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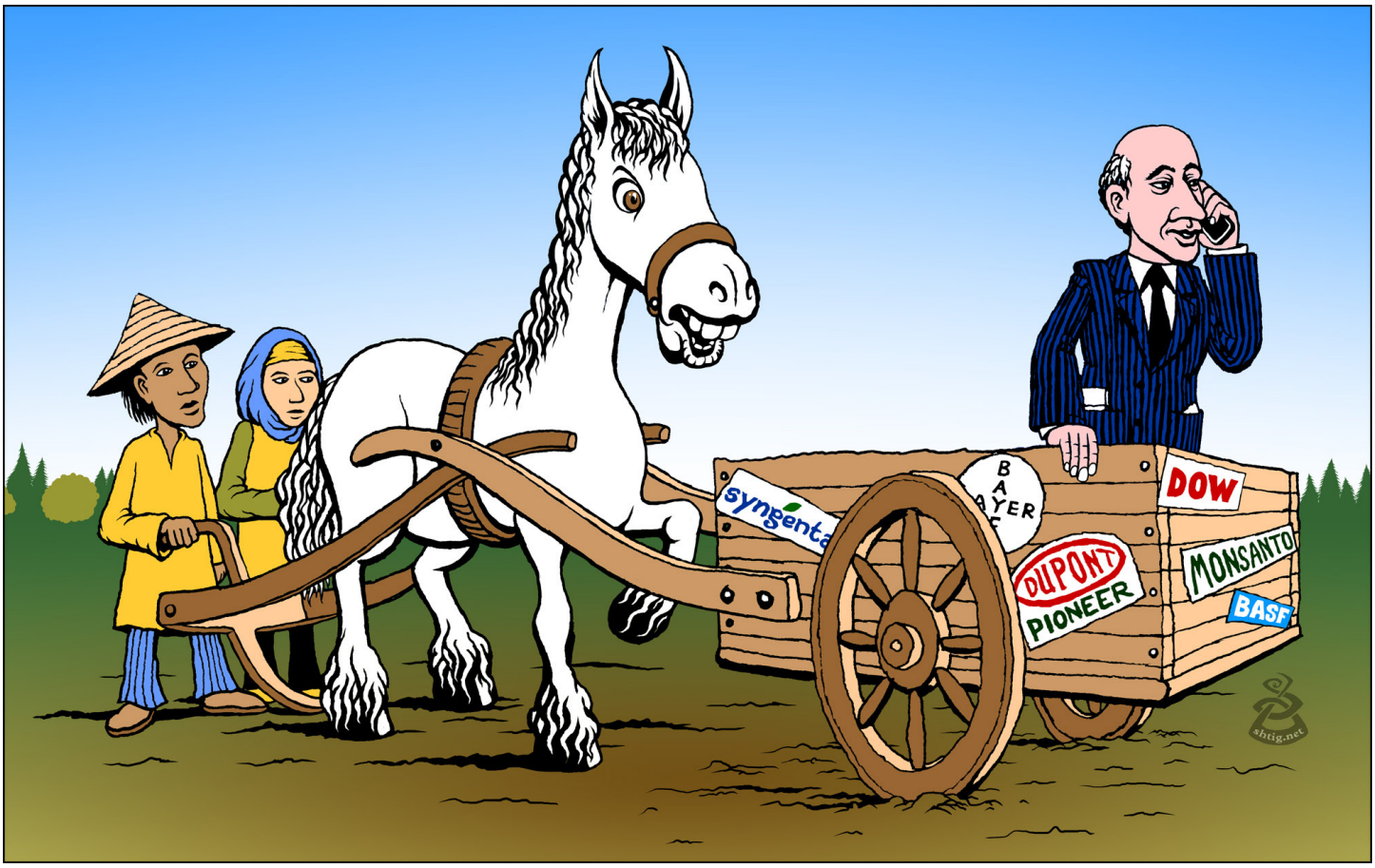
Putting the Cartel before the Horse ...and Farm, Seeds, Soil, Peasants, etc.

Who Will Control Agricultural Inputs, 2013?



In this Communiqué, *ETC Group identifies the major corporate players that control industrial farm inputs. Together with our companion poster,* Who will feed us? The industrial food chain or the peasant food web?, *ETC Group aims to de-construct the myths surrounding the effectiveness of the industrial food system.*

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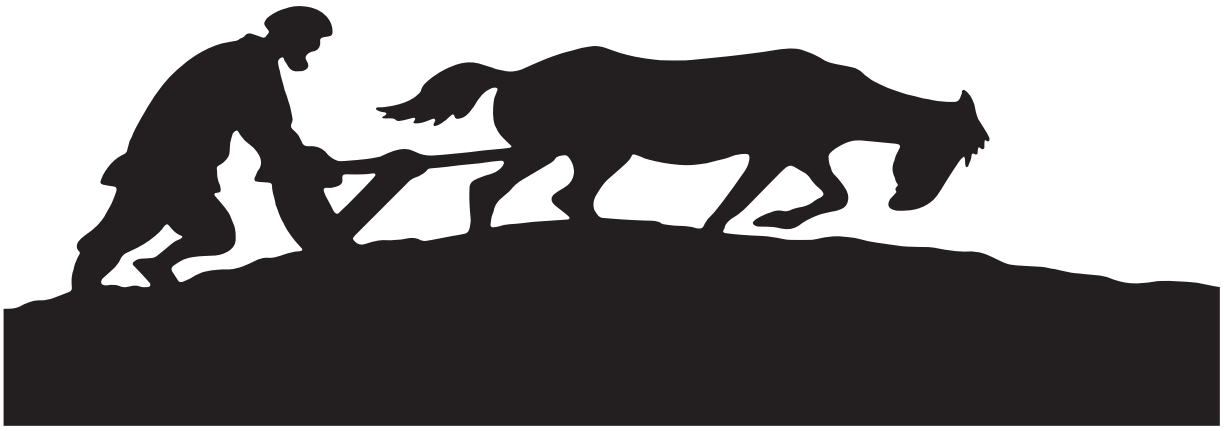


Introduction: 3 Messages

ETC Group has been monitoring the power and global reach of agro-industrial corporations for several decades – including the increasingly consolidated control of agricultural inputs for the industrial food chain: proprietary seeds and livestock genetics, chemical pesticides and fertilizers and animal pharmaceuticals. Collectively, these inputs are the chemical and biological engines that drive industrial agriculture.

This update documents the continuing concentration (surprise, surprise), but it also brings us to three conclusions important to both peasant producers and policymakers…

1. **Cartels are commonplace.** Regulators have lost sight of the well-accepted economic principle that the market is neither free nor healthy whenever 4 companies control more than 50% of sales in any commercial sector. In this report, we show that the 4 firms / 50% line in the sand has been substantially surpassed by all but the complex fertilizer sector. Four firms control 58.2% of seeds; 61.9% of agrochemicals; 24.3% of fertilizers; 53.4% of animal pharmaceuticals; and, in livestock genetics, 97% of poultry and two-thirds of swine and cattle research. More disturbingly, the oligopoly paradigm has moved beyond individual sectors to the entire food system: the same six multinationals control 75% of all private sector plant breeding research; 60% of the commercial seed market and 76% of global agrochemical sales.[1] Some also have links to animal pharmaceuticals. This creates a vulnerability in the world food system that we have not seen since the founding of the UN Food and Agriculture Organization. It's time to dust off national competition / anti-combines policies and to consider international measures to defend global food security.

2. **The "invisible hold" of the market is growing.** For all the talk of the invisible hand of the free market, the market is evermore opaque and far from "free." As the concentration grows, companies are more guarded with their information. Further, the investment companies that analyze markets have also become more concentrated and more proprietary (and their information is more expensive). As the "invisible hold" tightens, it is harder and harder for governments – and more so, peasants – to understand the level of food system control exercised by a handful of multinational enterprises. As a result, ETC's data – in order to be accurate – is dependent upon 2011 figures. Be assured that corporate concentration in these sectors is not receding. Agribusiness must be legally obliged to provide full and timely data on sales and market share.

3. **Climate research shows that we don't know (that) we don't know our food system:** One positive outcome since our last update is that society in general – and governments in particular – are more aware of the threat posed by climate change to global food security. There is now a popular mantra (but not much movement) emphasizing the central importance of smallholder producers in meeting global food requirements in the decades ahead. We couldn't agree more. To help policymakers move from mantra to marching orders, this *Communiqué* is accompanied by a poster contrasting the capacity of the Industrial Food Chain and the Peasant Food Web to address climate chaos. The poster raises 20 genuine questions. It is a work-in-progress. There may be more than one answer to the questions, but the data provides a basis for a fundamental change of mind and shift in policy direction. For some of the reasons cited already, the data policymakers need to make decisions are not always available (or accurate). As the United Nations Framework Convention on Climate Change prepares to receive the fifth assessment report of the Intergovernmental Panel on Climate Change over the coming months, we hope this report and accompanying poster will encourage a much needed constructive debate and complementary research on all of the issues we are raising.

AG INPUT CONSOLIDATION

SEEDS: The world's top three corporations control over half (53%) of the world's commercial seed market; the top 10 control over three-quarters (76%).

PESTICIDES: Just six firms hold 76% of the global agrochemical market. The top ten pesticide companies control almost 95% of the global market.

FERTILIZERS: The top 10 firms control 41% of the global market.

ANIMAL PHARMA: Three companies account for 46% of the global market. The top seven firms – all subsidiaries of multinational drug companies – control 72% of the market.

LIVESTOCK GENETICS: Four global firms account for 97% of poultry genetics R&D (broilers, layers, turkeys). In swine genetics, four companies account for two-thirds of industry R&D worldwide.

Over the past half-century, the corporations that dominate the industrial food system have wrested control of the agricultural R&D agenda while concentrating power and influencing trade, aid and agricultural policies to fuel their own growth. There was cautious hope in the United States that a new era was dawning when, in 2009 – the first year of President Obama's first term – the US Department of Agriculture and the Antitrust Division of the Department of Justice (DOJ) announced a joint investigation into anticompetitive practices in agriculture. The news that Monsanto specifically had been required to turn over internal documents related to seed prices raised the level of optimism. But when the DOJ dropped the Monsanto investigation almost 3 years later without explanation, it was clear that antitrust fervour had fizzled, despite the breathless claims[2] (which happen to be true) that anticompetitive practices in agriculture pose a threat to public health and security.

The argument in favour of "too big to fail" agro-industrial giants rests on a single powerful myth: Unless we intensify food production with the North's genetically-engineered seeds, agrochemicals, synthetic fertilizers and corporate breeding stock, the world's burgeoning population, living in the midst of climate change, will not have food to eat. In reality, the industrial food chain offers a very incomplete (and distorted) picture of global food and agricultural production. ETC Group's companion poster, *Who will feed us? The industrial food chain or the peasant food web?*, sheds much-needed light on the reality of most of the world's food production: the world's 3 billion or so indigenous and peasant producers – rural and urban, fishers and pastoralists – not only feed a majority of the world's people and most of the world's malnourished, but they also create and conserve most of the world's biodiversity and are humanity's best defense against climate change.[3]

The agro-industrial farming system has been spectacularly successful at encouraging uniformity, destroying diversity, polluting soil and water, corroding human health and impoverishing farm labour. By contrast, peasants, indigenous peoples and civil society organizations are building and promoting

alternative food systems based on diversity, democracy and food sovereignty. The peasant food web is largely ignored or invisible to policymakers who grapple with food, farming and climate crises. This must change.

Note: This *Communiqué* does not explicitly address the increasingly prominent role of "synthetic biology" in industrial agriculture or its implications for small producers. Synthetic biology is "extreme genetic engineering" – applying computer-aided design and engineering to living organisms for redesign or for the creation of entirely new ones. The goal is to derive commercially–valuable compounds from novel living organisms rather than from conventional sources (e.g., plants, petroleum). Initially, synthetic biology companies focused on biofuels, but due to problems with scale-up, some companies have shifted focus from biofuels to high-value / lower-volume products – especially compounds found in plants (e.g., essential oils, flavours, fragrances, colourants and pharmaceuticals, which are traditionally cultivated by farming communities in the global South). If commercially viable, synthetic biology's patented organisms have the potential to de-stabilize natural product markets, disrupt trade and eliminate jobs and livelihoods. As part of a *Who Will Control…?* series, ETC Group will publish a study explicitly devoted to synthetic biology and its current and potential impacts on agriculture. Other reports will address the corporate control of food retail and processing, pharmaceuticals, mining and energy, among other sectors.

