Ethical Issues Arising from Enviropigs
A Cooperative Learning Ethics Case Study
on Agricultural Biotechnology

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Background: Manure from farm animals is an important natural fertilizer for the growth of crops, but manure from intensive hog farms is a serious environmental problem. Because it is high in phosphorous, it can lead to water contamination, algae blooms which harm aquatic life, and the production of greenhouse gases. Researchers at the University of Guelph have developed transgenic pigs, Enviropigs, that use plant phosphorus more efficiently. By producing the enzyme phytase in the their saliva, the pigs can degrade normally indigestible phytate, which would otherwise release phosphorous into the pigs' manure. As a result, the phosphorus content of the manure is reduced by as much as 75 percent.

Some groups claim that Enviropigs will produce substantial benefits to the environment, consumers, and pork producers. Others claim that these benefits are a smokescreen that will divert attention from the long-term unsustainability of intensive pork production, and that Enviropigs pose unacceptable risks to consumers and the environment.

One of the primary funders of the research, Agriculture and Agri-Food Canada (AAFC), is deciding whether to renew their funding of the research. In response to increased public sensitivity to the use of genetic engineering in agriculture, and in response to several recent news articles critical of the Enviropigs, the agency will convene a meeting with various stakeholders. AAFC arbitrators will hear testimony from the groups and decide whether to renew the funding. They will base their decision on whether the Enviropig project conforms to the agency's mission of providing "information, research and technology, and policies and programs to achieve security of the food system, health of the environment and innovation for growth" and for satisfying the new Agricultural Policy Framework (APF), which is "composed of five elements: food safety and food quality, environment, science and innovation, renewal, and business risk management."

All of the materials included are actual materials from news reports, science journals, or web sites. Some of them have been edited to remove discussion of topics not directly relevant to the Enviropigs. The only things I am asking you to make up are the idea that the AAFC is presently deciding whether or not to renew funding and that they would convene a stakeholders group to get input on the decision. I don't have any idea how they actually decide what to fund or when the Enviropigs funding is up for renewal.

The Format: After dividing into small groups representing the adjudicating group (the AAFC panel) and the stakeholders, each group should pick a representative to do their presentation. You will have 30 minutes to discuss how to present your case to the AAFC panel. Each stakeholder group will then have either 5:00 (Group 1) or 3:00 minutes (Groups 2 and 3) to present their case. After the presentation, the AAFC panel has time to ask questions, and the stakeholder group has time to respond. After all of the presentations are done, each stakeholder group will have 2 minute to ask questions of the opposing stakeholder group(s)., with the questioned group having 1 ½ minutes to respond. Then the AAFC panel will adjourn and deliberate for 10 minutes. They will then return and take 5 minutes to present and justify their decision by drawing from those groups that supported their decision, and, indicating how they would respond to those groups that would not support their decision. The groups should then step back and discuss what they thought of the exercise. The exercise should take about 1 ½ hours.

Instructions

Instructions for the AAFC Panel: You will be asked to decide whether to renew funding for the Enviropig project. Your verdict should be based on the extent to which the project is consistent with the Ministry's mission and APF. Use your time to decide what additional facts you need to make a good decision and what moral questions need to be answered. After you hear testimony from each group, you should ask them any questions that you think remain unanswered. After all the testimony, you will have time to deliberate. Select a representative to present and justify your decision.

General instructions for all stakeholder groups: Begin by reading the description of your group's position, given below. You **must** frame your argument within the general framework specified in the description of your group's position. Although the description offers you some of the specific arguments you should consider, feel free to develop your own based on the materials for your group. Read the materials for your group, as well as any AAFC materials relevant for your argument. Generate moral and/or scientific reasons supporting your position. Plan to include both factual statements ("ENVIROPIGS produce substantially lower amounts of phosphorous in their manure") and moral principles ("The AAFC should endorse a project which will help reduce environmental harm." Formulate a strategy for briefly presenting your position to the AAFC panel in a persuasive manner, and be prepared to answer questions from the panel about your position. Choose one person to speak for your group. You will have three minutes to present your position.

Instructions for University of Guelph Scientists (Group 1): You will argue that AAFC should continue funding the Enviropigs project because Enviropigs will, by the time they reach the market, not pose any significant food safety risk , will benefit consumers by giving them price savings and an environmentally friendly product, and will have substantial environmental benefits, both for intensive hog production facilities as well as for small-scale and third-world hog farmers. You will also argue that by providing public funding, the AAFC increases its ability to direct the research towards the public good, which it would not be able to do if the research were entirely privately funded**.**

Instructions for Friends of the Earth International (Group 2): You represent an organization dedicated to protecting the environment and promoting sustainable agriculture. You will urge AAFC not to renew their funding on the grounds that Enviropigs, like many other products of genetic engineering, pose unacceptable risks to the environment by encouraging hog farms to scale up their production and by distracting them from more sustainable alternatives. Moreover, because you think that the use of genetically modified organisms only continues because of the unequal bargaining position wielded by large agribusiness companies, you will urge AAFC to refuse to give priority to industry over the environment.

Instructions for Organic Consumers Association (Group 3): The OCA is a grassroots non-profit public interest organization which deals with crucial issues of food safety, industrial agriculture, genetic engineering, corporate accountability, and environmental sustainability. You will argue against the Enviropig project on the grounds that Enviropigs, like many other genetically engineered products, have unacceptable food safety risks and goes against consumer preferences.

