts of central Africa, a wetter Decemberâ€"January season is expected. Although many diverse species and breeds of animals are currently available for food and agricultural production, there is more work to be done on classifying their risk of extinction: Nearly livestock breeds have gone extinct between and Unlike plants, which can be easily conserved in seed banks, a large portion of livestock genetic diversity relies on live populations and their interactions with the environment. Progress is being made in the characterization and management of animal genetic resources for food and agriculture. Recent advances in molecular genetics have provided data on the history and current status of animal genetic resources. Genetic markers and molecular studies are being used to characterize livestock diversity and to reconstruct the events that have shaped the present diversity patterns, including ancestry, prehistoric and historical migrations, admixture , and genetic isolation. In , six years after the completion of the human genome project, cattle became one of the first livestock species to have a fully mapped genome. Additionally, breeds with well-defined and appreciated traits tend to be inbred and have low genetic diversity, while non-descript local populations tend to have high molecular genetic diversity. Advances in molecular genetics have provided us with tools to better understand livestock origin and diversity. There are many technologies capable of determining genetic profiles, including whole genome sequencing , shotgun sequencing , RNA sequencing and DNA microarray analysis. These techniques allow us to map genomes and then analyze their implications through bioinformatics and statistical analysis. Molecular genetic studies, especially genome-wide association studies and whole-genome sequencing allow adaptive traits to be linked to genomic regions, genes, or even mutations. For example, horn size, meat quality, gait, and prenatal growth in cattle all have single genes found to be responsible for these phenotypic traits. However, DNA polymorphisms that are not linked to specific traits are now more commonly used as markers for genetic diversity studies. Different levels of genetic diversity information can be obtained from different kinds of genetic markers. For example, autosomal polymorphisms are used for population diversity estimates, estimation of genetic relationships and population genetic admixture , whereas mitochondrial DNA polymorphisms are used to detect geographic regions of domestication, [27] reconstructing migration routes and the number of female founders. Systems range from completely human-controlled to wild. They differ in terms of animal management, animal treatment, environmental impact, and market infrastructure. Intensive Chicken Farming Industrial livestock production Industrial livestock production or intensive animal farming employs large-scale, principally landless systems. The animals are separated from the land where their feed is produced, and their environment is highly controlled by management interventions. Since a vast majority of consumers demand low-cost products, industrial livestock production has become common. However, there are several issues with industrial livestock production systems including disease, antibiotic use and ethical animal treatment. Living in densely packed cages or small spaces makes animals more prone to disease transmission from one animal to another. Small-scale livestock production Small-scale livestock production entails less intensive production cycles, access to outdoors or pasture, typically judicious use of antibiotics, and a connection to local niche markets. This type of livestock production can be maintained in peri-urban and rural settings. There are advantages and disadvantages to each. While it is more difficult and costly to find land for livestock in peri-urban settings, incorporating livestock to small-scale farms can greatly increase the local food supply, reduce garden waste, and provide manure. Peri-urban environments can also provide excellent foraging for bees , with less exposure to the pests , diseases , and even pesticides that can be devastating to a colony. However, access to formal markets, both to acquire inputs and to sell outputs, is critical for economic sustainability. Close rural-urban linkages are important to overcome constraints of feed scarcity and to better utilize the advantages of each system. Mixed farming Mixed farming systems involves livestock keeping integrated with other agricultural activities. These systems are similar to small-scale systems, but tend to be in a more rural setting, given the need for larger tracts of land for crop production. As with small-scale livestock production, access to formal markets is critical. Ranching or grass-based production These systems revolve around access to privately owned or rented grasslands, which the ruminant livestock feed on. In general, the livestock keeper has a fixed home and animals move around the property as needed to obtain freshly grown grass. Pastoralism Pastoralism Pastoralism plays an important role in livestock management and food security, since pastoralists can produce food where no crops can grow. This system usually relies entirely on publicly-owned grasslands. Pastoralists move their livestock herds based on the season, which is also known as transhumance. Nomadic pastoralists follow an irregular pattern of movement. Current issues that pastoralists face include conflict over land rights, access to water, limited food resources, integration into global markets, and animal diseases. Climate change has been believed to harm pastoralists, but evidence suggests that the root causes of land disputes are historical and political, rather than climate-related. Conservation of animal genetic resources[edit] For some breeds, opportunities for sustainable use are limited. For such breeds, to ensure that their critical genetic diversity is not lost, conservation programs are required. Several approaches for conservation can be applied, including in situ conservation with live animal populations, and ex situ conservation or cryoconservation involving the freezing of genetic materials. In many instances, both of these approached are used in a complementary manner. In order to establish and strengthen these programs, more research on methods and technologies must be undertaken, especially for less common livestock species, and greater financial investment is required. Many countries are currently operating conservation programs for their animal genetic resources, at least for some species and breeds. In situ conservation programs are the most commonly used approach. With this knowledge it can make recommendations and advise the Commission on these matters, and consider progress resulting from proposed interventions. In , the GPA was adopted by countries as the first agreed international framework for the management of livestock biodiversity. The funding for this program arrives from a wide range of actors, under the guidelines of the Funding Strategy for the Implementation of the Global Plan of Action for Animal Genetic Resources. The Nagoya Protocol entered into force on 12 October and aims to provide a legal framework for the fair and equitable distribution of benefits arising from the utilization of all genetic resources, including animal genetic resources for food and agriculture. Number of plant and animal genetic resources for food and agriculture secured in either medium or long term conservation facilities. Proportion of local breeds, classified as being at risk, not at risk or unknown level of risk of extinction. Lack of adequate policies can lead to the insufficient capacity to manage AnGRs, further a loss of genetic diversity and marginalization of relevant stakeholders, such as pastoralists , who are valuable players in maintaining livestock diversity. To help regulate the ownership of genetic resources and control their utilization is one example where policies are necessary. Patenting of genetic resources is one approach that has been applied. Patenting of animal genetic resources reached its apex in the late s, focusing on expressed sequence tags ESTs and single nucleotide polymorphisms SNPs with associations in economically important traits. SNPs are important in marker-assisted breeding for the identification of traits such as meat or milk quality. At the same time, patenting activity involving transgenic livestock also increased. However, work on patents and characterization of AnGR declined sharply from , caused by a combination of factors including an increasingly restrictive approach to the patentability of DNA sequences by patent offices and a lack of markets for food products from transgenic animals. Increasingly complex issues are emerging that require balancing the interests of many stakeholders. In a time of rapid and unregulated change, livestock and their products should be used sustainably, developed and ultimately conserved. National planning should integrate "consumer affairs, human health matters, and the management of new biotechnologies, as well as physical and spatial planning of animal production in the context of urban expansion and protected areas.