Seeds

Seeds and the Peasant Food Web: Peasant and indigenous communities have been safeguarding, managing and contributing to the world's seed supply for millennia. In the 1970s and 1980s, institutional plant breeders and scientists widely assumed that traditional crop varieties maintained by peasant communities would rapidly disappear in the wake of the Green Revolution and the introduction of commercial varieties.[4] They were wrong. Today, despite a staggering level of corporate control over the world's commercial seed supply, the vast majority of the world's farmers – the peasant farmers who feed at least 70% of the world's population – are not tied to the corporate seed chain. Peasant and indigenous seed systems continue to be vital in meeting the needs of farming communities. Farmers are actively creating, improving and exchanging their own varieties, including management, use and domestication of wild crop relatives.[5]

Though the situation varies by crop and region, 80% - 90% of the seed planted by farmers in the global South comes from the so-called "informal sector" – that is, farm-saved seeds (including seed exchange with neighbouring farms and seed sales from local markets or seed fairs). Just 10% - 20% of seed requirements in developing countries is met by the "formal sector" – that is, seed companies, government seed sources or other institutions. Recent studies confirm what farming communities already know: the formal seed sector does not have the capacity to supply the diversity needed in sustainable farming systems or to meet the need for locally adapted varieties, especially in the face of climate change.[6]

World's Top 10 Seed Companies, 2011

Rank	Company	Seed Sales, 2011 US$ millions	% Market Share
1.	Monsanto	8,953	26.0
2.	DuPont Pioneer (USA)	6,261	18.2
3.	Syngenta (Switzerland)	3,185	9.2
4.	Vilmorin (France) (Groupe Limagrain)	1,670	4.8
5.	WinField (USA) (Land O Lakes)	1,346 (est.)	3.9
6.	KWS (Germany)	1,226	3.6
7.	Bayer Cropscience (Germany)	1,140	3.3
8.	Dow AgroSciences (USA)	1,074	3.1
9.	Sakata (Japan)	548	1.6
10.	Takii & Company (Japan)	548	1.6
Total Top 10		**25,951**	**75.3**

Source: ETC Group, Phillips McDougall

Commercial Seeds – The First Kink in the Industrial Food Chain

According to agribusiness consultants Phillips McDougall, the commercial seed market in 2011 was $34,495 million.[7] The top 10 seed companies control 75.3 % of the global market.

In ETC's 2011 survey,[8] we highlighted the Gene Giants' shifting focus to markets in the global South, a trend that has intensified over the last two years, with:

- More acquisitions of South-based companies and partnerships with South companies, especially in India and Africa;
- A focus on crops for markets in the South, including a new emphasis on fruits and vegetables;
- A push for strong intellectual property protection in the South and 'education' to discourage seed-saving;
- Various seed 'accords' (e.g., GEMAA) that aim to keep post-patent biotech traits on life-support by maintaining regulatory registrations in export countries (see ETC Group, "Gene Giants Seek Philanthrogopoly," *Communiqué # 109*, March 2013).

Consolidation continues, but industry analysts point out that pickings are slim in the North – there just aren't many seed companies left to buy.[9] Stragglers swept up in 2012 include the melon seed business of Abbott and Cobb, Inc. (Pennsylvania, USA) bought by Bayer CropScience. Three California-based seed companies – Sunfield Seeds (sunflower), Cal/West Seeds (alfalfa, clover) and the Campbell Soup Company's vegetable seeds business – were bought by Syngenta, Dow AgroSciences and Vilmorin, respectively. Vilmorin's purchase (through its HM-Clause business unit) included Campbell Soup's research facility for vegetable breeding and seed development.

With merger & acquisition opportunities drying up in the North, multinational seed firms are taking over seed companies in the South, and acquiring North-based companies that focus on crops for South markets. In 2012 and 2013:

- After battling for more than two years with antitrust authorities, civil society and competitors, DuPont Pioneer prevailed to buy Pannar Seed, South Africa's biggest seed company, which does business in more than a dozen countries on the continent.
- The world's third largest seed firm, Syngenta, has all but given up on South Africa, but plans to invest $500 million and hire 700 people to pursue markets in Ghana, Ethiopia, Tanzania, Mozambique, Ivory Coast, Nigeria and Kenya.[10]
- Vilmorin, seeking to "set up a significant base" in the Indian market, acquired a 61% stake in Bisco Bio Sciences Pvt. Ltd., an Andhra Pradesh-based company selling hybrid seeds of maize, rice, bajra and jowar (millets), sunflower and sorghum; Vilmorin also acquired vegetable seed seller, Delhi-based Century Seeds. In 2013, Vilmorin acquired a majority stake in Liberty Seed (80%), South Africa's fourth largest seed producer. The acquisition gives Vilmorin a foothold in the local market for corn and soybeans as well as emerging markets of South and East Africa.
- Enza Zaden, a Dutch vegetable breeding company that operates in more than 20 countries, created a new subsidiary in India focusing on new hybrid vegetable varieties for the local market. Enza Zaden already has subsidiaries in Indonesia, China and Tanzania.
- KWS (Germany) bought the Brazilian maize breeding companies Semília Genética e Melhoramento Ltd. and Delta Pesquisa e Sementes Ltd.
- Syngenta became the majority shareholder of Belgium-based Devgen NV, which produces rice seed for markets in India and Southeast Asia. Devgen's subsidiary in India, Devgen Seeds and

Technologies Pvt. Ltd. (Hyderabad), sells hybrid rice, sorghum, pearl millet and sunflower seed. Devgen also sells hybrid rice in the Philippines and Indonesia. Devgen's five-year R&D agreement with Monsanto related to biotech traits in rice ended in 2011 and allows Devgen to use the results of the partnership.

- Nufarm (ranked #8, agrochemicals), through its wholly owned Nuseed subsidiary in Brazil, acquired 51% of the equity in Atlântica Sementes Ltda. (Curitiba), a sorghum and sunflower seed company. According to Nufarm, the majority stake will allow Nuseed to supply a number of existing hybrids through the Atlântica distribution network and will leverage other development programs in Australia, Argentina and the USA.

We're also seeing more South-North strategic partnerships:

- Frequent Gene Giant partner, California-based Arcadia Biosciences, Inc. and Argentina-based Bioceres, an agricultural investment and development company owned by South America's largest soybean growers (2.5 million hectares), launched a 50-50 joint venture called Verdeca. The key contribution of Bioceres is expertise in deregulation; Arcadia is contributing its agbiotech know-how. The joint venture aims to deploy genetic traits in all key world regions for soybeans, beginning in South and North America and then in China.[11] Verdeca will invest up to $30 million in "the further development and deregulation" of its initial two technologies, expected to reach the market between 2015 and 2017 and incorporating drought tolerance and glyphosate tolerance (using Monsanto's first generation Roundup Ready trait, whose patent expires in 2014).[12] Gustavo Grobocopatel, Bioceres board member and known as Argentina's "soybean king," cites the regrettable lack of competition in the current soybean seed market, arguing, "There should be 20 Monsantos and 10 Bioceres."[13]

- Arcadia Biosciences, Inc. signed an agreement with Bioseed Research India Pvt. Ltd. (Hyderabad) to develop tomatoes with longer shelf life. India is the world's fourth largest producer of tomatoes.

- Another frequent Gene Giant partner, plant genomics company Evogene Ltd. (Israel), and SLC Agricola, a cotton, soybean and maize producer as well as one of the largest landowners in Brazil, expanded their 2011 agreement to develop castor bean seeds as a competitive feedstock for biofuels.

- Evogene Ltd. and Rasi Seeds (Tamil Nadu, India) are collaborating to develop hybrid rice with increased yield and drought tolerance. Rasi Seeds will integrate genes licensed from Evogene into rice and test them in field trials.

- Swiss-based Syngenta signed a sweet sorghum market development agreement with Ceres Sementes do Brasil, the Brazilian subsidiary of Ceres, Inc. (USA), to support the introduction of sweet sorghum as a source of fermentable sugars at Brazil's 400+ ethanol plants. The Brazilian government considers sorghum a strategic crop to expand the country's ethanol industry.

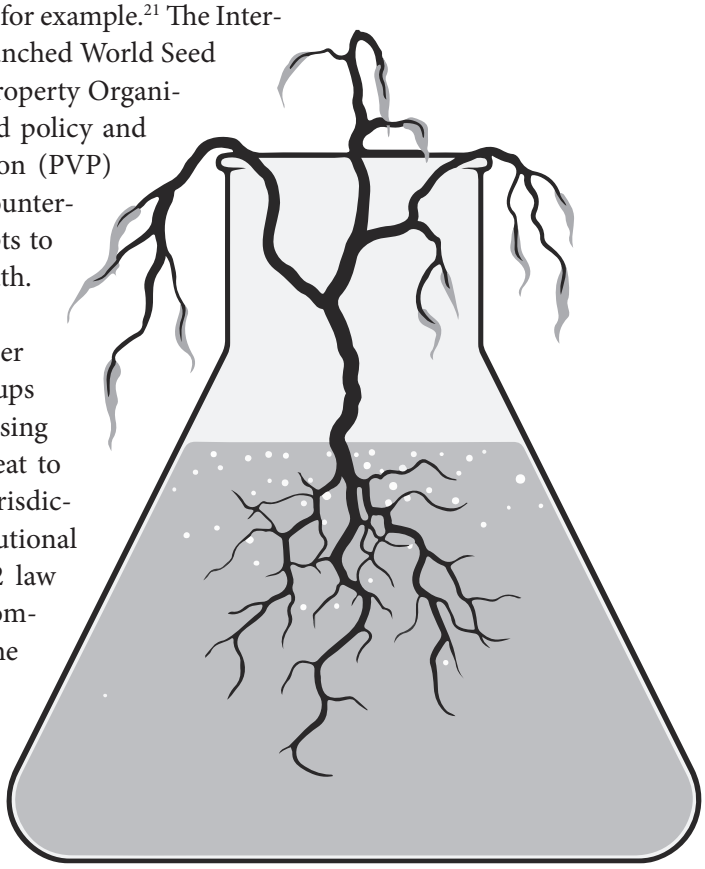
- Syngenta and Argentina's Buck Semillas are collaborating to develop new wheat varieties by combining Buck Semillas' "locally adapted genetics and Syngenta's…global germplasm pool."[14] [15]

- Genomic analysis company, California-based Affymetrix, Inc. signed an MOU with BGI (China), "the world's most prolific sequencer of human, plant, and animal DNA,"[16] to develop and

commercialize a portfolio of plant, crop and livestock microarrays for genotyping analysis for breeding and traceability applications. The collaboration will use data from the 1000 Plant and Animal Reference Genomes Project, initiated by BGI in 2010.

Mergers, acquisitions and partnerships with seed companies rooted in the global South are just a part of the seed industry's business strategy. In the seed industry's view, proprietary seeds can't turn a profit (anywhere) without so-called "enabling regulatory environments," including enforcement of intellectual property (IP). In the words of one industry spokesman, "opportunity is knocking loud and hard for countries with government agendas to protect IPR [intellectual property rights]."[17] While no one expects the developing world to accept patents on plants "in the near future,"[18] there is coordinated pressure, particularly on Africa and China, to enforce IP in agriculture by adopting and making operational the 1991 Act of the International Convention for the Protection of New Varieties of Plants, known as UPOV 91.[19] UPOV 91 prohibits the exchange of protected varieties between farmers (including through sale, barter or gift) and restricts the practice of farm-saved seed, forcing farmers to buy seed every planting season. But even in cases where some amount of seed-saving could be allowed by subsistence farmers under UPOV 91, saving seed "is not something we in any way, shape or form want to encourage," says Bernice Slutsky, vice president of science and international affairs for the American Seed Trade Association.[20] Given that the informal seed sector (including farm-saved seed and seed exchange between farmers) accounts for 80-90% of seed planted in the global South, the seed industry and IP advocates want nothing less than a revolutionary overhaul of agricultural practice.

Regional and national seed trade lobby groups, intellectual property organizations and governments that favour corporate breeders are pushing widespread adoption and enforcement of UPOV 91 – the updated version of Plant Breeders' Rights that strengthens monopoly and further restricts the rights of seed-saving farmers. The United States makes the adoption of UPOV 91 a condition of all its bilateral and regional free trade agreements, for example.[21] The International Seed Federation's (ISF) recently-launched World Seed Project, the African Regional Intellectual Property Organization's (ARIPO) draft regional harmonized policy and legal framework on Plant Variety Protection (PVP) and the East African Community's Anti-Counterfeit Bills[22] are just a few examples of attempts to strengthen plant-related IP in the global South.