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Readings

All Groups: Readings for all groups (word count: 707):

1. Agriculture and Agri-Food Canada – Backgrounder (707 words), p. 4

Group 1: Readings for the University of Guelph Scientists (word count: 4,281):

1. Forsberg, C. W. “The Enviropig: An Environmentally Friendly Pig That Utilizes Plant Phosphorus More Efficiently” (2,152 words), p.6
2. University of Guelph Research. “Sensational Science or Science Fiction?” (1,585 words), p. 10
3. Forsberg, C. “The Enviropig Will Reach The Meat Counter, But When?” Ontario Farmer (Jan 1, 2002) (544 words), p. 13

Group 2: Readings for the Friends of the Earth International (word count: 3,784):

1. Friends of the Earth International- Mission Statement (227 words), p. 15
2. Vestel, L. B. “The Next Pig Thing” Mother Jones (Oct 26, 2001) (1, 214 words), p. 16
3. Editorial, Minnesota Daily. “Enviropigs Will Not Help Environment” University Wire (Oct 30, 2001) (478 words), p. 19
4. Halverson, M. “The Price We Pay for Corporate Hogs: Executive Summary and Overview,” (July 2000) (1,865 words), p. 20

Group 3: Readings for the Organic Consumers Association (word count: 3,455):

1. Organic Consumers Association – Background Information (319 words), p. 25
2. Cummins, R. “Hazards of Genetically Engineered Foods and Crops” Organic Consumers Association (1,658 words), p.26
3. D’Amato, L. “Enviropig Studies Search for Effects of Meat on Humans” Kitchener Waterloo Record (Aug 3, 2001) (523 words), p. 29
4. Kirsch, V. “Tainted Animal Feed Risk Downplayed by Federal Officials” The Guelph Mercury (Feb 19, 2002) (607 words), p. 30
5. Council of Canada. “Poll on Attitudes to Genetically Engineered Foods.” (March 31, 2000) (348 words), p. 32

All Groups: Readings for all groups (word count: 707):

1. Agriculture and Agri-Food Canada – Backgrounder (707 words)

AAFC BACKGROUNDER
Overview of the Agricultural Policy Framework

The Government of Canada, along with provincial and territorial governments and the agriculture and agri-food industry, is putting in place a comprehensive agricultural policy that will increase the profitability of the entire agri-food sector. The Agricultural Policy Framework (APF), cost-shared with the provinces, will provide the tools and the choices for producers to strengthen their businesses. It will allow them to meet the demands of consumers in Canada and around the world while responding to increased global competition and keeping up with rapid technological change. Linking the following elements together in a comprehensive approach will ensure that the Canadian agriculture and agri-food sector has a solid platform from which to maximize economic opportunities in the global marketplace.

Food Safety and Quality: Canada's agriculture and agri-food sector enjoys a global reputation for consistently delivering safe, high-quality food. Many players in the industry are already moving to adopt systems that will offer documented evidence of safety and quality to meet consumer demands. The APF will help industry develop these systems to trace their products through the entire food chain to consumers and expand food safety and quality monitoring at the production level. The food safety surveillance and information systems that governments currently have in place would be strengthened.

Environment : Environmental stewardship is key to both the industry's long-term sustainability and its profitability. The industry is well aware of this and is already taking action to manage known environmental risks. The APF sets out areas where governments can provide help, including better information and research on the links between agriculture and the environment, the development of best management practices, and stepped-up action on environmental priorities on farms through agri-environmental scans and environmental farm plans.

Renewal: As agriculture is knowledge intensive, producers are increasingly engaging in continuous learning to keep pace with change. Renewal efforts include enhanced public and private business management and consulting services, management and marketing information to assist farmers to enhance their profitability, and networks to better link scientific advances to the creation of new economic opportunities.

Science and Innovation: Advances in science and technology have long been part of the success of Canada's agriculture and agri-food sector and one of the goals of the APF is to make the sector the world leader in innovation. The APF emphasizes the coordination of research and innovation efforts across governments, the sector and private research institutions to achieve maximum return on investments in the key areas of food safety, the environment and innovative production.

Gaining Recognition for Quality and Maximizing International Opportunities: As global competition intensifies, we have to continually innovate to stay ahead of our competitors in meeting market demand. The first step is building the infrastructure to make Canada the world leader in food safety and food quality, environmentally responsible production and the creation of innovative agri-based products and services that meet or exceed market demands. The next step is gaining recognition at home and abroad for our success in being the world leader, and ensuring our industry has the access to foreign markets to make the best use of its global leadership in food production. The Government of Canada will continue to work with industry to advance the trade interests of the sector by developing targeted market strategies for key, fast-growing international markets while pursuing Canada's objectives in the World Trade Organization. This is the key to reaping maximum benefit from the APF for the sector.

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The Enviropig: An Environmentally Friendly Pig That Utilizes Plant Phosphorus More Efficiently

Cecil W. Forsberg
August 31, 2001

[This document has been modified from its original form to include information from the article "Guelph Transgenic Pig research Program."]

A Biotech breakthrough at the University of Guelph in reducing the environmental impact of manure produced by pigs: Researchers at the University of Guelph have developed transgenic lines of Yorkshire pigs trademarked **Enviropig**™ that use plant phosphorus more efficiently (Golovan et al., 2001a; Golovan et al., 2001b). Non-transgenic pigs are unable to use an indigestible form of phosphorus called phytate present in the cereal grain diet. Therefore producers add supplemental phosphate to meet the dietary phosphorus requirement for optimal growth and development. The novel trait of the **Enviropig**™ enables it to degrade the indigestible phytate and absorb the phosphate eliminating the need to supplement the diet with readily available phosphate, and as a consequence the phosphorus content of the manure is reduced by as much as 75%. Digestion of the phytate also leads to improvements in digestion of minerals, proteins and starch in the diet.

The Environmental Problem: Manure from farm animals is an important natural fertilizer for the growth of crops. The manure from monogastric animals such as pigs and chickens, contains a higher concentration of phosphorus than is suitable for repetitive field application because indigestible (phytate) phosphorus passes through the digestive tract of the animal while other nutrients are absorbed. Therefore, the phytate phosphorus is concentrated in the manure. Consequently, at high application rates of manure to land in areas of intensive pork production, the potential for pollution of local surface water and ground water with phosphorus becomes a serious problem (Sims et al., 1998). When runoff and leachate from drainage tiles of fields that have a high phosphorus content drain into ponds and streams extensive plant and algal growth occurs, tainting the water and robbing it of oxygen leading to death of fish and other beneficial aquatic organisms (Jongbloed and Lenis, 1998; Kornegay, 2001) . Although rare, if there is flooding and rupturing of manure storage reservoirs more serious situations can arise (Mallin, 2000) .