Chapter 2 : International Treaty on Plant Genetic Resources for Food and Agriculture - Wikipedia

There is an urgent need to halt the loss of agricultural biodiversity. Food security and nutrition policies must include and address the sustainable use and conservation of genetic resources for food and agriculture.

The Fifth Session achieved: Civil Society including NGOs e. However, the IU was reliant on the principle of genetic resources being the common heritage of humanity. However, the CBD recognised the special and distinctive nature of agricultural genetic resources: Subsequently, the IU was renegotiated, to bring it in harmony with the CBD, and was renamed as a treaty. An account of the long process to achieve the treaty called Negotiating the Seed Treaty can be found at [1]. It was subject to ratification, acceptance or approval Article 26 , by all members. The International Treaty on Plant Genetic Resources for Food and Agriculture was open to accession a year after adoption and once closed to signatures Article 27 , i. In accordance with Article 28, the treaty entered into force on the ninetieth day after the deposit of the fortieth instrument of ratification, acceptance, approval or accession, provided that at least twenty instruments of ratification, acceptance, approval or accession have been deposited by Members of FAO. Having reached the required number of instruments in order for the treaty to enter into force 40 on 31 March , on which date 13 instruments including the European Union were deposited with the Director-General of FAO, the date of entry into force was on 29 June Discussion[edit] Plant genetic resources are essential to a sustainable agriculture and food security. FAO estimates humans have used some 10 species for food throughout history. Critics say many of the central issues are unresolved or open to interpretation. Some of the points raised are: The first group of 11 projects funded by the treaty was announced during the Third Session of the Governing Body in Tunis in June The projects were funded according to criteria established by the Governing Body including regional balance: The ranking of the projects was done by a Group of Experts nominated by the 7 regional representatives of the Bureau and the final approval was done by the Bureau on behalf of the Governing Body. Soya, sugar cane, oil palm and groundnut are among important crops missing from the list in Annex 1. The treaty came into force on 29 June at which time there were more than 54 ratifications by countries. An article prepared on the occasion of the treaty becoming law is posted at [2]. From the entry into force, countries that previously signed are allowed to ratify the treaty, while countries that did not sign the treaty before it came into force can also accede to it. Participating countries[edit] There are contracting parties to the Treaty states and the European Union as of September As people ventured forth, looking for new lands, their seeds were part of their diasporas. As a result, we now live in a world in which not one country can be considered self-sufficient in terms of being able to survive solely on crops indigenous within its borders. The Treaty facilitates the continued open exchange of food crops and their genetic materials. The Forages are also divided in legume forages and grass forages. They were selected taking into account the criteria of food security and country interdependence.

Chapter 3 : What is sustainable agriculture? â€” UC SAREP

The path toward a future sustainable agriculture lies in harnessing the best of all agricultural technologies, including the use of genetically engineered seed, within the framework of ecological farming.