There is resistance, however. In November 2012, more than two-dozen civil society groups in Africa issued a joint press release opposing ARIPO's draft seed law because of the threat to farmers and food security in ARIPO's jurisdiction.[23] In December, Colombia's Constitutional Court overturned the country's April 2012 law acceding to UPOV 91 (a condition of Colombia's bilateral Free Trade Agreement with the United States) as a violation of the country's constitution because indigenous and Afro-Colombian ethnic groups that would be directly affected were not consulted prior to the law's enactment.[24]

China is a special case. With the world's second largest domestic seed market (behind the USA), international seed players are less focused on developing the industry than on tapping into the current market. China has not yet acceded to UPOV 1991 (its PVP laws are based on the less stringent 1978 UPOV Act), but, according to insiders, the government is now considering "the benefit of accession to the 1991 Act."[25] In December 2012, ASTA signed a memorandum of understanding (MOU) with the China National Seed Association (CNSA) – described as "monumental" by ASTA's chairman, Blake Curtis. While the text of the MOU is not publicly available, it is, at least in part, about protecting IP. Explaining the significance of the MOU, Curtis said: "[it] gives the developers and providers of a lot of the technology that we've created the comfort zone of knowing that when they take these new technologies around the world, that they'll be protected and they'll be able to define and know the uses."[26] The ISF's 2014 World Seed Congress will be held in Beijing in a 5-star, lakeside convention center now under construction. ISF secretary general Marcel Bruins describes the opportunity to hold the Congress in China as "timely" given the size of China's seed market (which ISF estimates to be $9,000 million) and the speeding up of the country's "modern" crop development.[27]

Pesticides and Fertilizers

World's Top 11 Agrochemical Companies, 2011

Rank	Company (Headquarters)	Crop Protection Sales, 2011 US$ millions	% Market Share
1.	Syngenta (Switzerland)	10,162	23.1
2.	Bayer CropScience (Germany)	7,522	17.1
3.	BASF (Germany)	5,393	12.3
4.	Dow AgroSciences (USA)	4,241	9.6
5.	Monsanto (USA)	3,240	7.4
6.	DuPont (USA)	2,900	6.6
7.	Makhteshim-Agan Industries (Israel) acquired by China National Agrochemical Company, Oct. 2011	2,691	6.1
8.	Nufarm (Australia)	2,185	5.0
9.	Sumitomo Chemical (Japan)	1,738	3.9
10.	Arysta LifeScience (Japan)	1,504	3.4
11.	FMC Corporation (USA)	1,465	3.3
Total Top 10		**41,576**	**94.5**
Total top 11		**43,041**	**97.8**

Source: ETC Group

In 2011, the global 'crop protection' market (insecticides, herbicides, fungicides, etc.) is estimated to have increased by 14.9% to reach $44,015 million, according to Phillips McDougall.[28] The Big Six seed/agrochemical giants continue to dominate with 76% market share. The top ten pesticide companies control almost 95% of the global market. The top 11 companies have achieved a near-perfect oligopoly – controlling almost 98% of the market.

The trends identified in ETC's 2011 report[29] – the increase in agrochemical use in the global South and the industry scramble to deal with increasing glyphosate resistance – are still in play. Given the high level

of concentration and absence of viable agrochemical takeover targets, the Gene Giants are now beefing up their capacity in "biological pest control" – that is, the application of bugs or microorganisms to kill pests damaging to crops – which also allows the companies to sidestep the genetic engineering techniques necessary for herbicide-tolerance. "Biologicals" are promoted as a natural, "green" alternative to synthetic chemical pesticides and genetically engineered herbicide tolerance.[30] (The interest in biopesticides also reflects the Gene Giants' growing interest in fruits and vegetables, which have not been genetically engineered for herbicide tolerance.)

Although the current market for biological pest control – about $1.7 billion – represents less than 4% of the total agrochemical market, Monsanto expects it to grow at a rate of 10% per annum. Recent investments by Gene Giants related to biological pest control include:

- Syngenta's $113 million acquisition of biological controls company Pasteuria Bioscience (Florida, USA), which markets a microbe to control nematodes.[31]

- BASF's acquisition of Becker Underwood Inc. (Iowa, USA) for $1 billion. Becker Underwood sells beneficial worms that attack crop-damaging insects and bacteria that fight fungi harmful to crops.

- Bayer CropScience's acquisition of Agraquest Inc. (California, USA) and its biopesticide product line for $425 million.

- Monsanto's early 2013 acquisition of some assets of Agradis (California, USA), a company co-founded by synthetic biologist Craig Venter. The deal included Agradis's collection of "plant-associated microbes" and an agricultural research agreement with another of Venter's companies, Synthetic Genomics, Inc., focusing on screening and analysis of microbe-plant communities that could be used to develop biologicals. Financial details were not disclosed.

The Gene Giants continue their schizophrenic relationship – alternately hugging and haggling. In March 2013, DuPont surrendered to Monsanto in their increasingly costly legal battle: Monsanto agreed to drop its lawsuit accusing DuPont of infringing its Roundup Ready soybean patents; DuPont dropped its countersuit and agreed to pay Monsanto $1.75 billion in licensing fees.

Other recent "strategic alliances" – softer kinds of mergers less likely to offend antitrust regulators – include:

- BASF launching 'Engenia,' a dicamba-tolerant crop system in Monsanto's soybeans for the 2013/14 growing season.

- Syngenta and Dow AgroSciences' collaboration to sell two different "trait stacks" to seed companies (through Syngenta-owned GreenLeaf Genetics) in the United States and Canada.

- Syngenta and BASF's sunflower technology licensing agreement, in which BASF will license its Clearfield® Plus herbicide tolerance technology for sunflowers to Syngenta. In addition, the companies entered into a non-exclusive agreement under which BASF will supply Syngenta with imazamox-based herbicides for use with Clearfield and Clearfield Plus sunflowers in Europe.

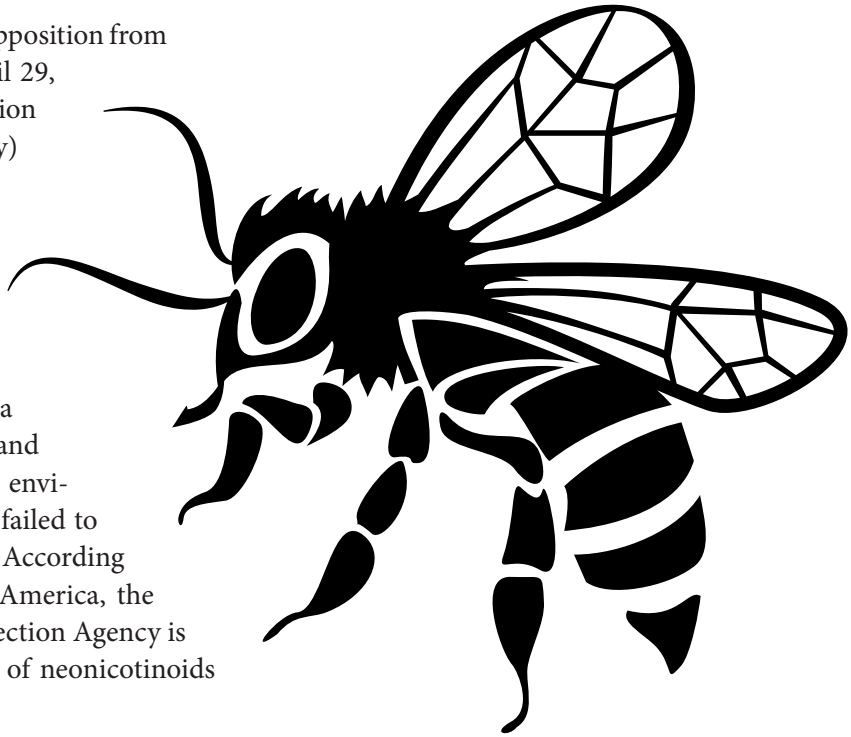
Pesticides: The Human Cost of Doing Business in the South: In understated candor, the United Nations Environment Programme (UNEP) notes that the cost of chemical exposure on national economies and the public health are "unrecognized and substantial."[32] By the year 2020, nearly one third of the world's

chemical production – including pesticides – will take place in the global South. The use of crop chemicals in the developing world continues to soar. In South Africa, for example, total pesticide expenditures rose 59% over the period 1999 to 2009, and are projected to climb another 55% in the period 2009 to 2019.[33]

In its 2013 report, *Cost of Inaction*, UNEP conservatively estimates that, for smallholder farmers in 37 sub-Saharan African countries, the costs of pesticide poisonings (lost work days, outpatient medical treatment, and inpatient hospitalization) amounted to $4.4 billion in 2005 (this figure does not include the cost of lost lives and livelihoods, environmental health effects and effects of other chemicals).[34] UNEP projects the total cost of pesticide-related illness and injury in sub-Saharan Africa between 2005 and 2020 could reach a staggering $90 billion.[35]

Honeybee Calamity: The annual value of pollination services to agriculture – primarily by bees – is conservatively estimated to exceed $200 billion worldwide.[36] Of the slightly more than 100 crop species that provide 90 percent of the food supplies for 146 countries, 71 are bee-pollinated (both wild and domesticated bees).[37] Pollinator populations are declining worldwide – but the massive die-off of the honeybee population – dubbed "colony collapse disorder" (CCD) in 2006 – is getting worse. Since 2006, 10 million beehives have been lost in the United States alone. In recent years, commercial beekeepers have witnessed losses of 28% to 33% of their hives. Up to half the commercial hives in the US perished in 2012.[38] Many researchers point to "a complex set of stressors and pathogens"[39] associated with CCD – including parasitic mites, viral and bacterial diseases, poor nutrition, lack of genetic diversity and pesticides. Although many factors may contribute to CCD, over 30 scientific studies have found a link between a class of insecticides known as neonicotinoids – which attack the central nervous system of insects – and the plummeting bee population.[40] Neonicotinoids are the world's most widely used class of insecticides.

Europe's "Bee-Day": Despite fierce opposition from the pesticide industry lobby, on April 29, 2013 the European Union took action to protect bees (and our food supply) by adopting a two-year ban on neonicotinoids – a move recommended by the European Food Safety Authority. The ban will restrict the use of Bayer's imidacloprid and clothianidin, as well as thiamethoxam, made by Syngenta. Despite a growing body of scientific evidence and growing demands from farming and environmental communities, the US has failed to take action to restrict neonicotinoids. According to Pesticide Action Network-North America, the ever-vigilant US Environmental Protection Agency is on course to conclude its evaluation of neonicotinoids in 2018!



Plan Bee: The agrochemical giants are responding to the honeybee wipe-out by accepting responsibility – not for harm done, but for future bee-security. Bayer features a "bee care" website and has spent millions to establish "Bee Care Centers" in Monheim, Germany and Research Triangle Park, North Carolina (USA) that are devoted to "honeybee health."[41] But don't expect neonicotinoids (or other pesticides) to be under the microscope at Bayer's Bee Care Centers. Bayer maintains that its neonicotinoids-based products "are safe for bees" and that the EU action is "a set-back for technology, innovation and sustainability."[42] Bayer's message to EU regulators: Buzz Off!

Not to be outdone, Monsanto acquired Beeologics in 2011 to conduct R&D on biological tools "to provide targeted control of pests and diseases," including those related to honeybee health. Rest assured, Beeologics' mission is "to become the guardian of bee health worldwide."[43] What's next, RoundUp Ready bees or BeeReady crops?

World's Top 10 Fertilizer Companies, 2011

Rank	Company (Headquarters)	2011 Sales US$ millions	% Market Share
1.	Yara (Norway)	10,277	6.4
2.	Agrium Inc. (Canada)	10,113	6.3
3.	The Mosaic Company (USA)	9,938	6.2
4.	PotashCorp (Canada)	8,715	5.4
5.	CF Industries (USA)	6,098	3.8
6.	Sinofert Holdings Ltd. (China)	5,760	3.6
7.	K+S Group (Germany)	4,349	2.7
8.	Israel Chemicals Ltd. (Israel)	3,836	2.4
9.	Uralkali (Russia) (includes Silvinit sales May-Dec. 2011)	3,496	2.2
10.	Bunge Ltd. (USA) Bunge will sell its fertilizer business to Yara in second half of 2013.	3,147	2.0
Total top 10		**65,710**	**41%**

Source: ETC Group

According to MarketLine, the global fertilizer market grew by 7.4% in 2011 to reach $160,300 million.[44] The top 10 companies controlled 41% of the global market in 2011.