A low phosphorus concentration in fresh water systems is key to clean water because its absence limits algal growth (Hudson et al., 2000). If phosphorus is not present at a growth-limiting higher concentration extensive eutrophication can occur, leading to the production of methane and nitrous oxide potent greenhouse gases (Huttunen et al. 2001; Steenbergen, et al. 1993). Eutrophication arising from agricultural sources also occurs in estuaries and near shore marine environments with production of nitrous oxide (Naqvi et al., 2000). The projected growth of the livestock industry (Delgado et al., 1999; Tilman et al., 2001) is expected to accelerate environmental problems on a global scale. It therefore is critical that agricultural practices be modified to reduce such environmental impacts.

The Current Strategy to Reduce the Phosphorus Content of Pig Manure: The current practice to reduce excretion of fecal phosphorus by pigs is to decrease the supplemental phosphorus and to simultaneously include in the feed the fungal enzyme called phytase, which is available commercially. This enzyme acts to digest dietary phytate releasing phosphorus in the stomach of the pig. The net effect is improved phosphorus absorption in the small intestine by approximately 20 to 40% at phytase concentrations of 500 to 1000 Units per kilogram of feed (Ketaren et al., 1993; Simons et al., 1990). The reduced content of phytate in the small intestine decreases complexes formed between phytate and trace minerals, proteins and starch, thereby improving their absorption as well. Phytase is currently added to the swine diet in many countries.

Currently crops are being developed that contain phytase in the seeds, however, there is a problem with stability of the enzyme during pelleting and storage. Research is also in progress on the development of phytate-reduced cereal grains, for example, corn that contains 65% less phytate (Raboy et al., 2000) which reduced the need for added phytase, however, supplementation was still beneficial for pigs (Sands et al., 2001) and poultry (Huff et al., 1998) . The potential of low phytate cereals is not fully resolved, since at least low phytate corn exhibits a lower germination and reduced yield as compared to unmodified lines of the corn.

What is novel about the Enviropig?: The Enviropig produces the enzyme phytase in the salivary glands that is secreted in the saliva. The enzyme acts in the stomach in the same way as fungal phytase added to the feed, except it is synthesized in larger quantities in the salivary glands (perhaps as much as 100,000 Units per kg of feed consumed) than the amount commonly added to the diet. The Enviropig was produced in the following way: A *transgene* constructed by linking a small portion of a mouse gene responsible for production of a salivary protein in the parotid, sublingual and submaxillary salivary glands to a phytase gene from a non-pathogenic strain of the common intestinal bacterium *Escherichia coli* (strain K12). This *transgene* was introduced into fertilized pig embryos, which were subsequently implanted into pseudopregnant surrogate sows. The offspring were tested for the presence of the gene by analysis of DNA from the piglets, and by testing saliva for phytase. Initially thirty-three different Enviropigs were produced with the same *transgene*. The transgene probably was introduced into a different location of the chromosome of each of these pigs, therefore, each pig is considered to be a different line. Several of these lines have been studied in more detail. They produce sufficient phytase to digest practically all of the phytate in a cereal grain diet. Phosphorus in feces from young grower pigs not supplemented with phosphate was reduced by 75% while that in finisher pigs was reduced by 56 to 67% when fed diets not supplemented with phosphate. The enzyme is reasonably stable and fully active in the stomach, but is degraded in the small intestine by pancreatic proteases, preventing excretion from the pig. Furthermore, because of the high specificity of the transgene promoter, the phytase is produced primarily in the salivary glands with only trace concentrations (less than 0.1%) in the major tissues such as muscle, liver, heart, skin, etc..

Are the Enviropigs Healthy?: All indications are that the pigs have a similar health status to that of non-transgenic pigs. They grow at rates similar to non-transgenic pigs and they appear to have similar reproductive characteristics.

Benefits of the Enviropig TM:

(i) They excrete as much as 75% less phosphorus in the manure as compared to non-transgenic pigs when fed a diet not containing supplemental phosphorus, producing a fertilizer with a higher ratio of nitrogen to phosphorus, which is better suited for long-term repetitive application to agricultural land. Pigs receiving a typical industry standard diet without supplemental phosphorus excreted fecal material with 64 to 67% less phosphorus.

(ii) They utilize practically all of the phosphorus present in soybean meal and do not require supplemental phosphate for growth on a standard diet consisting of corn, barley, wheat and soybean meal, with a saving of $1.14 per pig (CDN) for supplemental phosphorus, or an equal or greater saving in the cost of phytase. Furthermore, added phytase to the diet at the concentrations normally used does not release phosphorus from dietary phytate as effectively as the salivary phytase

(iii) We expect the pigs will utilize dietary trace minerals, proteins and starch more efficiently.

(iv) Because the **Enviropig** can utilize plant phosphorus efficiently it may be of great benefit in countries with low phosphorus resources, and which often lack currency for the purchase of phytase, and furthermore, which often lack the infrastructure for precise mixing and distribution of feed containing phytase.

When will the Enviropig be available to Pork Producers?: We predict it will be three to five years before this line of pigs will be available to swine breeders. The research is at an early stage, but some questions have been answered:

(i) The phytase gene is stably transmitted.
(ii) The phytase functions effectively in the stomach of the pig.
(iii) The phytase protein is largely limited to the salivary glands and to the digestive system as far as the small intestine. It is destroyed before it reaches the large intestine.
(iv) All indications are that the **Enviropig** exhibits similar growth and carcass characteristics to non-transgenic market pigs.