Abstract The United States and the world face serious societal challenges in the areas of food, environment, energy, and health. Historically, advances in plant genetics have provided new knowledge and technologies needed to address these challenges. Plant genetics remains a key component of global food security, peace, and prosperity for the foreseeable future. Millions of lives depend upon the extent to which crop genetic improvement can keep pace with the growing global population, changing climate, and shrinking environmental resources. While there is still much to be learned about the biology of plantâ€"environment interactions, the fundamental technologies of plant genetic improvement, including crop genetic engineering, are in place, and are expected to play crucial roles in meeting the chronic demands of global food security. However, genetically improved seed is only part of the solution. Such seed must be integrated into ecologically based farming systems and evaluated in light of their environmental, economic, and social impactsâ€"the three pillars of sustainable agriculture. In this review, I describe some lessons learned, over the last decade, of how genetically engineered crops have been integrated into agricultural practices around the world and discuss their current and future contribution to sustainable agricultural systems. THE number of people on Earth is expected to increase from the current 6. Because the amount of arable land is limited and what is left is being lost to urbanization, salinization, desertification, and environmental degradation, it no longer possible to simply open up more undeveloped land for cultivation to meet production needs. Another challenge is that water systems are under severe strain in many parts of the world. The fresh water available per person has decreased fourfold in the past 60 years United Nations Environmental Programme Thus, increased food production must largely take place on the same land area while using less water. Compounding the challenges facing agricultural production are the predicted effects of climate change Lobell et al. As the sea level rises and glaciers melt, low-lying croplands will be submerged and river systems will experience shorter and more intense seasonal flows, as well as more flooding Intergovernmental Panel on Climate Change In addition to these environmental stresses, losses to pests and diseases are also expected to increase. For this reason, a reduction in losses to pests, pathogens, and environmental stresses is equivalent to creating more land and more water. Thus, an important goal for genetic improvement of agricultural crops is to adapt our existing food crops to increasing temperatures, decreased water availability in some places and flooding in others, rising salinity, and changing pathogen and insect threats World Bank ; Gregory et al. Such improvements will require diverse approaches that will enhance the sustainability of our farms. These include more effective land and water use policies, integrated pest management approaches, reduction in harmful inputs, and the development of a new generation of agricultural crops tolerant of diverse stresses Somerville and Briscoe These strategies must be evaluated in light of their environmental, economic, and social impactsâ€"the three pillars of sustainable agriculture Committee on the Impact of Biotechnology on Farm-Level Economics and Sustainability and National Research Council This review discusses the current and future contribution of genetically engineered crops to sustainable agricultural systems. Genetic engineering differs from conventional methods of genetic modification in two major ways: In contrast, most conventional methods of genetic modification used to create new varieties e. Conventional modification can in some cases transfer genes between species, such as wheat and rye or barley and rye. Half of the increase will be crops designed for domestic markets from national technology providers in Asia and Latin America. After 14 years of cultivation and a cumulative total of 2 billion acres planted, no adverse health or environmental effects have resulted from commercialization of genetically engineered crops Board on Agriculture and Natural Resources, Committee on Environmental Impacts Associated with Commercialization of Transgenic Plants, National Research Council and Division on Earth and Life Studies These and other recent reports conclude that the processes of genetic engineering and conventional breeding are no different in terms of unintended consequences to human health and the environment European Commission Directorate-General for Research and Innovation This is not to say that every new variety will be as benign as the crops currently on the market. This is because each new plant variety whether it is developed through genetic engineering or conventional approaches of genetic modification carries a risk of unintended consequences. Whereas each new genetically engineered crop variety is assessed on a case-by-case basis by three governmental agencies, conventional crops are not regulated by these agencies. Still, to date, compounds with harmful effects on humans or animals have been documented only in foods developed through conventional breeding approaches. For example, conventional breeders selected a celery variety with relatively high amounts of psoralens to deter insect predators that damage the plant. Some farm workers who harvested such celery developed a severe skin rashâ€"an unintended consequence of this breeding strategy Committee on Identifying and Assessing Unintended Effects of Genetically Engineered Foods on Human Health and National Research Council Some are already in use and have achieved brilliant success. Others are in the stage of laboratory testing. Still others are little more than ideas in the minds of imaginative scientists, waiting for the opportunity to put them to the test. All have this in common: Specialists representing various areas of the vast field of biology are contributingâ€"entomologists, pathologists, geneticists, physiologists, biochemists, ecologistsâ€"all pouring their knowledge and their creative inspirations into the formation of a new science of biotic controls. Carson , p. This is one reason some of the first genetically engineered crops were designed to reduce reliance on sprays of broad-spectrum insecticides for pest control. Corn and cotton have been genetically engineered to produce proteins from the soil bacteria Bacillus thuringiensis Bt that kill some key caterpillar and beetle pests of these crops. Bt toxins cause little or no harm to most nontarget organisms including beneficial insects, wildlife, and people Mendelsohn et al. Bt crops produce Bt toxins in most of their tissues. These Bt toxins kill susceptible insects when they eat Bt crops. This means that Bt crops are especially useful for controlling pests that feed inside plants and that cannot be killed readily by sprays, such as the European corn borer Ostrinia nubilalis , which bores into stems, and the pink bollworm Pectinophora gossypiella , which bores into bolls of cotton. First commercialized in , Bt crops are the second most widely planted type of transgenic crop. The genes encoding hundreds of Bt toxins have been sequenced Crickmore Most of the Bt toxins used in transgenic crops are called Cry toxins because they occur as crytalline proteins in nature Carriere et al. More recently, some Bt crops also produce a second type of Bt toxin called a vegetative insecticidal protein Carriere et al. Bt toxins in sprayable formulations were used for insect control long before Bt crops were developed and are still used extensively by organic growers and others. The long-term history of the use of Bt sprays allowed the Environmental Protection Agency and the Food and Drug Administration to consider decades of human exposure in assessing human safety before approving Bt crops for commercial use. In addition, numerous toxicity and allergenicity tests were conducted on many different kinds of naturally occurring Bt toxins. These tests and the history of spraying Bt toxins on food crops led to the conclusion that Bt corn is as safe as its conventional counterpart and therefore would not adversely affect human and animal health or the environment European Food Safety Authority Planting of Bt crops has resulted in the application of fewer pounds of chemical insecticides and thereby has provided environmental and economic benefits that are key to sustainable agricultural production. Although the benefits vary depending on the crop and pest pressure, overall, the U. Fewer insecticide treatments, lower costs, and less insect damage led to significant profit increases when pest pressures were high Fernandez-Cornejo and Caswell When pest pressures are low, farmers may not be able to make up for the increased cost of the genetically engineered seed by increased yields. A recent study indicates that the economic benefits resulting from Bt corn are not limited to growers of the genetically engineered crop Hutchison et al. This is because area-wide suppression of the primary pest, O. These data confirm the trend seen in some earlier studies indicating that communal benefits are sometimes associated with planting of Bt crops Carriere et al. Planting of Bt crops has also supported another important goal of sustainable agriculture: An analysis of 42 field experiments indicates that nontarget invertebrates i.