Getting a clear snapshot of the global synthetic fertilizer industry is tricky. For one thing, it's crowded: Big Ag is in the picture, as well as Big Energy and its spawn, fracking (since nitrogen fertilizer production requires natural gas), with Mining in the background (and sometimes in the foreground). Even defining a 'fertilizer company' can be challenging – companies can be involved in fertilizer production, processing or distribution or some combination – and what they're producing, processing and distributing varies: some are focused on potash; others on nitrate and/or phosphate fertilizers, or the NPK (Nitrogen, Phosphorous, Potassium) package. That nobody will stand still for the picture adds to the difficulty: while consolidation is the general trend, individual companies are constantly buying or selling off regional assets, investing in other companies, launching joint ventures or refining cartel arrangements, which have been a feature of the fertilizer industry for more than a century – all to keep both barriers to competition and profits high. While a 2012 court decision will allow US-based buyers of potash to sue the world's biggest potash producers (including PotashCorp, Mosaic and Agrium) for creating a cartel to keep prices

artificially high, there is little chance that the suit will dampen the fertilizer sector's enthusiasm for cartels.

A 2013 report commissioned by the Heinrich Böll Foundation calculates that the world market price for mineral fertilizers has risen disproportionately when compared to the price of food – by over 250% in 40 years.[45] Further, the report argues that because mineral fertilizers achieve only minimal yield increases in many smallholder regions of Africa, Asia and Latin America, the wisdom of their use (often subsidized) is questionable. Nonetheless, private foundations and governments, particularly in Africa, are focused on increasing the use of mineral fertilizers.[46] Wheat, rice and maize consume about half of all fertilizer used in agriculture. Nitrogen (N) is the largest segment of the global fertilizer market, accounting for almost two-thirds of the market's total value and, according to a 2013 report, the production of nitrogen fertilizer alone is responsible for 2% of annual global GHG emissions. [47] Meat production (that is, fertilizer used on crops and pastures that feed livestock) accounts for a whopping 80% of all the nitrogen and phosphorus used in farming.[48] Phosphorous (phosphate rock) and Potassium (potash) are mined fertilizers; Mosaic is the world's largest supplier. Agrium, the world's second largest fertilizer company, supplies all three: NPK.

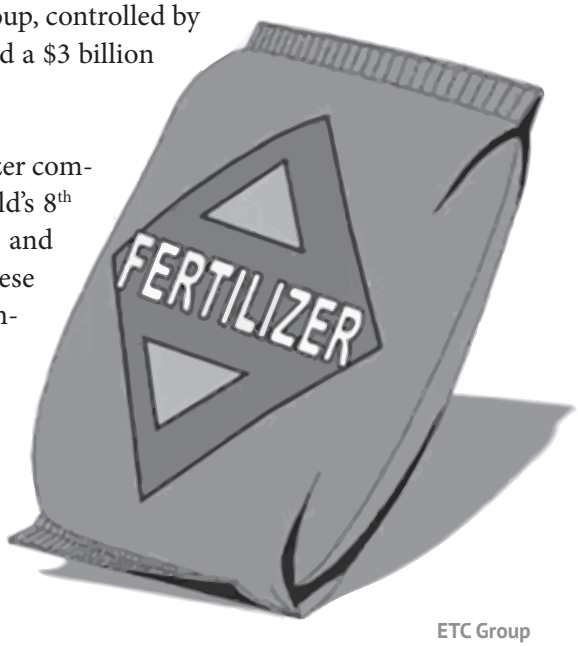
Fertilizer companies are watching the progress of high-profile biotech research to improve crops' resistance to abiotic stress, understanding that improved nitrogen efficiency (one area of research) could affect sales of nitrogen fertilizer. Yara takes heart, noting that "no major breakthroughs have been made on this recently and research on this trait is still at the 'proof of concept' stage."[49]

The biggest news in fertilizer business world:

- Oslo-based Yara, the world's largest fertilizer company, aims to increase its production of nitrogen fertilizer by 33% over 2010 levels in just four years. To that end, Yara bought Bunge Ltd.'s fertilizer business in Brazil for $750 million.

- In 2011, Brazil's government set a goal of being self-sufficient in fertilizers by 2020. Brazil currently imports 60% of the fertilizers it consumes. In December 2012, state oil company, Petrobras, announced that it will buy a fertilizer plant from mining giant Vale for $234 million; in October 2011, Brazil's EBX group, controlled by billionaire Eike Batista, announced its plan to build a $3 billion fertilizer plant in Brazil.

- Canadian-based PotashCorp., the 4th largest fertilizer company, owns 14% of Israel Chemicals Ltd., the world's 8th largest fertilizer company. Potash also owns 28% and 32% of APC and SQM, respectively. Both of these companies were among the world's 10 biggest companies based on 2009 revenues.



Animal Pharma

World's Top 10 Animal Pharmaceutical Companies, 2011

Rank	Company	Animal Pharma Sales, 2011 US$ millions	% Market Share
1.	Zoetis (formerly Pfizer Animal Health) (USA)	$4,070	18.5
2.	Merck Animal Health (USA)	$3,195	14.5
3.	Merial (Sanofi) (USA)	$2,783	12.6
4.	Elanco Animal Health (Eli Lilly) (USA)	$1,729	7.8
5.	Bayer HealthCare (Germany)	$1,500	7
6.	Boehringer Ingelheim (Germany)	$1,319	6
7.	Novartis (Switzerland)	$1,187	5.6
8.	Virbac Group (France)	$811	4
9.	Ceva Santé Animale (France)	$740	3
10.	Vètoquinol (France)	$398	2
Total Top 10		**$21,992**	**81%**

Source: Vetnosis, 2012

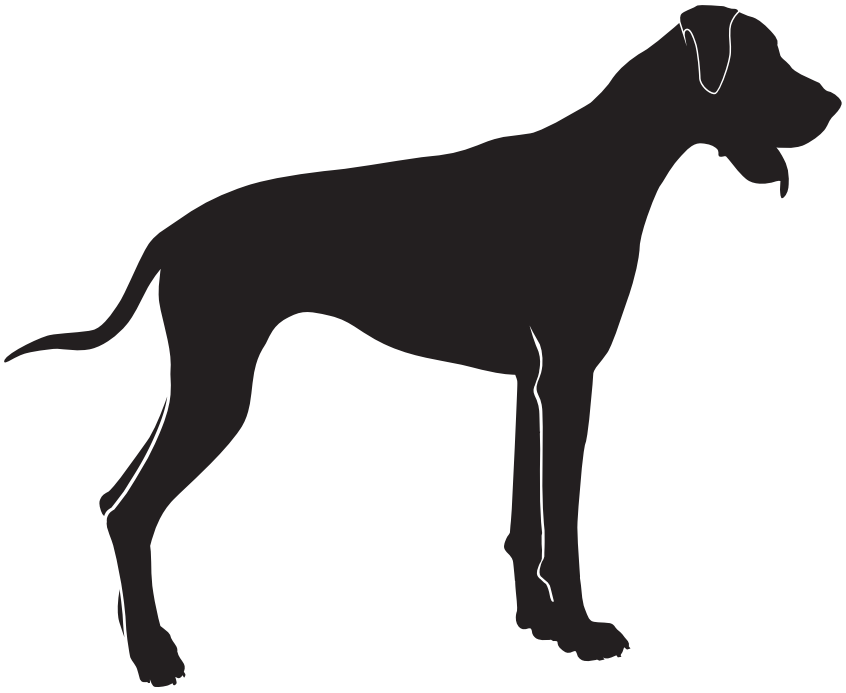
The animal health industry – the little brother of the much larger human pharmaceutical industry – makes medicines, vaccines, diagnostics and medical feed additives for both livestock and non-food 'companion animals' (i.e., pets, primarily dogs, cats and horses). At $22 billion, the global animal pharmaceutical market represents a tiny fraction of human drug industry sales (~$900 billion), but there are obvious parallels in products, R&D and market concentration.

- Just 3 companies – Pfizer, Merck and Sanofi – account for 46% of the animal pharma market.[50]
- The top 7 firms – all subsidiaries of Big Pharma – account for 72% of the industry's 2011 revenues.
- The top 10 firms account for 81% of the animal pharma industry's global sales.

Protein vs. Pets: Livestock-related products make up 60% of the total animal health market; products for domestic pets account for the remaining 40%.[51] Globally, the pharma business for pets is the fastest-growing sector of the industry. According to industry sources, pet ownership and spending per pet are increasing worldwide and pet owners are more willing to sacrifice other discretionary spending (entertainment, eating out) rather than reduce spending on pet care.[52] Pets are living longer and their owners are willing pay for "more aggressive and expensive medical interventions."[53] Big Pharma's drugs for ageing consumers are now finding lucrative cross-over markets for their geriatric dogs and cats, including drugs for skin infections, cardiovascular diseases, osteoarthritis and cancer.[54] While the farm animal sector of the industry remains stagnant in Europe and the USA, analysts see longer-term growth in China, India, South America and other emerging markets.[55]

Animal Pharma spin-off: Pfizer, Inc., the world's largest drug maker for both humans and animals, spun off its animal pharma unit in early 2013 to ease the company's debt-burden. The initial public offering sold off a 20% stake in the new business, called Zoetis, raising $2.2 billion. According to the *Wall Street Journal*, the new company is worth more than $15 billion.[56]

Merger Misstep: Plans announced in 2010 to create the world's largest animal pharma business with the merger of the animal health units of Merck and Sanofi-Aventis were abandoned due to the "increasing complexity of the proposed transaction."[57] The two companies continue to operate as separate businesses.



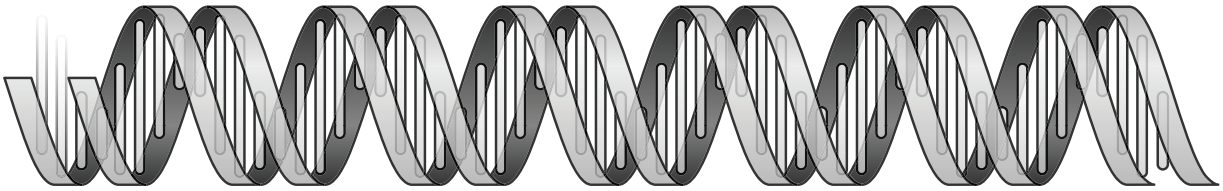
Dog-Eat-Dog Consolidation: Recent mergers & acquisitions[58] include: In early 2011 Pfizer acquired the animal health operations of King Pharma for $3.6 billion; Eli Lilly bit back with the 2011 acquisition of Janssen Animal Health. Tenth ranked Vétoquinol took over Brazil's Farmagricola in 2011. Sanofi is expanding its reach in emerging markets with plans to acquire Colombian-based Genfar SA and a separate deal to buy the animal health division of Indian firm Dosch Pharmaceuticals. In January 2013 Bayer's animal pharma division acquired Teva Pharmaceutical Industries' US-based generic animal health business for $145 million.

Beefing-Up Antibiotic Resistance: Efforts to restrict sales of medicated animal feed – due to mounting concerns about antibiotic resistance in humans – continue to hound the industry. The overuse and misuse of antibiotics (in both agriculture and human health) contribute to the costly and dangerous rise of antibiotic-resistant infections and now pose a worldwide human health threat – the spectre that human infections will become rampant and untreatable with any existing antibiotics. The EU has already phased out the use of medicated feed when it is used for the purpose of accelerating animal growth.