The Enviropigs are subject to the Canadian Environmental Protection Act (CEPA) under the auspice of Environment Canada. When these animals or samples of tissue, blood or even fecal samples are moved from one University of Guelph facility to another, under the present arrangement, tracking documents must be maintained for each animal and each sample collected from them. The animals are subject to the Health of Animals Act under the auspice of the Canadian Food Inspection Agency. When the phytase pigs reach the stage of testing to determine suitability as a food for humans, they will be subject to the Novel Food Regulations (http://www.hc-sc.gc.ca/food-aliment/) of the Federal Food and Drug Act under the auspice of Health Canada. These stringent requirements will assure that pork from these animals, will be safe when it is eventually approved for the consumer.

Publications forthcoming from Health Canada:

(i) Guidelines for the safety assessment of novel foods. Volume III. Genetically modified livestock animals and fish.
(ii) Guidelines for the slaughter and disposal of livestock animals and fish derived from modern biotechnology

Animal Welfare Issues: All animal experiments are conducted following the strict guidelines of the Canadian Council on Animal Care (http://www.ccac.ca/. Guidelines on the production of transgenic animals may be downloaded from the site. Pigs are raised in accordance with the Canadian code of practice for environmentally sound hog production (http://www.canpork.ca/codes.html).

Who is supporting the research?: The research was supported by Ontario Pork, Ontario Ministry of Agriculture, Food and Rural Affairs through a contract to the University of Guelph, Natural Sciences and Engineering Research Council of Canada, Agriculture and Agri-Food Canada, and the Food Systems Biotechnology Center at the University of Guelph. The University of Guelph provides the expertise and facilities.

Some Regulatory Issues: I will make some personal comments regarding issues relating to the development of a protocol for assessing food safety of transgenic animals.

The Key Aspects of Novel Food Assessments:

1. The host organism.
2. The donor organism.
3. The modification process.
4. DNA analysis of the transgene.
5. The genetic stability of the modified organism.
6. Expressed material/effect.

I believe that the protocol for assessing transgenic plants can be applied to transgenic animal, except for the method of sampling tissues, pretreatment prior to sample analysis, and the extent of testing.

1. Will the assessment be performed on whole animals or tissues? With plants I understand that the whole raw seed is analyzed if the whole seed is to be eaten. In the case of fish I would assume that the whole animal might be ground and assessed because large pieces of the fish are eaten. However, in the case of animals, such as the **Enviropig** where organs, such as liver, kidney, or muscle are eaten separately there may be a desire to carry out assessment of separate organs rather than grinding up the whole carcass and sampling that. In the case of the **Enviropig** TM the salivary glands would be candidate organs to assess. In preparation for developing guidelines I recommend a broad survey of the published literature to assess the variation in composition between organs.
2. Pork and chicken meats are always cooked before consumption. Therefore I think it is reasonable that the samples should be cooked before testing. In contrast, plant samples are edible in the raw form and therefore sampling of the raw material is reasonable.
3. Some scientists have stated that transgenic animals will be more difficult to assess than transgenic plants because of their greater complexity. I contend that because the animal is more complex it will be easier to assess than plants. Arguments:
    a. Plants can produce toxic compounds without affecting their growth and appearance.
    b. Transgenic plants are normally tested for safety by feeding to animals. Therefore it may be argued that transgenic animals serve as their own internal control of food safety. Thus a healthy animal with a normal growth rate likely is safe to eat.
    c. I expect that after the first transgenic animal has been approved by the regulatory system, you will no longer need such a stringent analyses for vitamin content, amino acids composition etc. I suspect that a vitamin deficiency would affect the growth and would to symptoms before the content of a vitamin would have decreased dramatically. This comment leads to suggestion that it would be very useful to do an extensive literature survey of the nutritional literature to determine the relation between minimal requirements for essential nutrients and tissue composition of that nutrient. The survey will help to set a baseline for whether it is necessary to analyze the chemical composition of all tissues.

Sensational Science or Science Fiction?
University of Guelph Research

Virtually all the foods we eat today have been genetically modified through selective breeding, says Prof. Gord Surgeoner, Environmental Biology, and president of Ontario Agri-Food Technologies, a non-profit organization based in Guelph. "Fruits, vegetables, chickens, cattle, etc., bear little resemblance to their wild ancestors." In fact, crop scientists contend that selective breeding is one reason we don't have major food shortages today.

What is new about the genetic modification of plants and animals is that scientists now have the ability to speed up the process of genetic transformation and even move genes between species.

The agricultural industry seems to have embraced GE technology. The U.S. Department of Agriculture estimates that half of the country's last soybean crop and one-third of its corn crop used genetically engineered seed. In Ontario, farmers used transgenic seed on 35 per cent of corn, 20 per cent of soybeans and 60 per cent of canola grown last year.

Across Canada, growers now have access to more than 30 varieties of transgenic crops, including corn, canola, soybeans, potatoes, cotton, flax, wheat and tomatoes.

Biotech opposition: For the past six months, the media have been bringing us a transgenic revolution of a different kind, being waged on the field of public opinion. Think of that towering, menacing ear of corn erected by Greenpeace protestors in downtown Montreal during January's meeting of negotiators on the biosafety protocol on trade in genetically engineered products.

The monster image may be larger than life, but the depth of consumer concern over GE foods should not be underestimated. Speaking at a recent conference to mark the official opening of the FSBC, Guelph food science professor Mansel Griffiths, director of the Canadian Research Institute for Food Safety, said that eight out of 10 people polled by Angus Reid had heard of genetically engineered foods, and about 65 per cent said they would be less likely to buy a particular food if they knew it had been genetically altered.

Other polls suggest consumers have only a marginal understanding of the concept of biotechnology, and Prof. Larry Milligan, vice-president (research), says much of the current media coverage adds to that misunderstanding. GMO (genetically modified organism) has become the accepted acronym for genetic engineering, when the literal meaning is quite different, he says.