Benefits of Bt crops have also been well-documented in less-developed countries. For example, Chinese and Indian farmers growing genetically engineered cotton or rice were able to dramatically reduce their use of insecticides Huang et al. In a study of precommercialization use of genetically engineered rice in China, these reductions were accompanied by a decrease in insecticide-related injuries Huang et al. This study also indicated a slight increase in insecticide use on all cotton fields from to Although Bt cotton has effectively controlled its primary target pest in China the cotton bollworm Helicoverpa armigera , reduced use of broad-spectrum insecticides has apparently increased the abundance of some pests that are not killed by Bt cotton Wu et al. In particular, mirids, which are hemipteran insects not targeted by Bt cotton, have become more serious pests in China Lu et al. These results confirm the need to integrate Bt crops with other pest control tactics Tabashnik et al. Mirids such as the Lygus bug Lygus hesperus are controlled with a feeding inhibitor, and the sweet potato whitefly Bemisia tabaci is controlled with insect growth regulators Naranjo and Ellsworth One limitation of using any insecticide, whether it is organic, synthetic, or genetically engineered, is that insects can evolve resistance to it. For example, one crop pest, the diamondback moth Plutella xylostella , has evolved resistance to Bt toxins under open field conditions. This resistance occurred in response to repeated sprays of Bt toxins to control this pest on conventional nongenetically engineered vegetable crops Tabashnik Partly on the basis of the experience with the diamondback moth and because Bt crops cause a season-long exposure of target insects to Bt toxins, some scientists predicted that pest resistance to Bt crops would occur in a few years. However, global pest monitoring data suggest that Bt crops have remained effective against most pests for more than a decade Tabashnik et al. Nonetheless, after more than a dozen years of widespread Bt crop use, resistance to Bt crops has been reported in some field populations of at least four major species of target pests Bagla ; Carriere et al. The theory underlying the refuge strategy is that most of the rare resistant pests surviving on Bt crops will mate with abundant susceptible pests from refuges of host plants without Bt toxins. If inheritance of resistance is recessive, the hybrid offspring produced by such matings will be killed by Bt crops, markedly slowing the evolution of resistance. In cases where resistance to Bt crops has evolved quickly, one or more conditions of the refuge strategy have not been met. For example, resistance occurred rapidly to the Bt toxin Cry1Ac in transgenic cotton in U. In other words, the concentration of Cry1Ac in Bt cotton was not high enough to kill the hybrid offspring produced by matings between susceptible and resistant H. In a related case, failure to provide adequate refuges of non-Bt cotton appears to have hastened resistance to this same type of Bt cotton by pink bollworm in India Bagla In contrast, Arizona cotton growers complied with this strategy from to , and no increase in pink bollworm resistance occurred Tabashnik et al. In the United States, Bt cotton producing only Cry1Ac is no longer registered and has been replaced primarily by Bt cotton that produces two toxins Carriere et al. More generally, most newer cultivars of Bt cotton and Bt corn produce two or more toxins. These multi-toxin Bt crops are designed to help delay resistance and to kill a broader spectrum of insect pests Carriere et al. For example, a new type of Bt corn produces five Bt toxinsâ€"three that kill caterpillars and two that kill beetles Dow Agrosciences Despite the success of the refuge strategy in delaying insect resistance to Bt crops, this approach has limitations, including variable compliance by farmers with the requirement to plant refuges of non-Bt host plants. An alternative strategy, where refuges are scarce or absent, entails release of sterile insects to mate with resistant insects Tabashnik et al. The success of such creative multidisciplinary integrated approaches, involving entomologists, geneticists, physiologists, biochemists, and ecologists, provides a roadmap for the future of agricultural production and attests to the foresight of Rachel Carson. One method to control weeds is to spray herbicides that kill them. Many of the herbicides used over the past 50 years are classified as toxic or slightly toxic to animals and humans classes I, II, and III. Some newer herbicides, however, are considered nontoxic class IV. An example of the latter, the herbicide glyphosate trade name Roundup , is essentially a modified amino acid that blocks a chloroplast enzyme [called 5-enolpyruvoyl-shikimatephosphate synthetase EPSPS] that is required for plant, but not animal, production of tryptophan. Glyphosate has a very low acute toxicity, is not carcinogenic, and breaks down quickly in the environment and thus does not persist in groundwater. Some crop plants have been genetically engineered for tolerance to glyphosate. In these herbicide-tolerant crops, a gene, isolated from the bacterium Agrobacterium encoding an EPSPS protein resistant to glyphosate, is engineered into the plant. Growers of herbicide-tolerant crops can spray glyphosate to control weeds without harming their crop.

Chapter 4 : Animal genetic resources for food and agriculture - Wikipedia

Resources cited above: Clive A. Edwards, Rattan Lal, Patrick Madden, Robert H. Miller, and Gar House, editors, Sustainable Agricultural Systems (Soil and Water.