Despite wide public support in the United States, legislative efforts to restrict antibiotic-laced animal feed are stalled, thanks largely to the powerful agro-industrial lobby. According to the US Food & Drug Administration, nearly 30 million pounds of antibiotics were sold in the United States for meat and poultry production in 2011 – four times more than the amount used to treat humans.[59] The majority of the antibiotics used in livestock feed is for non-therapeutic purposes – that is, to treat animals that are not sick.[60]

China is now the world's largest consumer of meat (primarily pork and poultry). As industrial-scale livestock production replaces China's backyard chicken farmers and small-scale pig producers, Chinese factory farms are using high levels of antibiotics in animal feed to promote faster growth and to help livestock survive crowded conditions.[61] A recent study of manure-enriched soil samples near three large-scale Chinese hog farms found 149 unique antibiotic-resistant genes.[62] According to the researchers, "Diverse, abundant, and potentially mobile ARGs [antibiotic resistance genes] in farm samples suggest that unmonitored use of antibiotics and metals is causing the emergence and release of ARGs to the environ-

ment."[63] The study's implications are particularly alarming, given that by the end of March 2013, 16,000 pig carcasses had been fished out of Shanghai's Huangpu River – the cause of the mass death has been cited as weather, and the subsequent dumping of dead pigs the result of a crackdown on the black market for selling pork from diseased pigs.[64] (A particularly vivid story in the *Wall Street Journal* focuses on the economic upside, explaining why "every flotilla of dead pigs has a silver lining:" in this case, sales of Dow Chemical's plastic packaging have skyrocketed in China as consumers choose pre-packaged foods due to food safety concerns.[65])



Livestock Genetics

The Other Seed Stock: Global Animal Genetics Industry

Introduction

Although a small number of transnational firms (many are privately held) supply the breeding stock for an ever-increasing share of the world's industrial meat, milk, eggs and farmed fish, the majority of the world's livestock keepers, especially in the global South, are self-provisioning in breeding stock. They breed their own animals, exchange stock with neighbors or obtain animals through breed associations. The same is true for farmed fish – only 10% of aquaculture production is based on stocks bred by the formal sector.[66]

The role of livestock is central to both rural and urban people in the global South, where 68% of households earn money from livestock.[67] An estimated 600 million peasant farmers, including 100 million who are landless,[68] raise livestock. The majority of the world's meat and milk is produced by small-scale farmers in mixed crop-and-livestock systems, not by intensive production systems. In mixed crop-livestock systems across the developing world, livestock contributes, on average, one-third of household income, and 55% of pastoral incomes.[69]

The driving force behind the loss of livestock diversity is the industrialization of animal production based on a narrow range of uniform breeds. With the introduction of industrial breeding stock, native animals are subject to rapid replacement or genetic dilution. Corporate breeders focus on maximizing production (growth rate, feed conversion efficiency, yields). Typically, these high-performance breeds can't survive without high-protein feeds, expensive medications and climate-controlled housing.

The loss of livestock genetic diversity forecloses options for responding to future environmental challenges, market conditions and societal needs – all of which are unpredictable. The reduced genetic diversity of commercial animal breeds increases their vulnerability and poses long-term risks for food security. Indigenous, locally adapted animals are the source of genes and traits that underpin sustainable, low-input agriculture – such as disease and parasite resistance and ability to thrive in harsh and variable conditions, including extreme heat or drought. In the face of climate change, the long-term sustainability of livestock-keeping communities – as well as industrial livestock systems – is jeopardized by the loss of animal genetic diversity.

Animal Genetics Industry: Big Seven Global Breeders

Company (headquarters)	What they do
Charoen Pokphand Group (Thailand)	Sells broilers and pigs; aquaculture. Agro-industrial and telecom giant with annual revenues of $33 billion. Subsidiary companies with animal breeding operations, including shrimp.
EW Group GmbH (Germany)	Sells broilers, layers, turkeys; aquaculture. Privately-held. The world's largest player in industrial poultry genetics. With acquisition of Norway's AquaGen in 2010, EW Group is largest supplier of genetic material to global salmon farming industry (over 35% market share).
Genus, plc (UK)	Sells pigs, dairy and beef cattle. 2012 revenues ~$540 million; operates in 30 countries on six continents, with biotech research laboratories located in the United States.[64] North America and Europe account for 70% of the company's profits but the company sees major growth potential in the global South.
Groupe Grimaud (France) –	Sells broilers, layers, pigs; aquaculture. Privately-held animal genetics and biopharma company. Annual turnover ~$323 million, of which 75% is on the international market (more than 100 countries).[65] About 1,700 employees; R&D facilities and production in the Americas, Europe and Asia. With the recent establishment of "Blue Genetics," the company is expanding into aquaculture breeding.
Hendrix Genetics (Netherlands)	Sells layers, turkeys, pigs; aquaculture. Employs more than 2,400 people in more than 24 countries; the company provides breeding stock to more than 100 countries. Privately held. In 2011, expanded into aquaculture with the acquisition of salmon breeding companies (Landcatch & LNS Landcatch Natural Selection) from Scotland-based Lithgows Ltd.
Smithfield Foods (US)	Sells pigs. $13 billion global company is world's largest pork processor and hog producer. In May 2013, Shuanghui International, China's largest meat processor, made a $4.7 billion acquisition bid that includes Smithfield Premium Genetics, the company's pig breeding subsidiary.
Tyson Foods (US)	Sells broilers. $33 billion in sales in 2012. Subsidiary Cobb-Vantress distributes broiler breeding stock to more than 90 countries.

A handful of corporate breeders dominate R&D in the animal genetics industry (particularly for poultry, swine and cattle). The tightly-held ownership and control of breeding stock for industrial, large-scale animal production contrasts sharply with the millions of smallholder farmers and pastoralists who are guardians of the world's endangered livestock diversity.

According to FAO's 2012 update on the state of livestock biodiversity, there are 7,634 unique farm animal breeds, but 22% are at risk of extinction, primarily due to growth of industrial livestock production.[72] A total of 1,881 breeds are classified as being at risk in 2012 compared to 1,649 in 2008. The proportion of mammalian species at risk is 20%; for avian species the figure is 31%. However, population data are missing and thus risk status is unknown for more than one-third of all reported breeds.

Today the responsibility for managing and using the world's livestock diversity rests on the shoulders of small-scale livestock keepers. Of the world's 600 million livestock keepers who are classified as poor, around two-thirds are women living in marginalized farming areas with harsh environments in the global South.[73] A 2012 report authored by Ilse Köhler-Rollefson for FAO, *Invisible Guardians*, notes that women are the main users and caretakers of locally adapted animal breeds.[74] Indigenous, multipurpose breeds (rather than exotic or "improved" breeds) are the livestock of choice in these communities because they are less risky, don't depend on access to markets, and offer a means to generate income and savings.[75] As the main users of locally adapted livestock breeds, women livestock keepers play a major role in managing and conserving the world's animal genetic resources.[76]

Market demand for new genetic traits: As a result of animal welfare campaigns, the European Union outlawed the factory-farm practice of raising sows in closely confined stalls as of January 1, 2013.[77] At least 10 states in the United States have followed suit. Pigs raised in factory farms are prized for churning out large litters, but they are forced to do so in extreme confinement. To maximize production, corporate sows have been confined to cages (sow stalls or gestation crates) that restrict their movement – even preventing them from turning around. In response to consumer outcry, fast food giants like McDonald's announced they would no longer buy from pig producers who use the confinement practice. Unsurprisingly, corporate sows aren't so keen on "group housing" and they exhibit bullying behaviors. To develop pigs with a milder temperament, some pig genetics companies are turning to breeds that incorporate genes from the Chinese Meishan breed – which is not only prolific, but also docile.[78] Meishan pigs were introduced to the United States in 1989.

The Forgotten Farm Animals: "Working animals" (e.g., buffaloes, camels, horses, mules, asses, llamas and more) play a vital role in the wellbeing of smallholder and pastoralist communities in the global South, yet their immense contributions are under-appreciated and often invisible outside of farming communities. Working animals provide an essential source of traction, transport, fuel, fertilizer and milk. According to FAO, "working animals remain largely invisible in the eyes of decision- and policy-makers, civil society, and development agencies."[79] Beyond generating cash income, animals contribute to the overall livelihood support systems of livestock keeping communities. Despite this essential role, FAO notes, "almost no information is available on the genetic make-up of many working animals in developing countries and little consideration is given to breeding and/or biodiversity conservation strategies."[80]

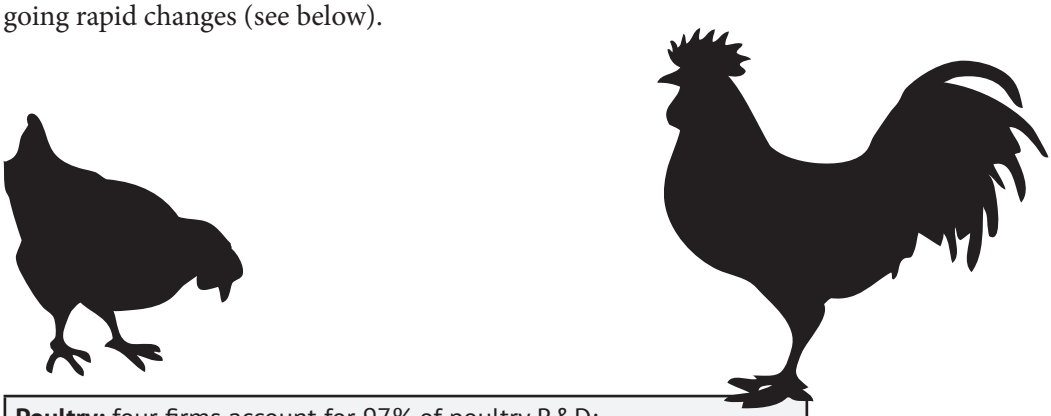
Livestock Genetics Industry: Overview

Despite its global reach, the market for commercial livestock genetics is surprisingly tiny – especially compared with other industrial input suppliers. Based on a survey of 72 companies worldwide that conduct R&D in animal and fish breeding, the US Department of Agriculture (USDA) estimates, in a study published in 2011, that the global market for the animal genetics industry (including poultry, swine, cattle and aquaculture) was $4.06 billion in 2006-07 (cf. the $34 billion commercial seed market in 2011).[81] According to the USDA, the global livestock genetics industry collectively spent $295 million on R&D in 2006-07. Large-scale poultry breeders dominate the field of animal genetics, accounting for 43% of the industry's total sales and about half of the industry's total R&D. Commercial sales for swine genetic material account for 32% of the world market; cattle genetics (embryos and semen for artificial insemina-

tion) account for just 23% of the worldwide commercial sales of animal breeding materials. Aquaculture accounts for only 2%.[82]

Note: Many of the global livestock genetics firms are privately held and the companies don't publish figures on revenues or R&D, nor do they provide an inventory of their private germplasm or breeding stock collections. There is a major gap in publicly available information on the size of private sector animal genetics markets and the sales/prices of genetic materials.

Although USDA's 2011 study identified 72 companies that invest in animal genetics, R&D is dominated by a handful of global, multi-species firms. Four of the top 7 animal genetics firms have recently expanded into aquaculture. Market concentration in animal genetics is highest for poultry, followed by swine and then cattle. USDA was unable to provide data on market concentration in aquaculture, which is undergoing rapid changes (see below).



Poultry: four firms account for 97% of poultry R&D;

Broilers: three companies control 95% market share;

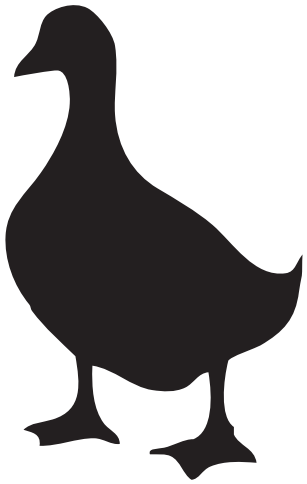
Layers: two companies control an estimated 94% of all commercial breeding stock;

Turkeys: two companies supply virtually all of the commercial turkey genetics.

Swine: the top 4 companies account for two-thirds of the total industry R&D

Cattle: the top 4 companies account for two-thirds of the total industry R&D

Aquaculture: industrial aquaculture genetics firms focus primarily on Atlantic salmon, shrimp and tilapia.



Industrial Poultry Genetics: Who Rules the Roost?

In its 2011 study, USDA researchers identified 18 companies worldwide engaged in some poultry breeding.[83] **But just four firms account for 97% of poultry R&D.** In addition, two of the four companies (Tyson Foods and Hendrix) have been conducting joint research on poultry genomics since 2008, and recently announced they will expand their collaboration.[84] The big four corporate poultry breeders are "multi-species" firms, meaning that their breeding operations involve more than one animal species.

Commercial poultry breeding:

- Three companies (Tyson Foods, EW Group, Groupe Grimaud) supply 95% of the commercial breeding stock for broilers (chickens that are raised for meat).

- Two companies (EW Group, Hendrix Genetics) supply nearly all of the global breeding stock for turkeys.

- The same two companies (EW Group, Hendrix Genetics) control the breeding stock for layers (the chickens that produce eggs for human consumption).

- Two of the world's largest poultry breeders (Tyson and Hendrix) have a multi-year R&D collaboration.