Opposing GM foods would include virtually everything on the dinner table, as Surgeoner pointed out, but Milligan says most consumer concerns are more likely focused on the transfer of genetic material in the laboratory, specifically between different species. "We all agree that people must trust what they eat," says Surgeoner. "Clearly, the process of modifying genetic material to improve foods must be subject to strict regulatory oversight."

He believes that's already being done in Canada and says the country's food supply "has an enviable reputation for safety and reliability based on a regulatory system for the assessment and approval of all foods marketed in Canada, including those produced through biotechnology."

Skeptics have capitalized on widespread public ignorance about the science and regulation of so-called GMOs, calling them "Frankenfoods" and conjuring up images of mad scientists running amok in laboratories. This couldn't be further from the truth, says Wildeman.

"It's important to understand that researchers do not randomly transfer genes about which they know nothing. There is a great amount of basic research conducted on a specific gene before it can be selected for transference."

Prof. Larry Erickson, Plant Agriculture, says activist organizations like Greenpeace have stirred up fears over the imponderables, such as what might happen in crossing species barriers and mixing, say, viral DNA with alfalfa genes. He and his colleagues, however, point out that the mixing of DNA even across species is routine and often benign. "The human genome consists of a high proportion of copies of viral DNA," says Prof. John Phillips, Molecular Biology and Genetics. Pointing, for example, to lengthy and apparently meaningless stretches of the human genetic code that incorporate portions of DNA from retroviruses that have co-existed with humans since time immemorial, he says: "There's a mistaken perception that the genomes of individual species are pure and pristine."

Other academics like Prof. Ann Clark, Plant Agriculture, say essentially no effort is being devoted to assessing the potential risks and side effects of consuming and introducing transgenic organisms into the environment. "Biotechnology is exciting science, and there's a lot of potential for understanding gene-to-gene interactions," she says, "but this is also a very costly technology. While we spend vast amounts of society's resources -- and researchers' time -- to service the biotech industry, we are not developing the capability to ask or answer other, potentially more fruitful, questions."

A specialist in pasture management and an advocate of organic farming, Clark raises issues like genetic pollution, food-safety testing and possible environmental side effects of introducing GE plants. She questions the real benefits of GE to the farming community, and flags the issues of liability and accountability should health or environmental risks actually materialize.

Other people oppose biotechnology for political reasons, including antipathy toward the multinationals that make genetically engineered seed. Prof. Karl Meilke, Agricultural Economics and Business, says there are a number of organizations opposing GMOs "that have an agenda where health and safety are, in fact, not at the top of the list. They are 'anti-Big Business' first and foremost and use the GMO issue to drive their agenda against companies like Monsanto and Novartis."

Food-safety guarantees: According to Guelph faculty, two questions are central to the debate over genetically engineered foods: Is there a risk in eating them and, perhaps as important, do people think there's a risk in eating them? "No one's saying this food is absolutely risk-free," says Surgeoner. "You can't guarantee zero risk with anything."

He notes that today's number-one health risk from food is posed not by genetic engineering but by overeating. Number two is food-borne illnesses resulting from natural pathogens such as E. coli, salmonella and listeria. Says Prof. Doug Powell, Plant Agriculture: "Several million Canadians are sickened and a couple of hundred are killed each year from food- and water-borne illness. Not one has ever been linked with genetic engineering. While vigilance is warranted with any new technology, the excessive concern about genetically engineered foods trivializes efforts of farmers, processors, distributors and consumers to enhance the safety of the food supply."

Adds Prof. Karen Finlay, Consumer Studies: "People use herbal remedies without questioning them, despite the fact they undergo no testing. People assume that because they're health-oriented, they've been tested. They haven't. They're assumed to be somehow safe because they're 'natural.'"

In fact, says Griffiths, biotechnology may be used to improve food safety, including detecting pathogens, improving epidemiology and surveillance, and learning more about the development

of pathogens causing food-borne illnesses. His centre is an interdisciplinary group of more than 50 university and government scientists established with an $8-million grant from the Canada Foundation for Innovation, the Ontario Innovation Trust and industry partners to study food safety and provide information to a food-policy centre also being developed at Guelph.

Powell points to the need to inform consumers about the regulations and practices that govern biotechnology and food safety. "There is one country in the world that has a mandatory safety assessment of new and novel foods -- whether derived through genetic engineering, mutagenesis breeding, new enzymes, whatever -- rightly focusing on the safety of the end product rather than how that end product was derived. It is Canada. Others should follow suit."

He recently joined a new federal advisory committee intended to brief federal cabinet ministers on ethical, social, regulatory, scientific, environmental and health aspects of biotechnology, and says testing of transgenic plants includes field trials to understand putative environmental risks and whether the crop performs as expected. For some crops, animal feeding trials are required, as well as nutritional, toxicological and molecular studies. Since 1993, genetically engineered foods have been regulated in Canada in the same way as any new food produced by conventional methods.

Health Canada and the Canadian Food Inspection Agency (CFIA) are both involved in assessing the safety of new food products, guided by the premise that genetically engineered foods are substantially equivalent to traditionally bred organisms and lend themselves to well-defined risk-assessment methods and principles. As the CFIA points out, regulators frequently have more knowledge about GMOs than about naturally grown foods.

The result? "We have not seen a single food-safety outbreak attributable to any genetically modified food that has passed through Canada's regulatory system," says Surgeoner. "That covers GM corn, canola, soybeans -- the products approved since 1994."

That assurance isn't good enough for retired botany professor Ann Oaks, who chuckles at the Health Canada assumption that GE foods are "substantially equivalent" to non-GE foods, "but they are different enough to qualify for a patent." She says Health Canada assessment panels rely on tests conducted in industry laboratories, and to her that is not as reliable as conducting the tests in independent labs. She also advocates food-safety testing that is as stringent as the procedures used to assess new pharmaceutical products, which check for allergens, immune system responses and growth responses.