Industrial Agriculture US policy changes shifted agriculture towards ever more consolidation and industrialization. But there are sustainable alternatives that are gaining ground. The industrialization of agriculture began after World War II, as a way of addressing global hunger and making the food supply more efficient and safe. The global shift towards this model of farming in the last sixty years has come with many costs. Industrialized agriculture is highly concentrated and mechanized, relying on chemical inputs like fertilizers, pesticides and non-therapeutic antibiotics. However, sustainable agriculture, which uses methods that protect the environment, public health, human communities and animal welfare, is gaining traction. How Was Agriculture Industrialized? The US has always been a nation quick to embrace technology and industrialization. As farms and fields were consolidating and expanding, farming methods changed too, moving towards specialization, mechanization and ever-increasing reliance on fossil fuels. Tractors and other equipment got bigger; chemical fertilizers revolutionized crop yields; improved irrigation forced dry areas into production; animals were moved into controlled confinement; and seed genes began to be spliced. The Impacts of Industrial Agriculture The rationale for the industrialization of agriculture was the need to ensure a cheap, safe food supply for a rapidly growing US and world population. In some ways, that goal has been met: Americans spend just 6. On the other hand, industrial agriculture has not solved hunger, either worldwide â€" where million people one in nine are undernourished 5 â€" or in the US, where nearly 16 million Without a broad base of farmers, rural economies in the US have been hollowed out, which has fed into persistently higher rates of poverty , drug epidemics, 8 and rapidly rising rates of suicide in rural areas. Such externalities â€" for example, cleaning water so that it is drinkable or the cost of treating diabetes â€" amount to very real costs that someone ends up paying for. And more often than not, these costs are paid by the taxpayers, or by communities suffering from the impacts of these problems. Industrial agriculture would not be profitable for agricultural corporations and would not produce food that was so cheap for the consumer if corporations had to pay all of these costs. Animal feed , a key element of industrialized agriculture, is made from corn and soybeans that are cheap for feed companies to purchase owing to government subsidies. A Tufts University study found that the cost advantages of industrial producers would be significantly or entirely eliminated if they had to pay full production cost for their feed. Many states also provide sales tax exemptions for farm supplies, from animal feed to equipment. The exemptions benefit all farmers, but they provide much greater benefit to large, industrialized farms that purchase many more inputs and bigger implements than to smaller, diversified operations. State sales tax exemptions are especially common for the construction and operation of concentrated animal feeding operations CAFOs , including livestock bedding, poultry litter and pollution control â€" which means, in practice, construction and management of manure lagoons. The Sustainable Alternative Industrial agriculture consumes finite resources without replenishing them, including the resources on which it depends. This is the very definition of unsustainable. Sustainable agriculture is regenerative and self-sustaining; it produces its own inputs fertilizer, feed and manages its outputs crop waste, manure in a closed loop cycle and contributes to soil fertility, clean water systems, biodiversity and other ecosystem services, rather than depleting them. There has long been interest in sustainable agriculture, but since the mids traction has been gaining. Benefits of Sustainable Agriculture Environment Truly sustainable farms do not use chemical pesticides, fertilizers or genetically modified seeds. They do not dispose of vast amounts of untreated manure by spreading it in toxic quantities on cropland. They instead grow a diversity of crops, raise animals primarily on pasture and use techniques such as crop rotation, cover cropping, beneficial insects and other non-synthetic methods of pest control and fertilization. These practices increase organic matter in the soil, sequester carbon and support biodiversity. Many sustainable farmers see farming as it fits into their local ecosystem, examining how they can support the complex natural interplay of plants, insects, predators and microorganisms on their farm so that the ecosystem will best ward off pests and disease from their crops. Public Health Without the use of hazardous chemical pesticides, sustainable farms are much safer and healthier for their farmers, workers and surrounding communities, and the food they produce is free of chemical residues. Runoff from manure and other agricultural fertilizer is a significant pollutant in many waterways, but sustainable farming practices do not contribute to this pollution. Further, the high organic matter in the soil of sustainable farms retains more water, leading to less runoff overall. Industrial livestock farming and ranching has dangerous implications for public health, including several practices that generate toxic amounts of untreated waste and the use of non-therapeutic antibiotics, which is breeding and spreading antibiotic resistant pathogens. Sustainable livestock farmers and ranchers raise animals without these practices. Animal Welfare Sustainable farmers and ranchers raise their animals in ways that allow them to graze or forage, move outdoors freely and express natural behaviors, without the stress and illness common in CAFOs. They focus their practices on diminishing as much as possible if not eliminating the pain and suffering that animals experience as they live and are killed through the production process. Pain relief is used for necessary procedures like castration and no unnecessary alterations, like horn removal or tail docking, are used. Concern for the experience of the animals extends through to the slaughtering process. Local Economies and Workers Years ago, independent farms were the backbone of the rural economy, as farmers spent money at local businesses, from the feed store and implement dealer to the coffee shop. As farming has consolidated, with some farms getting much bigger and the rest closing down, the downtown businesses that relied on them have shuttered as well. Because sustainable farms are smaller than their consolidated industrial counterparts, they still purchase goods from local vendors, when they can find them. It is important to note that workers on sustainable farms too often get left out of this equation. For a host of reasons, costs of production are generally higher on these farms than those of large farm operations. They must pass these costs along to the consumer, but there is a limit to what consumers will pay. Even with higher prices, many farms are operating at the narrowest of margins â€" sometimes the farmers are not even paying themselves a salary. How to pay their workers a living wage is a complicated financial question many sustainable farmers wrestle with. Industrial operators are not much better in terms of workers, however. These days, industrial operations like a large CAFO or a meat processing plant attempting to open in a rural community will make promises about jobs; the reality rarely lives up to the hype. Jobs at these operations are inevitably low-wage and without benefits or long-term security, and carry high risks of personal injury. Further, the jobs frequently do not even go to community residents, as operators have found that they can pay migrant workers or immigrants far less for the same work. All too often, this ends up with a community bitter about the tax burden from the influx of new residents, the smell or noise from the facility and the broken job promises, and an immigrant labor force who is underpaid and exploited. The only winner is the corporate operator. This is despite the fact that agricultural production today already produces 2, daily calories for every person on earth 10 â€" enough to feed the population of 10 billion we expect by The fact is that feeding the world is a problem of power , not of calories, and industrial agriculture has concentrated power in an increasingly small number of hands. Additionally, research has shown that various kinds of sustainable agriculture do achieve yields in the range of those obtained by chemical-dependent methods. Depending on the circumstances and crop, sustainable yields have been shown to be equivalent, slightly greater particularly in drought conditions, which is increasingly important as the climate changes , or 15 to 20 percent lower than those of chemical agriculture. A policy based on supply management, which creates a grain reserve a common sense protection against low yield years and a floor price for farmers, would not incentivize fencerow-to-fencerow planting, making it easier for farmers to take marginal lands out of production. A analysis by Dr. The Food from Family Farms Act by the National Family Farm Coalition , is one example of a farm bill proposal to reinstate reserves and fair prices, along with ecologically sustainable planting and a more secure disaster program. There are also ways to put a price tag on externalities. Costa Rica, a country that relies heavily on ecological tourism, developed a system of payments for ecosystem services. It is important to buy sustainably produced food, to demand a different kind of agricultural system. While food grown and raised sustainably is more expensive, ultimately, we would like to see a structure of government incentives and supports that favors these production methods. In the meantime, people who can pay the premium are building the market. Voting with your vote is also important. While food and agriculture are not frequent topics in Washington, DC, in farm states, there are frequent bills introduced in the state legislature on issues such as: Such bills are generally driven by corporate interests and big farm groups that claim to speak for all farmers. But organizations of independent family farmers are partnering with environmental, public health and other groups to fight these bills. At the county, state, federal and institutional level, you can support increased investment in sustainable agriculture research, as well as education for beginning and transitioning farmers. Throughout farm country, there are corn and soybean farmers who would prefer to be growing food more directly for people, but do who not have the knowledge, market, equipment or wherewithal to make a change. Education and incentive programs can help. An Adaptive Plan for Agriculture. Committee on Economic Development. US Government Printing Office. Retrieved April 30, , from http: The State of Food Insecurity in the World Meeting the international hunger targets: US Department of Agriculture n. Food Security in the US: Key Statistics and Graphics. Retrieved April 30, , from https: World Health Organization April Retrieved January 13, , from http: Retrieved May 1, , from https: Part 3, Feeding the World. Retrieved April 26, , from http:

Chapter 5 : Sustainable Agriculture â€“ International Seed Federation

The conservation and sustainable use of genetic resources in agriculture are essential to the sustainable development of agricultural production and of rural areas.

Increased Production Costs A growing movement has emerged during the past two decades to question the role of the agricultural establishment in promoting practices that contribute to these social problems. Today this movement for sustainable agriculture is garnering increasing support and acceptance within mainstream agriculture. Not only does sustainable agriculture address many environmental and social concerns, but it offers innovative and economically viable opportunities for growers, laborers, consumers, policymakers and many others in the entire food system. This page is an effort to identify the ideas, practices and policies that constitute our concept of sustainable agriculture. We do so for two reasons: Because the concept of sustainable agriculture is still evolving, we intend this page not as a definitive or final statement, but as an invitation to continue the dialogue. What is Sustainable Agriculture? A variety of philosophies, policies and practices have contributed to these goals. People in many different capacities, from farmers to consumers, have shared this vision and contributed to it. Despite the diversity of people and perspectives, the following themes commonly weave through definitions of sustainable agriculture: Sustainability rests on the principle that we must meet the needs of the present without compromising the ability of future generations to meet their own needs. Therefore, stewardship of both natural and human resources is of prime importance. Stewardship of human resources includes consideration of social responsibilities such as working and living conditions of laborers, the needs of rural communities, and consumer health and safety both in the present and the future. Stewardship of land and natural resources involves maintaining or enhancing this vital resource base for the long term. A systems perspective is essential to understanding sustainability. The system is envisioned in its broadest sense, from the individual farm, to the local ecosystem, and to communities affected by this farming system both locally and globally. An emphasis on the system allows a larger and more thorough view of the consequences of farming practices on both human communities and the environment. A systems approach gives us the tools to explore the interconnections between farming and other aspects of our environment. Everyone plays a role in creating a sustainable food system. A systems approach also implies interdisciplinary efforts in research and education. This requires not only the input of researchers from various disciplines, but also farmers, farmworkers, consumers, policymakers and others. Making the transition to sustainable agriculture is a process. For farmers, the transition to sustainable agriculture normally requires a series of small , realistic steps. Family economics and personal goals influence how fast or how far participants can go in the transition. It is important to realize that each small decision can make a difference and contribute to advancing the entire system further on the "sustainable agriculture continuum. Finally, it is important to point out that reaching toward the goal of sustainable agriculture is the responsibility of all participants in the system, including farmers, laborers, policymakers, researchers, retailers, and consumers. Each group has its own part to play, its own unique contribution to make to strengthen the sustainable agriculture community. The remainder of this page considers specific strategies for realizing these broad themes or goals. The strategies are grouped according to three separate though related areas of concern: They represent a range of potential ideas for individuals committed to interpreting the vision of sustainable agriculture within their own circumstances. Farming and Natural Resources Back to top. When the production of food and fiber degrades the natural resource base, the ability of future generations to produce and flourish decreases. The decline of ancient civilizations in Mesopotamia, the Mediterranean region, Pre-Columbian southwest U. Water Water is the principal resource that has helped agriculture and society to prosper, and it has been a major limiting factor when mismanaged. Water supply and use. In California, an extensive water storage and transfer system has been established which has allowed crop production to expand to very arid regions. In drought years, limited surface water supplies have prompted overdraft of groundwater and consequent intrusion of salt water, or permanent collapse of aquifers. Periodic droughts, some lasting up to 50 years, have occurred in California. Several steps should be taken to develop drought-resistant farming systems even in "normal" years, including both policy and management actions: The most important issues related to water quality involve salinization and contamination of ground and surface waters by pesticides, nitrates and selenium. Tile drainage can remove the water and salts, but the disposal of the salts and other contaminants may negatively affect the environment depending upon where they are deposited. Temporary solutions include the use of salt-tolerant crops , low-volume irrigation, and various management techniques to minimize the effects of salts on crops. In the long-term, some farmland may need to be removed from production or converted to other uses. Other uses include conversion of row crop land to production of drought-tolerant forages, the restoration of wildlife habitat or the use of agroforestry to minimize the impacts of salinity and high water tables. Another way in which agriculture affects water resources is through the destruction of riparian habitats within watersheds. The conversion of wild habitat to agricultural land reduces fish and wildlife through erosion and sedimentation, the effects of pesticides, removal of riparian plants, and the diversion of water. The plant diversity in and around both riparian and agricultural areas should be maintained in order to support a diversity of wildlife. This diversity will enhance natural ecosystems and could aid in agricultural pest management. Energy