Among avian species, chickens have by far the highest number of breeds at risk on a world scale. About one-third (32%) of the world's chicken breeds are designated at risk.[85] According to the authors of a 2008 study on genetic diversity in commercial poultry, today's commercial broilers descend from about three lines of chickens, and poultry used in egg production come from only one specialized line.[86] Not surprisingly, commercial chickens are missing more than half of the genetic diversity native to the species.[87]

Broilers (three companies control 95% market share)

- **Tyson Foods –** Tyson's subsidiary, Cobb-Vantress, is one of the leading poultry breeding stock suppliers in the world, with about 2,500 employees and breeding stock supplied to more than 90 countries. Tyson's operations include breeding stock, contract growers, feed production, processing, further-processing, marketing and transportation of chicken and related products. The company operates its own feed mills (in 2012, corn, soybean meal and other feed ingredients represented roughly 69% of the cost of raising a chicken to slaughter weight).[88]

> **How Uniform?** According to Tyson's wholly-owned subsidiary, Cobb-Vantress, the company's Cobb500 broiler – a single line of chicken – supplies 100% of Namibia's industrial chicken flock. Cobb-Vantress describes the line as "the world's most efficient broiler due to the efficiency of the breed" with "the best uniformity in the market."[89]

- **EW Group (Aviagen)** – The Aviagen Group is the self-described "global market leader in poultry genetics." The company claims it is number one in R&D and a "pioneer in the development of progressive biosecurity programs" for chickens and turkeys. Broiler brands include Arbor Acres, Ross and Indian River. Aviagen's CWT Farms International provides broiler hatching eggs worldwide. CWT (as S&G Poultry) also maintains its own proprietary breeding lines to supply the niche markets of the Heritage Breeds.[90]

- **Groupe Grimaud (Hubbard)** – In the USA, the world's largest broiler market, the company claims its "Hubbard M99 breeder male" represents more than 50% of the broiler industry, supplying almost every poultry company in the USA."[91]

- **Charoen Pokphand Group (CP Group) –** In addition to the big three chicken breeders, Thailand-based agro-industrial giant CP Group, is a significant player in Asia.[92] CP Group and its sub-

sidiaries produce and distribute animal feed; breed poultry, swine and aquatic animals; process meat and packaged foods and operate food retail outlets.[93] CP Group employs more than 280,000 people, including 80,000 in China, and generates more than $33 billion in revenue per annum.[94] Although 75% of its agribusiness operations come from Thailand, at the end of 2011, CP Foods had investments in 9 other countries and exported meat and ready-to-eat products to more than 20 countries worldwide. CP India operates breeding farms in at least 7 Indian states.

***Layers* (2 companies control an estimated 94% of all commercial breeding stock for layers)**

- **EW Group** (H&N, Hy-Line International and Lohmann Tierzucht) is the largest layer poultry genetics company.[95]

- **Institut de Sélection Animale (ISA),** the layer breeding division of **Hendrix Genetics**. With roots dating back to the first half of the 20th century, ISA claims to be the world's leading breeder of brown and white egg layers. Besides layer breeding, ISA produces and sells layer parent stock under the brand names Isa, Babcock, Shaver, Hisex, Bovans and Dekalb.

- **Groupe Grimaud** (Novogen) claims 6% global market share in layer breeding stock in 2012.[96]

***Turkeys* (2 companies control virtually 100% commercial turkey breeding stock)**

- **EW Group** – Aviagen Turkeys is the largest supplier of turkey breeding stock worldwide, supporting the brands of B.U.T. and Nicholas. The company operates breeding programs in the US (Aviagen Turkeys, Inc.) and Europe (Aviagen Turkeys, Ltd.).

- **Hendrix Genetics (Hybrid Turkey)** – Hendrix Genetics acquired Hybrid Turkey in 2007. Hybrid's head office, hatcheries and research and production farms are located in Ontario, Canada.

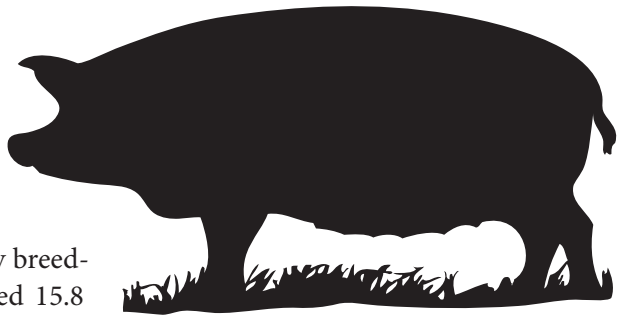
Powerhouse Pig Genetics

In pig genetics, the top 4 companies account for about two-thirds of the total industry R&D.[97]

According to FAO's global database, of 557 known pig breeds, 23% are at risk of extinction.[98]

- **Genus, plc –** UK-based biotech breeder Genus acquired **Pig Improvement Co. (PIC)** in 2005, and now supplies pig genetics to 30 countries on 6 continents. According to the company's 2012 annual report, "In the porcine market, we have a 25% share, more than double our nearest competitor."[99] PIC sells breeding males, females and semen. The company owns 9 pure-bred pig lines and maintains nucleus herds in the USA and Canada. According to PIC, more than 100 million slaughter pigs produced each year contain PIC genetics.[100]

- **Hendrix Genetics** – Hendrix acquired its pig-breeding subsidiary, **Hypor**, in 2007. The company claims that "more than 40 years of successful breeding experience has brought us to the top 3 of this industry."[101] Hypor has operations in 19 countries. In 2012 Hypor claimed it was the first to employ "genomic selection" based on DNA-markers to enhance the precision of genetic selection in pig breeding.



- **Smithfield Foods, Inc.** – A $13 billion global food company, US-based Smithfield is the world's largest pork processor and hog producer. Its breeding subsidiary, **Smithfield Premium Genetics**, owns approximately 851,000 sows and contracts with 2,100 farmers, all of whom use the company's proprietary breeding lines.[102] In FY 2012, Smithfield slaughtered 15.8 million market hogs in its own processing plants (contract farmers supplied only 48% of the company's live hog requirements). The company also operates hog production facilities in Poland, Romania and Mexico. In May 2013 China's Shuanghui International announced a $4.7 billion offer to acquire Smithfield Foods.

- **Groupe Grimaud** – In 2010 Groupe Grimaud acquired 100% ownership of its pig genetics division, **Newsham Choice Genetics** (Iowa, USA).[103] In 2011 Grimaud acquired a majority share of **PEN AR LAN** (France), an international pig genetics firm with operations in France, Poland, Brazil and Canada. Newsham claims it is the second largest swine genetics supplier in North America and the leader of marker assisted selection in pigs, with "exclusive access to the world's most comprehensive map of the swine genome."[104]

In addition to the multi-species "big box" swine breeders mentioned above, independent pureline hog breeders continue to play a role in swine genetics, including producer-owned cooperative breeding programs. These include, for example:

- **TOPIGS –** TOPIGS is a Netherlands-based cooperative owned by about 1800 pig farmers. With production of more than 1,250,000 crossbred gilts and over 7 million doses of semen per year, is among the biggest swine genetics suppliers in the world. The company is active in more than 50 countries.

- **Genesus Genetics** – Based in Manitoba, Canada, Genesus claims the "largest independent registered purebred swine herd in the world" and invests millions of dollars in R&D.

- **DanBred International** – DBI was founded in 1972 by owners of all registered breeding herds in Denmark. DanBred collaborates with 25 private breeders in Denmark and exports purebred pigs and fresh semen to more than 40 countries in South America, North America, Europe, Africa, and Asia.[105]

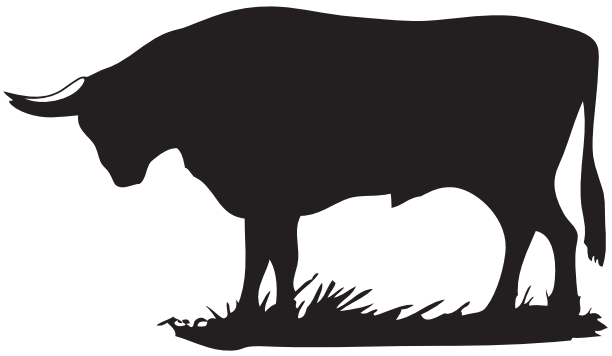
China: Bringing Home the Bacon. China accounts for about half of all pig production and consumption worldwide. Pork is China's most popular protein, and demand is skyrocketing. In 2003, Chinese farms with capacity to produce more than 50 pigs accounted for just 20% of the country's total production.[106] As a result of Chinese policies favoring vertically integrated factory farms, China's backyard pig producers (and their native breeds) are rapidly losing ground. By 2012, large-scale pig producers accounted for 37% of marketed pigs. By 2015, an estimated 50% of China's pigs will come from factory farms.[107] Despite that China is home to more pig diversity than any other country (72 native pig breeds[108]) factory farms rely on imported breeding stock. Swine genetics firms are playing a major role in the transformation of China's pig production – a trend that is likely to accelerate with the proposed takeover of Smithfield Foods by China's largest meat processor, Shuanghui International. In addition, Genus (PIC) has joint ventures with

two of China's leading integrators, Besun and Shennong, to establish new herds with combined capacity of over 5,000 breeding sows. PIC has already delivered 1,200 animals via air freight to the central province of Shaanxi. In March 2013, Genus (PIC) signed a new joint venture to provide breeding stock for 1,000 sow farms in Yunnan province that will eventually produce 3 million hogs for slaughter.[109] In 2012, Canada's Genesus loaded 850 of its purebred pigs on a Boeing 747 destined for Sichuan province.[110] The buyer, Giastar, is a vertically integrated company with the goal of producing 5 million pigs. Numerous swine genetics firms have announced major deals with China.

Cattle Genetics Industry

According to FAO, cattle are the mammalian species with the highest number of breeds at risk.[111]

The top 4 companies active in cattle genetics account for an estimated two thirds of the sector's total industry R&D.[112]



Compared to poultry and pig genetics, the genetic supply industry for dairy and beef cattle is decentralized, with a slower rate of industry consolidation. Genetic improvement in beef and dairy cattle involves individual breeders, breed associations, companies/cooperatives that specialize in reproductive technologies, particularly artificial insemination (AI) and embryo transfer, as well as public sector researchers. Even in industrialized countries, artificial insemination and embryo transfer companies/cooperatives often work closely with individual, small-scale producers/breeders. Since the 1950s, artificial insemination has played a major role in the global reach and dispersal of bovine genetics. Artificial insemination, combined with the freezing and storing of semen, theoretically enables a single bull to produce 50,000 offspring per annum. Embryo transfer technology, commercially widespread since the 1980s, facilitates the distribution of genetics from elite female cows. (The same technologies play an important role in breeding and conservation of endangered livestock breeds.)

Today, the majority of beef cattle are typically subject to cross-breeding, whereas industrial dairy cattle have been subjected to selection from within the same breed. For example, after decades of selective breeding for maximizing milk production, a single breed, Holstein (originating in the Netherlands) accounts for over 91% of the US dairy herd.[113]

The technology revolution in bovine genetics today focuses on the use of genomic testing based on single nucleotide polymorphisms (SNPs). By evaluating variants in DNA, SNP-based testing can detect particular patterns or genetic signatures throughout the genome that are associated with particular traits. These tools (molecular biology and quantitative genetics) enable breeders to select and evaluate animals much earlier in the animal's life and accelerate genetic changes in breeds. As the cost of SNP-based testing continues to drop, genomic testing is becoming routine for screening of animals in US dairy herds (in 2012, the cost of one test was approximately $35 per animal). The leading animal pharma firm, **Zoetis** (formerly Pfizer Animal Genetics), is also one of the leaders in developing genomic tests for the evaluation of dairy cows. **Neogen Corporation** (USA) is a smaller firm active in the development of animal genomic tests, especially for beef cattle. Neogen claims that its "GeneSeek Genomic Profiler" (GGP-HD) can reveal an

animal's genetic potential well before breeding, as well as the animal's parentage, and the animal's genetic traits and disease information.[114]

Major R&D firms in cattle (beef and dairy) include, among others:

- **ABS Global,** a subsidiary of **Genus (UK)**, is a publicly-traded firm and a major player in cattle genetics. The company claims "a leading position of 8% of global sales in dairy and 25% of the market in artificial insemination for beef."[115]

- **Koepon Holding (Netherlands)/Alta Genetics** – Based in Calgary (Canada), Alta claims to be "the largest privately owned reproduction and genetic improvement company in the world" with "partnerships" in over 80 countries.[116] Koepon Holding purchased Alta in 2000.

- **Select Sires** (USA) is a federation of nine farmer-owned-and-controlled cooperatives specializing in reproductive- and herd-management services for dairy and beef producers.