"**G**enetic engineering is a cutting-edge science that we don't fully understand. We need to do much more basic research and move more slowly in the commercialization of GE products. It's easier to solve problems that arise during testing than to correct health problems that may occur in the general population after products have been in the marketplace for several years."

ONTARIO FARMER Tuesday, January 1, 2002
Letters
The Enviropig will reach the meat counter, but when?

Dear editor:
In the December 4th issue Tom Van Dusen asked where does the Enviropig fit in' to help the pork producer satisfy the proposed Nutrient Management Act, and still remain profitable?

To provide a refresher, manure from pigs and poultry is enriched in phosphorus, the major pollutant in areas of pork and poultry production. The Enviropig is designed to secrete in its saliva the enzyme phytase. This endows the pigs with the capability to utilize practically all of the phosphorus present in cereal grains.

This has two primary benefits: there is no need to add either supplemental phosphate or phytase enzyme to the diet, and second, the phosphorus content of the manure will be reduced by 60 to 80 per cent, which will allow manure to be spread on land at the same or greater rate than before and still meet stringent nutrient management requirements. Trials are in progress to determine whether the Enviropig manure has less odour.

Initial testing has documented that the transgenic phytase pigs are as healthy and grow as rapidly as other pigs. If the transgenic pigs appear healthy, why are they not in the food chain? Because of strict Canadian legislation including the Canadian Environmental Protection Act, the Novel Foods Act and the Health of Animals Act, which we fully support, and will necessitate extensive studies to document that the pigs have no deleterious effect on the environment, that they are healthy, and produce safe pork over an extended period of time.

Has industry shown interest in the Enviropig? Despite the tide of interest from the press, government and individuals throughout the world, no major player has come forward to sponsor the last hurdle for the Enviropig. However, we have had discussions with several swine breeders in Canada and with scientists in China who are keen to import the Enviropig.

There are good reasons for this wait and see attitude; first, there is the matter of cost, taking the first transgenic pig through the regulator process will be expensive and uncharted course, and second, the Enviropig is a GMO, and at least one major player in the pork industry is concerned that being associated with research and development on genetically modified pigs may leave the impression that their breeding stock is genetically modified, a factor which could have financial consequences.

When can we expect industry to take the Enviropig flag and run with it? The worst-case scenario is that the pork industry will not embrace the Enviropig until nutrient legislation is pressing the financial bottom line such that the continued profitability supersedes the concern over the GMO issue.

A factor that has been discounted is the flexibility of consumers when it comes to price shopping. Knowing that the pigs had been thoroughly tested, and if enviro-pork is a few cents cheaper than conventional pork, many consumers will go for the cheaper product. Some may even buy it because the Enviropig leaves a significantly smaller footprint in the environment.

The bottom line is yes the Enviropig is "hogtied in red tape'", however, be patient, its time will come, perhaps sooner than we expect.

Cecil W. Forsberg, Professor,
Department of Microbiology, U. of Guelph

Group 2: Readings for the Friends of the Earth International (word count: 3,784):

1. Friends of the Earth International- Mission Statement (227 words)
2. Vestel, L. B. "The Next Pig Thing" Mother Jones (Oct 26, 2001) (1, 214 words)
3. Editorial, Minnesota Daily. "Enviropigs Will Not Help Environment" University Wire (Oct 30, 2001) (478 words)
4. Halverson, M. "The Price We Pay for Corporate Hogs: Executive Summary and Overview," (July 2000) (1,865 words)

Instructions for Friends of the Earth International (Group 2): You represent an organization dedicated to protecting the environment and promoting sustainable agriculture. You will urge AAFC not to renew their funding on the grounds that Enviropigs, like many other products of genetic engineering, pose unacceptable risks to the environment by encouraging hog farms to scale up their production and by distracting them from more sustainable alternatives. Moreover, because you think that the use of genetically modified organisms only continues because of the unequal bargaining position wielded by large agribusiness companies, you will urge AAFC to refuse to give priority to industry over the environment.

Friends of the Earth International Mission Statement

Friends of the Earth International is a worldwide federation of national environmental organizations. This federation aims to:

- protect the earth against further deterioration and repair damage inflicted upon the environment by human activities and negligence;
- preserve the earth's ecological, cultural and ethnic diversity;
- increase public participation and democratic decision-making. Greater democracy is both an end in itself and is vital to the protection of the environment and the sound management of natural resources;
- achieve social, economic and political justice and equal access to resources and opportunities for men and women on the local, national, regional and international levels;
- promote environmentally sustainable development on the local, national, regional and global levels.

Friends of the Earth International has a democratic structure with autonomous national groups which comply with the guidelines established by the federation.

Friends of the Earth member groups are united by a common conviction that these aims require both strong grassroots activism and effective national and international campaigning and coordination. They see Friends of the Earth International as a unique and diverse forum to pursue international initiatives, taking advantage of the varied backgrounds and perspectives of its members.

By sharing information, knowledge, skills and resources on both the bilateral and multilateral levels, Friends of the Earth groups support each other's development and strengthen their international campaigns.

The Next Pig Thing Canadian researchers have developed a genetically-engineered pig that could help clean up a major source of water pollution -- but environmental groups want the swine squelched.

by Leora Broydo Vestel October 26, 2001

Once upon a time there were three little pigs. They were very special pigs. Their genes were engineered by scientists to make them less damaging to the environment than any of their swine brethren. And everybody lived happily ever after.

Or maybe not. The three pigs in question, developed by researchers in Canada and already patented as 'Enviropigs,' represent a unique dilemma for environmentalists. Major green environmental organizations are virtually unanimous in the view that genetically-modified products should be banned. But the Enviropigs address a major environmental problem -- one those same groups have been fighting for years.

At this point, while researchers and pig farmers have extolled the environmental benefit Enviropigs present, most of the leading environmental groups aren't following suit. While the hogs' virtues may be attractive to the green groups, their modified genes represent a vice too significant to overlook.