Modern agriculture is heavily dependent on non-renewable energy sources, especially petroleum. The continued use of these energy sources cannot be sustained indefinitely, yet to abruptly abandon our reliance on them would be economically catastrophic. However, a sudden cutoff in energy supply would be equally disruptive. In sustainable agricultural systems, there is reduced reliance on non-renewable energy sources and a substitution of renewable sources or labor to the extent that is economically feasible. Air Many agricultural activities affect air quality. These include smoke from agricultural burning; dust from tillage, traffic and harvest; pesticide drift from spraying; and nitrous oxide emissions from the use of nitrogen fertilizer. Options to improve air quality include: Soil Soil erosion continues to be a serious threat to our continued ability to produce adequate food. Numerous practices have been developed to keep soil in place, which include: Enhancement of soil quality is discussed in the next section. Sustainable production practices involve a variety of approaches. Despite the site-specific and individual nature of sustainable agriculture, several general principles can be applied to help growers select appropriate management practices: Selection of site, species and variety Preventive strategies, adopted early, can reduce inputs and help establish a sustainable production system. When possible, pest-resistant crops should be selected which are tolerant of existing soil or site conditions. When site selection is an option, factors such as soil type and depth, previous crop history, and location e. Diversity Diversified farms are usually more economically and ecologically resilient. By growing a variety of crops, farmers spread economic risk and are less susceptible to the radical price fluctuations associated with changes in supply and demand. Properly managed, diversity can also buffer a farm in a biological sense. For example, in annual cropping systems, crop rotation can be used to suppress weeds, pathogens and insect pests. Also, cover crops can have stabilizing effects on the agroecosystem by holding soil and nutrients in place, conserving soil moisture with mowed or standing dead mulches, and by increasing the water infiltration rate and soil water holding capacity. Cover crops in orchards and vineyards can buffer the system against pest infestations by increasing beneficial arthropod populations and can therefore reduce the need for chemical inputs. Using a variety of cover crops is also important in order to protect against the failure of a particular species to grow and to attract and sustain a wide range of beneficial arthropods. Optimum diversity may be obtained by integrating both crops and livestock in the same farming operation. This was the common practice for centuries until the mids when technology, government policy and economics compelled farms to become more specialized. Mixed crop and livestock operations have several advantages. First, growing row crops only on more level land and pasture or forages on steeper slopes will reduce soil erosion. Second, pasture and forage crops in rotation enhance soil quality and reduce erosion; livestock manure, in turn, contributes to soil fertility. Third, livestock can buffer the negative impacts of low rainfall periods by consuming crop residue that in "plant only" systems would have been considered crop failures. Finally, feeding and marketing are flexible in animal production systems. This can help cushion farmers against trade and price fluctuations and, in conjunction with cropping operations, make more efficient use of farm labor. Soil management A common philosophy among sustainable agriculture practitioners is that a "healthy" soil is a key component of sustainability; that is, a healthy soil will produce healthy crop plants that have optimum vigor and are less susceptible to pests. While many crops have key pests that attack even the healthiest of plants, proper soil, water and nutrient management can help prevent some pest problems brought on by crop stress or nutrient imbalance. In sustainable systems, the soil is viewed as a fragile and living medium that must be protected and nurtured to ensure its long-term productivity and stability. Methods to protect and enhance the productivity of the soil include: Regular additions of organic matter or the use of cover crops can increase soil aggregate stability, soil tilth, and diversity of soil microbial life. Efficient use of inputs Many inputs and practices used by conventional farmers are also used in sustainable agriculture. Sustainable farmers, however, maximize reliance on natural, renewable, and on-farm inputs. Equally important are the environmental, social, and economic impacts of a particular strategy. Converting to sustainable practices does not mean simple input substitution. Frequently, it substitutes enhanced management and scientific knowledge for conventional inputs, especially chemical inputs that harm the environment on farms and in rural communities. The goal is to develop efficient, biological systems which do not need high levels of material inputs. Growers frequently ask if synthetic chemicals are appropriate in a sustainable farming system. Sustainable approaches are those that are the least toxic and least energy intensive, and yet maintain productivity and profitability. Preventive strategies and other alternatives should be employed before using chemical inputs from any source. However, there may be situations where the use of synthetic chemicals would be more "sustainable" than a strictly nonchemical approach or an approach using toxic "organic" chemicals. For example, one grape grower switched from tillage to a few applications of a broad spectrum contact herbicide in the vine row. This approach may use less energy and may compact the soil less than numerous passes with a cultivator or mower. Consideration of farmer goals and lifestyle choices Management decisions should reflect not only environmental and broad social considerations, but also individual goals and lifestyle choices. Management decisions that promote sustainability, nourish the environment, the community and the individual. Animal Production Practices Back to top. In the early part of this century, most farms integrated both crop and livestock operations.