- **Accelerated Genetics** (USA), also a cooperative, is one of the leading artificial insemination companies in the world.

- **Genex Cooperative, Inc.** (USA/Canada) is a cattle genetics and artificial insemination subsidiary of Cooperative Resources International (CRI).

- **CRV (Netherlands)** is a cattle genetics cooperative (owned by 30,000 farmers) based in Arnhem, Netherlands that was established in 1874. Today, CRV has operations in Europe, New Zealand, South Africa, Brazil and the USA. CRV specializes in artificial insemination.

Pony Express – Cloning Revisited: In 1996 Scottish scientists announced they had cloned the world's first mammal – a female sheep, Dolly, cloned from an adult cell. The iconic sheep, suffering from lung disease, was euthanized six years later. At least 10 other mammal species have been cloned since Dolly – cows, goats, pigs, rats, mice, rabbits, cats, dogs, horses and mules – but the technique remains costly and generally inefficient.[117] The first cloned polo pony was born in 2010. In January 2013 the *Economist* reported that a 3-month old clone of a world-class polo horse sold for $800,000 at auction in Argentina.[118] No cloned pony has reached the age where it has competed in a polo match, but two companies, Crestview Genetics (USA) and Kheiron Laboratories (Argentina) are vying for the lucrative cloned polo pony market. Crestview claims that it has already created 60 cloned ponies.

Aquaculture Genetics Industry

Introduction

Fish and the Peasant Food Web: 1.5 billion people (one-fifth of world population) depend on fish for their primary protein source.[119] Artisanal fisheries – small-scale fisheries using traditional fishing techniques for subsistence or local markets – exist around the world, but particularly in the developing world, and are vital to livelihoods and food security. In 2008, it was estimated that artisanal and commercial fisheries catch about the same amount of fish for human consumption (30 million tons), yet artisanal fisheries employ 25 times more fishers (over 12 million people) and use one-seventh the amount of fuel that industrial fisheries use.[120] While industry focuses on a handful of commercially important fish species (see below), the Peasant Web also nurtures aquatic genetic resources beyond fish – including marine snails, seaweeds and sea cucumbers – as diverse sources of food, nutrition and medicines.

As with other informal sectors of the food-related economy, data on subsistence fish farming are incomplete. Rice-fish farming, for example, has been practiced in China for millennia and in other parts of Asia for centuries, but its contribution to household protein requirements and overall nutritional security is not fully known. Using a kind of water-based intercropping, rice-fish farmers introduce freshwater fishes into rice fields (or allow them to enter during flooding); the fish are then managed as a protein source, but also to increase soil fertility, control insects and pests that feed on rice plants and to increase oxygen circulation around the plants.[121] Rice-fish farming is also known to increase rice yields.[122] Throughout the Mekong River basin, rural people use a plethora of species caught or collected in rice-based wetlands. In one season in Cambodia, China, Lao PDR and Viet Nam, rice-fish farmers netted 243 species: 145 fish, 11 crustacean, 15 mollusc, 13 reptile, 11 amphibian, 11 insect and 37 plant species.[123]

From 1980-2010, commercial aquaculture fish production has expanded 12-fold, increasing at an annual average rate of 8.8%.[124] According to FAO, the value of food fish production from aquaculture reached $119 billion in 2010 (not including aquatic plants and non-food products).[125] While capture fisheries have steadily over-exploited or depleted all major fish stocks, aquaculture's share of world fish production jumped from 21% percent in 1995 to just over 40% percent in 2010. Almost half of the fish food we eat (47% in 2010) comes from aquaculture – compared to just 9% in 1980.[126] Globally, aquaculture output is overwhelmingly dominated by China. In 2010, China alone accounted for 61% of worldwide aquaculture production. (Asia supplied 89% of the world's aquaculture production by volume). With the exception of Norway, industrialized countries are losing ground in aquaculture fish production. In 2010, industrialized countries collectively produced just 7% of the world's farmed fish compared with 22% in 1990. In 2010, the top ten producing countries accounted for 88% by volume and 82% by value of the world's farmed food fish. Freshwater fishes dominate global aquaculture production (56%), followed by molluscs (24%), crustaceans (10%), diadromous[127] fishes (6%), marine fishes (3%) and other aquatic animals (1.4%).

Compared to poultry, pigs and cattle, the fish genetics industry is in its infancy. Although aquaculture is the world's fastest growing agribusiness, less than 10% of aquaculture production is based on commercial and formal sector breeding material (many aquaculture producers rely on wild breeding stock).[128] Today, about 600 aquatic species are raised in captivity (freshwater, brackish and marine water),[129] but a 2010 survey of 101 selective aquaculture breeding programs worldwide focused on just 25 species.[130] The survey reported the highest number of breeding programs for tilapia (27), followed by Atlantic salmon (13) and rainbow trout (13). Large-scale, industrial breeding programs focus on a handful of aquaculture species – primarily salmonoid (Atlantic salmon and rainbow trout), tropical shrimp and tilapia.

Although intensive aquaculture production based on selective breeding still represents a tiny portion of aquaculture production worldwide, the animal genetics industry is turning blue. Since 2008, four of the world's largest multi-species breeders (see above) have acquired aquaculture genetics programs:[131]

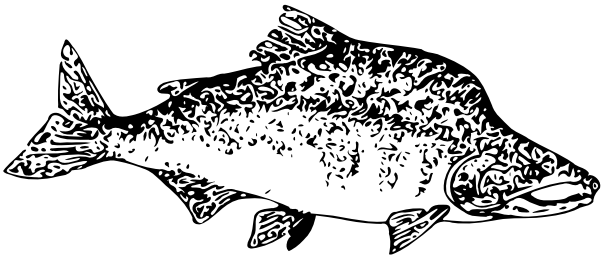
- **EW Group GmbH** – EW Group acquired a 50.2% share of Norway's AquaGen in 2008, and now owns 90% of the company. According to EW Group, AquaGen is the leading supplier of genetic material to the global salmon farming industry, with just over 35% of the world market. With operations in Norway and Chile, the company develops, produces and sells genetic material for farmed Atlantic salmon and rainbow trout.

- **Hendrix Genetics** – In 2010, Hendrix Genetics took its first plunge in aquaculture with the acquisition of Scotland-based salmon breeders, Landcatch and LNS (Lithgow family).[132]

- **Charoen Pokphand Group (Thailand)** – CP Group operates all of its own shrimp hatcheries and feed mills, with extensive aquaculture holdings in China, Malaysia, India and Thailand. At the end of 2011, CP Group employed 16,982 workers in its aquaculture operations.[133]

- **Groupe Grimaud** –The privately-held company supports a new aquaculture company called Blue Genetics, but few details are available.[134]

Aquaculture Genetics Industry – By Farmed Species:



Salmonoid (salmon & rainbow trout)

Today, wild-caught salmon accounts for less than 1% of Atlantic salmon production; the rest is farmed. Norway manages 50% of the world's Atlantic salmon. With innovations in the farming of Atlantic salmon in marine cages, aquaculture production in Norway exploded from 151,000 tonnes in 1990 to more than one million tonnes in 2011.[135] Publicly funded research established Norway's largest salmon breeding programs, one of which (**AquaGen**) was acquired by Germany's EW Group in 2008. The other, SalmoBreed, is owned by Norwegian interests. Both companies continue to rely on public sector research.

Norway's breeding stock for Atlantic salmon and rainbow trout was initially collected from Norwegian rivers and farmed populations.[136] Once under the cooperative ownership of fish farmers' organizations, Norway's salmon and rainbow trout breeding population is now in private hands. Norwegian researchers caution:

> "Through the sale to a private foreign company, Norwegian salmon farmers may end up in a situation with limited access to breeding material from Norwegian rivers. This breeding material can now in theory be patented and removed from the public domain. The development has moved from a situation of public control and ownership, via a cooperative situation, to the current situation of increasingly dominating market actors."[137]

AquaGen develops, produces and sells genetic material for farmed Atlantic salmon and rainbow trout. In addition to Norway, the company has operations in Chile.

Scotland-based **Landcatch** (owned by Hendrix) is working with biotech company Affymetrix and UK partners to pinpoint inherited traits in salmon DNA.[138] The company has analyzed hundreds of thousands of variations in salmon DNA and claims to be the first company to identify a gene associated with resistance to Infectious Pancreatic Necrosis (IPN), which poses a major threat to Atlantic salmon.

Marine Harvest (Norway) operates in all major salmon farming regions in the world (Norway, Scotland, Chile, Canada) and claims to be the number one producer of farmed salmon, with one-fifth of the global production. In 2011, the company had revenues of about $2.9 billion. The company conducts advanced breeding of salmon based on its proprietary "Mowi" strain, but declines to give more details. (The Aquagen and Mowi strains are the two main strains of farmed Atlantic salmon in Norway.)

AquaBounty Technologies (Massachusetts, USA) is a small biotechnology company trying to commercialize – amid a storm of controversy – the world's first genetically engineered food animal: Atlantic salmon. The salmon are engineered with a growth hormone gene from Chinook salmon, and genetic material from ocean pout (an eel-like species). The company claims its salmon will grow to market-size twice as fast as other farmed salmon. As of early June 2013, regulatory review by the USDA is pending. In February 2013 synthetic biology company**,** Intrexon, announced a proposed collaboration with AquaBounty (subject to shareholder approval), including investment of up to $6 million "to advance the sustainability and efficiency of fish production."[139]

Shrimp

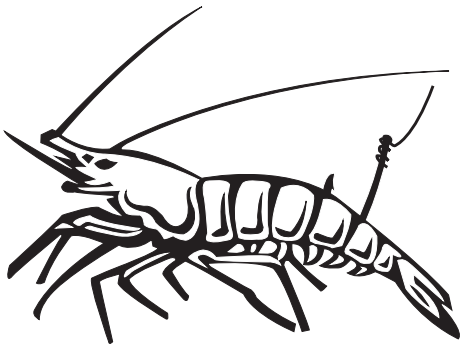
About 55% of the world's commercial shrimp catch now comes from aquaculture. Large-scale shrimp breeders include:

CP Group – Shrimp hatcheries supply the company's vertically integrated farming operations in China, Malaysia, Thailand and India. Production statistics are not available.

Gold Coin/SyAqua – In 2011, Malaysia-based feed milling group, Gold Coin, purchased SyAqua Shrimp Genetics, which focuses on Pacific white shrimp (*Penaeus vannamei*), developed over two decades at Hawaii's Oceanic Institute. The company provides "specific pathogen free" (SPF) broodstock to the international shrimp farming industry.[140]

Gold Coast Marine (Australia) is family-owned and focuses on Black Tiger shrimp and claims yields of 17.5 tonnes per hectare, more than double the industry's average.

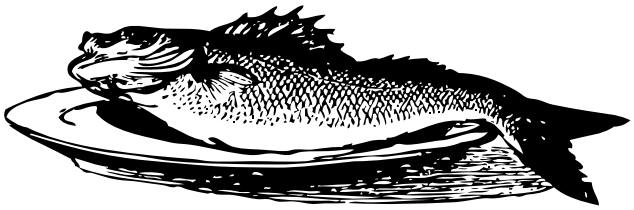
Shrimp Improvement Systems LLC (SIS), located in Florida (USA), is privately-held and the self-described "world leader in selective breeding of shrimp."[141] The company also provides "specific pathogen free" (SPF) stocks of Pacific white shrimp to the worldwide aquaculture industry.



Norwegian researchers note that the requirement established by several Asian countries to permit only certified, "specific pathogen free" (SPF) shrimp broodstock has created a monopoly-like

market barrier that favors larger firms – despite that SPF status "does not provide information about the animals' genetic qualities for any trait, including its ability to resist pathogens that the animals encounter in the new production environments."[142] Ironically, breeding stock with strong natural resistance to relevant pathogens could thus be excluded from importing countries due to lack of SPF certification.[143]

Tilapia



Genomar AS (Norway) is one of the world's leading aquaculture companies with special focus on tilapia. Genomar's hatchery in southern China (island of Hainan), supplies a large part of the tilapia industry in southern China. In Malaysia, GenoMar operates a large integrated tilapia farm designed to produce "verifiably traceable tilapia," or "Trapia." Through its subsidiary Genopass Pte Ltd in Singapore, GenoMar is involved in providing the aquaculture industry with a verifiable traceability system, which uses DNA technology to verify the origin of individual fish and fish products.[144] Genomar's privatized tilapia breeding stock is particularly notable (and controversial) because it is based on public sector research sponsored by the Consultative Group on International Agricultural Research,[145] with support from the governments of the Philippines and Norway, known as Genetic Improvement of Farmed Tilapia (GIFT). After the GIFT program ended in 1997, a non-profit foundation was set up to continue the research. In 1999, the foundation made an agreement with Genomar, and subsequently turned over commercial rights to the GIFT strain. A case study prepared by researchers at Norway's Fridtjof Nansen Institute concludes, "the rights to use a strain that had been developed with public funds with the purpose of benefitting small, poor farmers, were transferred to a profit oriented private company. As a consequence, the focus of research, development and target farmers changed."[146]

Spring Genetics (Norway) is an aquatic breeding company that markets the Spring-Tilapia strain. Established in 2009, the company is the production arm of Akvaforsk Genetic Center AS, the world's largest R&D and consultancy group on selective breeding programs for aquaculture species. The company's facility in Florida (USA) supplies hatcheries in the Americas with selected genetic material, which in turn distributes Spring-Tilapia fingerlings to grow-out farmers. Like Genomar's (see above), the company's tilapia strain (Spring Tilapia) is based on the selected material developed by the publicly-funded GIFT project.[147] Using the GIFT strain as the base, Spring Genetics continues to carry out breeding programs in Asia and Latin America.