The crux of the debate centers around the manure pigs produce. Modern pig farming often involves raising thousands of swine in a single facility -- which can in turn generate thousands of tons of manure every year. That manure is then spread in fields or stored in "lagoons." The contaminants in the manure can spread from either fields or lagoons into water sources. In 1995, for instance, an eight-acre hog-waste lagoon in North Carolina burst, spilling 22 million gallons of manure into a nearby river and killing enormous numbers of fish. Concentrations of manure rank "among the greatest threats to our nation's waters and drinking water supplies," according to a recent Environmental Protection Agency study.

The Enviropig, developed at the University of Guelph in Ontario and introduced to the world in August, have been modified so that their manure contains up to 75 percent less phosphorus than the average swine. Several substances in pig manure cause environmental damage, but phosphorus is one of the major culprits. The presence of phosphorus in waterways can cause fish kills, biodiversity loss and foster the growth of toxic organisms, according to the EPA.

Unlike their predecessors, such as a salmon that are designed to grow faster, the Enviropig is the first animal engineered for environmental benefit. Not surprisingly, scientists and pork industrialists are thrilled, since proposed government limits on phosphorus output threaten the industry's growth. Ontario Pork, a trade association representing pig farmers in the Canadian province, calls the Enviropig "the biggest breakthrough in pig farming since the invention of the trough."

"The environmental barriers are the largest in terms of growing as an industry," says Clare Schlegel, chairman of Ontario Pork, which represents 4,400 hog farmers in the province and has been a primary funder of the Enviropig research. "[Pork producers] are being looked at as polluters -- this is one technology to show that we do care."

Environmentalists aren't buying it. The Sierra Club, which has made lobbying for controls on pig manure pollution a centerpiece of its clean water campaign, calls the Enviropig a load of hogwash.

"This is just another quick fix," says Laurel Hopwood, chair of Sierra Club's genetic engineering committee. "The way to reconcile [the problem] is to stop factory farming." Greenpeace and other

environmental groups have echoed the Sierra Club message, arguing that the only real solution is moving away from massive industrial-style hog-growing and instead raising fewer pigs in bigger outdoor spaces.

Other technical fixes also exist. Pigs don't digest most of the phosphorus in their grain-based diet, so it ends up in their manure. A new breed of corn, developed by a USDA researcher, reduces phosphorus in manure by up to 50 percent. A widely practiced strategy of adding the enzyme phytase to feed can also reduce phosphorus content by 56 percent.

"There are a lot of sustainable agriculture programs that offer real benefits to food security and to the environment that take far less resources than the biotech solutions being proposed," says Michael Khoo of the Union of Concerned Scientists.

The Guelph researchers addressed the problem by modifying the pigs' digestive abilities. They combined a bacterial gene which makes an enzyme that breaks down the form of phosphorus found in pig feed with a mouse gene that causes the enzyme to be secreted from an animal's mouth. The composite gene was then injected into one-celled pig embryos that were subsequently surgically implanted into a surrogate mother.

The results were the first three Enviropigs, which researchers named Wayne, Jacques and Gordie after famous Canadian hockey players. Today, Guelph houses more than 100 Enviropigs -- the result of three generations of breeding, and all of them have inherited the genetic trait that allows for the digestion of phosphorus. All produce manure that contains 60-75 percent less phosphorus than non-engineered pigs.

Apart from that helpful trait, "there's nothing we've seen so far that would indicate that there's any abnormality" with the pigs, says molecular biologist Dr. John Phillips, the lead researcher in the Enviropig project. Nonetheless, he adds, these piggies still must undergo three to five years of testing before they can go to market.

"These animals are going to be tested like no other animals have been tested before they're certified to go into the human food chain," says Phillips.

Pig farmers are apparently eager for the day when they can begin raising Enviropigs, saying they represent a particularly promising solution to the phosphorus problem. Some independent experts also think Enviropig is a solid bet. Dr. Joann Whalen a soil expert at McGill University in Montreal, Canada, thinks Enviropig is even better than a non-biotech solution to the phosphorus problem that she helped develop. Whalen found that mixing limestone in with hog manure could net a 50 percent reduction in phosphorus content. But, she says, this method is expensive and impractical, as the limestone has to be trucked in to farms and requires extensive manpower to spread.

"It's dealing with the problem after the fact," Whalen concedes. "[Enviropig] is definitely a much better approach -- it's more cost effective to have a pig that excretes less phosphorus."

Still, for virtually all major environmental groups, the matter boils down to the fact that they oppose the introduction of genetically-engineered organisms into the environment.

"The GMO issue is a deal breaker," says Melanie Shepherdson Flynn, an attorney with National Resource Defense Council's Clean Water Project. "It's an extreme solution without knowing what the result will be."

If Enviropig passes regulatory muster, the rights to the technology will be sold to pig breeders. But given the charged debate developing around it, Enviropig's path to the dinner table remains questionable.

"It's a technology that adds a great deal of value," says Schlegel. "But we're not interested in seeing the technology commercialized if the public is not interested in genetically modified foods."

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HEADLINE: Enviropigs will not help environment
BYLINE Editorial, Minnesota Daily
University Wire
October 30, 2001
SECTION: EDITORIAL
LENGTH: 471 words
SOURCE: U. Minnesota
DATELINE: Minneapolis

BODY: In the near future, a side of bacon might be more than just pig. It will probably contain some mouse and a little bit of an E. coli bacterium too. The reason: Canadian scientists genetically designed a pig by injecting genes from an E. coli bacterium and a mouse into a single-cell pig embryo. And this new combination is in demand. These transgenic pigs excrete manure containing 50 to 75 percent less phosphorous -- a chemical the EPA says is a major threat to our nation's water and drinking supply. The pigs, trademarked Enviropigs, will be the first genetically modified farm animals to reach the market anywhere in the world, their creators at Ontario's University of Guelph believe. Microbiologist Cecil Forsberg, involved in the project, said the Enviropig is "for sure, the first modified farm animal engineered to solve an environmental problem."