Chapter 6 : Plant Genetics, Sustainable Agriculture and Global Food Security

Animal genetic resources for food and agriculture (AnGR) are a subset of genetic resources (defined by the Convention on Biological Diversity as "genetic material of actual or potential value") and a specific element of agricultural biodiversity.

The State of Food Insecurity in the World As the world population continues to grow, much more effort and innovation will be urgently needed in order to sustainably increase agricultural production, improve the global supply chain, decrease food losses and waste, and ensure that all who are suffering from hunger and malnutrition have access to nutritious food. Many in the international community believe that it is possible to eradicate hunger within the next generation, and are working together to achieve this goal. The Zero Hunger Challenge has since garnered widespread support from many member States and other entities. Beyond adequate calories intake, proper nutrition has other dimensions that deserve attention, including micronutrient availability and healthy diets. Inadequate micronutrient intake of mothers and infants can have long-term developmental impacts. Unhealthy diets and lifestyles are closely linked to the growing incidence of non-communicable diseases in both developed and developing countries. The Scaling-Up Nutrition SUN Movement has made great progress since its creation five years ago in incorporating strategies that link nutrition to agriculture, clean water, sanitation, education, employment, social protection, health care and support for resilience. Extreme poverty and hunger are predominantly rural, with smallholder farmers and their families making up a very significant proportion of the poor and hungry. Thus, eradicating poverty and hunger are integrally linked to boosting food production, agricultural productivity and rural incomes. Agriculture systems worldwide must become more productive and less wasteful. Sustainable agricultural practices and food systems, including both production and consumption, must be pursued from a holistic and integrated perspective. Land, healthy soils, water and plant genetic resources are key inputs into food production, and their growing scarcity in many parts of the world makes it imperative to use and manage them sustainably. Boosting yields on existing agricultural lands, including restoration of degraded lands, through sustainable agricultural practices would also relieve pressure to clear forests for agricultural production. Wise management of scarce water through improved irrigation and storage technologies, combined with development of new drought-resistant crop varieties, can contribute to sustaining drylands productivity. Halting and reversing land degradation will also be critical to meeting future food needs. Given the current extent of land degradation globally, the potential benefits from land restoration for food security and for mitigating climate change are enormous. However, there is also recognition that scientific understanding of the drivers of desertification, land degradation and drought is still evolving. There are many elements of traditional farmer knowledge that, enriched by the latest scientific knowledge, can support productive food systems through sound and sustainable soil, land, water, nutrient and pest management, and the more extensive use of organic fertilizers. An increase in integrated decision-making processes at national and regional levels are needed to achieve synergies and adequately address trade-offs among agriculture, water, energy, land and climate change. Given expected changes in temperatures, precipitation and pests associated with climate change, the global community is called upon to increase investment in research, development and demonstration of technologies to improve the sustainability of food systems everywhere. Building resilience of local food systems will be critical to averting large-scale future shortages and to ensuring food security and good nutrition for all.

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Chapter 7 : Genetic resources definition | Biodiversity A-Z

The FAO adopted the International Treaty on Plant Genetic Resources for Food and Agriculture which entered into force on 29 June and calls for the conservation, sustainable use and fair and equitable sharing of benefits arising from genetic resources.

Approximately seventeen percent of livestock breeds face extinction and of the thousands of cultivatable plants species, just thirty produce ninety-five percent of our food-energy. Genetic resources for sustainable food production. Conserving by using agrobiodiversity e. Genetic diversity allows farmers to adapt their produce to climate change and consumer preferences. It also reduces the impact of pests and diseases, provides more nutritious diets, and conserves habitats and soils. FAO hosts the Commission on Genetic Resources for Food and Agriculture and the International Treaty on Plant Genetic Resources for Food and Agriculture, which strive to sustainably use and conserve genetic resources and fairly and equitably share benefits derived from them. The Commission guides the development of State-of-the-World assessments and, in response, agrees on Global Plans of Action. Key policy messages There is an urgent need to halt the loss of agricultural biodiversity. Food security and nutrition policies must include and address the sustainable use and conservation of genetic resources for food and agriculture. Conserving genetic resources for food and agriculture requires complementary policies. The diversity of ecosystems needs to be maintained. Genetic resources need to be conserved in situ i. Policies need to facilitate and, where necessary, actively support the continued and sustainable use of biodiversity and farmers. Breeders and other stakeholders need to participate in making decisions on matters related to the conservation and sustainable use of biodiversity. Cross-sectoral approaches are needed to ensure policies addressing genetic diversity are aligned across sectors. Coordination between Ministries responsible for agriculture, fisheries, forestry, environment, education, economy, trade and social affairs is needed. Policies should be inclusive, involving producer organizations, civil society and the private sector. Research, education and capacity building are needed to increase understanding and awareness of the importance of agricultural biodiversity. Policies should seek to improve scientific knowledge, harness traditional knowledge and effectively communicate the need to utilize and conserve species, breeds and varieties for now and the future. The Sustainable Development Goals SDG highlight the importance of biodiversity, particularly in relation to ending hunger Goal 2 , and preserving life on earth Goal 15 and in oceans Goal

Chapter 8 : Plant Genetic Resources | International Center for Biosaline Agriculture

Download ISF supports a single international regime to govern the development of rules and regulations concerning access to all genetic resources for plant breeding.

Chapter 9 : Sustainable Agriculture vs. Industrial Agriculture | FoodPrint

In Ireland the Department of Agriculture, Food and the Marine has direct responsibility for the coordination and promotion of measures for the conservation and utilisation of genetic resources for food and agriculture. In this task, the Department is aided and advised by an Advisory Committee on Genetic Resources for Food and Agriculture.