Salmon Farming: Adverse Impacts on Biodiversity and the Environment

Aquaculture advocates believe that selective breeding of aquatic species is the key to meeting the world's growing demand for animal protein.[148] Selective breeding programs for most fish and shellfish species have claimed average genetic gains of 12.5% growth rate per generation – substantially higher than that of farm animals.[149] According to Norwegian researchers, if 50% of the world's aquaculture production were based on improved genetic stock, availability of fish and shellfish for human consumption could increase 3-fold by 2020. This rosy scenario overlooks the massive ecological costs of aquaculture expansion. In recent decades, the spread of industrial fish farms has been linked to pollution of the marine environment, spread of disease and devastating loss of wild fish populations. The amount of fish food required to raise

farmed salmon is inefficient and wasteful – requiring about three pounds of wild fish to grow one pound of farmed salmon (although industrial feed practices have improved recently).[150] Interbreeding between wild stocks of salmon and farmed salmon has also reduced the fitness of native populations and their ability to survive. Recent examples include:

- Chile's farmed salmon industry crashed in 2007 following the introduction of infectious salmon anaemia (ISA), a virus that was likely introduced in fish eggs imported from Norway.[151] The virus killed millions of fish, caused over $2 billion in losses and displaced over 26,000 workers.

- In 2010, aquaculture in China suffered production losses of 1.7 million tonnes caused by diseases, pollution and natural disasters.

- In 2011, disease outbreaks virtually wiped out marine shrimp farming production in Mozambique.[152]

- In 2008, Canadian scientists reported that wild populations of salmon in Canada, Scotland and Ireland were being wiped out by infestations of parasitic sea lice that spread from nearby salmon farms.[153]

- In 2012, Scottish researchers found that 39% of deaths each year among free-ranging Atlantic salmon in European waters was caused by sea lice found largely in stocks of farmed fish.[154]

Industrial aquaculture is one of the fastest-growing sub-sectors of the agro-industrial food chain. Fish farming practices vary enormously, depending on the species farmed, size of operation, location and management practices. However, the parallels between corporate-controlled farming and fishing are undeniable: industrial aquaculture, based on capital intensive inputs and uniform breeding stock, is depleting biodiversity, marginalizing small-scale fisherpeople, polluting our food, water and environment and emphasizing the use of proprietary germplasm and technologies as the solution to world hunger.

Conclusions and Policy Recommendations

The concentration of corporate power – including the concentration of corporate R&D – belongs at the forefront of any attempt to answer the question, who will feed us (and what will they feed us) in the era of climate chaos?

Most economists and government studies agree that whenever, in any economic sector or geographic region, four or fewer enterprises control 50% or more of sales, it's a cartel that will grind both competition and innovation to a halt. Cartels exercise their power through obvious strategies like price-fixing and divvying up markets, but high-tech cartels emphasize patent-sharing, cross-licensing and joint venture initiatives that can be made to look collaborative or even socially-beneficial.

Given agriculture's need to respond to climate change, the impact of concentration and cartels on research and development is especially worrisome. Yet, in today's world of industry-regulated governments, the official so-called regulators don't raise a hand when six companies – awash in cross-licenses and joint ventures – control 75% of all research in agricultural inputs around the world.

So, when the world's largest seed companies declare that they have ended their patent infringement lawsuits and have decided to cross-license one another, are they putting an end to costly litigation or are they announcing a new cartel? When seed companies announce that they are prepared to share the critical know-how required to keep technologies alive whose patents are expiring with a group of companies willing to share in the costs, is this an act of corporate benevolence or, again, a new cartel?

Recommendations:

Most economists agree that whenever four or fewer enterprises control 50% or more of sales in a given sector, a *de facto* cartel exists and competition suffers, but even that level of concentration would still be dangerous for the world's food supply. In food and agriculture, the four-firm market share should never exceed 25% and a single firm's share should never rise above 10%. There should be no exclusive monopoly intellectual property exercised over vital agricultural resources including plant and animal genetic resources. With this perspective, ETC Group offers the following recommendations.

At the national level:

1. Whenever four or fewer enterprises control 25% or more of sales in any commercial sector relevant to food and agriculture, in any one of the three most recent years for which data are available:

   a) The corporate clique should be dismantled so that it does not collectively control more than 25% of the market and no single enterprise controls more than 10%;

   b) Appropriate government agencies should individually examine all intellectual property, know-how and joint venture arrangements to eliminate restrictive business practices; and,

   c) If a cartel is identified, all forms of intellectual property held by any member of a cartel, relevant to the operations of the cartel, should be rescinded and made public.

2. Enterprises should be required to make publicly available any information previously regarded as "confidential business information" that is relevant to determining market share and defining inter-firm arrangements such as strategic alliances and joint ventures.

3. Competition policy should make it unlawful for any enterprise to sell seeds whose viability and/or productivity is dependent on that same enterprise's agrochemicals.

4. Governments should strengthen or implement national competition policies that include strong anti-monopoly and combines provisions that protect small food producers and consumers, as an effective mechanism to impede cartel formation.

At the international level:

5. The UN Committee on World Food Security should request the High-Level Panel of Experts to immediately undertake a study of the impact on food security of cartels and corporate concentration in food and agriculture with a view to recommendations for national, regional and global regulatory action.

6. UNCTAD, in cooperation with other relevant multilateral agencies, should undertake a study of the capacity of national governments, regional intergovernmental associations, and the UN system to monitor and control industry cartels and corporate concentration and make recommendations for the establishment of appropriate regulatory measures and mechanisms.

7. The UN Committee on World Food Security should convene a special conference on "Agriculture, Climate, and Innovation" in order to assess the capacity of the industrial food chain, the peasant food web, and alternative food systems to successfully innovate to ensure food security to address climate change.

Cartels: The Road from "Restrictive Business Practices" to "Confidential Business Information"

Monopolies and cartels are as old as trade and commerce but we had to wait until the Industrial Revolution and the arrival of large manufacturing enterprises to achieve prime-time multinational corporate collusion. The first modern complaint against corporate cartels came in 1879 from the German Reichstag railing against (appropriately enough) price-fixing in rails, locomotives and trucks.[155] Although European consumers (and the companies outside the cartels) complained bitterly, European governments were often supportive of cartels if they were thought to advance cross-border trade. Still, a decade after the problem was identified in Germany, both Canada and the United States adopted anti-combines legislation.

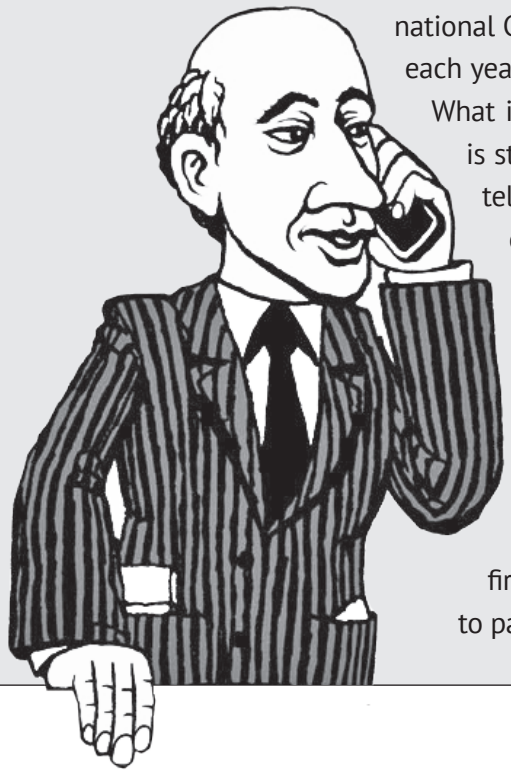
Historically, cartels have been rampant in the broad chemicals sector that includes industrial chemicals, dyestuffs, pesticides, synthetic fertilizers, explosives, plastics, pharmaceuticals, etc. The high cost of research in this high-tech field and the risk that sudden technological change could devastate investment encourages corporate collusion. Of all these industrial sectors, the fertilizer industry is notorious for a century of non-stop cartels. Yet, this is the least concentrated of all agricultural inputs. How come? Fertilizer is mostly sold as a combination of nitrogen (N), phosphorous (P) and potash/potassium (K). Phosphates and potash are mined in different parts of the planet while nitrogen is sucked out of the atmosphere and produced using natural gas – by default, nitrogen fertilizers are manufactured where gas is cheaper. History and practice have made it more difficult to merge companies here than in other fields of chemistry. But, when so many companies are involved in producing a common product line, even ambivalent regulators have to take notice.

Public anger against cartels peaked post-World War II when the citizenry recognized that their largest corporations had quietly honoured pre-war cartel agreements with "the enemy" even in the midst of brutal hostilities.

UN inaction: As a consequence, in the 1940s and '50s, the United States and some other industrialized countries looked to the newly-created United Nations to constrain the power of multinational corporations. US President Roosevelt saw

trust-busting as an important obligation of the new global body and his successor, Harry Truman, advocated for the formation of a UN International Trade Organization, in part, to block cartel arrangements. In 1951, the USA led the UN Economic and Social Council (ECOSOC) to establish an Ad Hoc Committee on Restrictive Business Practices whose report the USA, under the next administration, rejected in 1953. There were other moves outside the UN. The Treaty that established the Organization for Economic Cooperation and Development (OECD) included a mandate to prevent corporate cartels and the 1957 Treaty of Rome that ultimately led to the present-day European Union also came out explicitly against cartel arrangements. In the 1970s, the United Nations and the UN Conference on Trade and Development (UNCTAD) drafted a Code of Conduct on Multinational Enterprises that was blocked by leading OECD states. Defensively, the OECD then produced its own watered-down code of conduct in 1976.

From RBPs to CBI: Between World War II and the Reagan/Thatcher era, whether it was UNCTAD, OECD, Canada's Royal Commission on Corporate Concentration, or even the US Senate, the big concern was around "Restrictive Business Practices" and the capacity for highly concentrated markets and cartels to create insurmountable barriers to entry for new and often more innovative enterprises. Not only could cartels fix prices and mount campaigns against newcomers but their collective know-how and market knowledge could also dictate technology access. Today, the reverse is true: RBPs are passé and governments are anxious to protect Confidential Business Information (CBI). The sin is now a virtue.



Since 2001, a global antitrust effort known as the International Competition Network (ICN) has been meeting each year to "address practical competition concerns." What is clear from the ICN's work is that antitrust is still the name of the corporate game and cartels are ubiquitous. Successful prosecution of over 100 international cartels between 1990 and 2010 demonstrates, apparently, that the system is working, where 'successful' means that the companies involved were found guilty and paid a fine, though the EU has recently instituted a leniency policy for companies that provide inside information about cartels in which they participate: "The first company in a cartel to do so will not have to pay a fine."

Notes

1 The six companies are Monsanto, DuPont, Syngenta, Bayer, Dow, and BASF. Note that BASF is not included among the top 10 seed companies. While the company does not have significant retail seed sales, it is heavily engaged in seed research and has partnerships with several of the other five companies and investments in several start-up enterprises.

2 See, for example, then-Assistant Attorney General Christine Varney's remarks in quoted Department of Justice, "Competition and Agriculture, May 2012, p. 2: "...well functioning agricultural markets are not only a matter of economic efficiency, but a matter of national security and public health."

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17 Kari Belanger, "IPR Makeover," *Seed World*, June 2012, p. 31.

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monitoring power
tracking technology
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