Lilian Schaer, a spokeswoman for Ontario Pork -- a marketing group that represents 4,500 pig producers and has financially supported the genetic research, agrees. "A pig that produces less phosphorous would be a dream pig from just about everyone's point of view," she said.

These pigs, however, have nothing to do with cleaning up the environment and everything to do with increasing profits.

In 1950 the average hog sales per farm were about 31. Now 105 farms raising more than 50,000 pigs each account for 40 percent of the U.S. hog industry, according to the Minneapolis based Institute for Agriculture and Trade Policy. And the only thing keeping these farms from getting larger is their inability to dispose of large quantities of manure in a manner adhering to the Clean Water Act. But now that the phosphorous levels can be lowered, don't expect these large farms to sit back and applaud themselves for being more environmentally conscious. Instead they will increase their farms' sizes until the hazardous effects of the manure again straddle the regulatory limits set forth by the Clean Water Act.

Although this might lower the price of pork, it does nothing to address the current environmental issues and in fact only compounds many of them. Currently, the hog industry poses a grave threat to humans. Their antibiotic-laced feed creates bacteria resistant to human antibiotics. The large hog farms emit greenhouse gasses and nitrogen gas, which can radically change the surrounding ecosystem. The increased number of Enviropigs will exacerbate these problems.

Swine will eat anything they are given. Unfortunately, the byproduct of this behavior threatens both the environment and humans. Even though scientists claim they can minimize the harm of these insatiable appetites, don't be fooled. The intent here is not to protect the environment, but rather exploit regulations and increase profits.

The Price We Pay for Corporate Hogs
Executive Summary and Overview

Marlene Halverson
Institute for Agriculture and Trade Policy
July 2000

The industrialization of U.S. animal agriculture has pressed on, unabated, for half a century, gradually changing the faces of American farming and rural communities. The changes wrought by industrialization are occurring in all of animal agriculture. This report focuses on the impacts of hog factories.

The industrialization of hog farming has been attributed in great part to inexorable advances in science and technology and the freedom afforded economic development by an unfettered marketplace. Indeed, some experts see current industry structure as simply "what has evolved out of the marketplace,"[1] the inevitable result of impersonal, irresistible economic forces triggering a kind of "natural selection" process over which we are powerless to do anything but go with the flow.

Writing about mega-hog factory Seaboard Corporation's move to Guymon, Oklahoma, however, authors from the North Central Regional Center for Rural Development note that the move was hardly due to market forces at work. Describing the over $60 million in publicly supported incentives that drew Seaboard to Guymon and helped it build its facilities and train its workers, they note:[2]

Guymon is a case of state-directed, rather than market-driven introduction of new economic activity.

The chink in the armor of the natural selection theory is that the industrialization process is not impersonal or natural or necessary. It, too, has been engineered. Says rural sociologist Doug Constance:[3]

It is very important that we do not accept the industrialization process, the industrialization of agriculture, as something natural, as something inevitable, as something determined. It is no such thing. It is a plan. It is a plan for certain people to benefit and others to pay.

The industrialization of hog farming has taken place in a political-economic environment or context in which the quality of natural resources, the quality of human and animal life, the safety and quality of our food, and the quality of life for future generations are valued lower than short-term economic gain.

The choice as to whether or not to change the political-economic context in which American agriculture operates that is, the set of laws, regulations, penalties, incentives, and community expectations influencing agricultural development is a political choice. We can change the political-economic context, within which structural change in agriculture occurs, and thereby change its direction. For the good of the planet, our response to the changes the industrialization process in agriculture is invoking must not be hands-off.

Summary of Parts 1 through 7

II. *Putting Lives in Peril*

Part Two: Putting Lives in Peril, describes two major health hazards associated with factory farming: workplace dangers and antibiotic resistance.

Workplace dangers: Manure from animal factories is liquefied when massive quantities of groundwater are used to flush the buildings where the animals are housed. The resulting "slurry" may be stored temporarily in cement pits under the slatted floors of the barns or in outdoor structures, and emptied once or twice a year by being spread or sprayed onto land. The problems result from the anaerobic (absence of free oxygen) nature of manure that has been liquefied by the addition of water. Decomposition of liquid manure by anaerobic bacteria during storage and treatment produces and emits nearly 400 volatile organic compounds. Gaseous emissions from the anaerobic decomposition of liquefied manure have led to human and animal fatalities. Dusts inside intensive confinement facilities have led to respiratory illnesses among farmers and farm workers. These problems, too, have been known at least since 1964. Yet, waste handling technologies remain essentially the same and still no Occupational Safety and Health Administration (OSHA) standard exists for work in intensive confinement buildings or around manure pits. Instead, the industry and land grant university focus has been on ways to control liquid manure odors. Little research or technology development effort has focused on the readily available alternative forms of animal waste management that do not produce deadly manure gasses in the first place, such as raising hogs and cattle on pasture or using solid floors and ample bedding in indoor environments.

III. *Building Sewerless Cities*

Part Three: Building Sewerless Cities describes the impacts on water quality resulting from the separation of animals from the land. At one time, crop and livestock production were complementary enterprises on farms. Most of the nutrients originating from the soils of a given area were returned to that same area. Animals' living quarters were bedded with hay or straw and, when soiled, the bedding was removed to a manure heap where it composted, killing most of the pathogens that may have been present in the manure. Under such conditions, environmental problems arising from animal production activities, when they sometimes occurred, were minimal and relatively easily solved by improving management or taking other, relatively low-cost, remedial measures.

Environmental problems were exacerbated when specialization separated livestock production from the land and the availability of cheap, mineral fertilizers made it possible to produce crops without manure nutrients. Today, most farm animals are concentrated in large holdings on small acreages and are raised under intensive conditions resembling manufacturing processes. Animal feeds generally come from areas far away from the industrialized livestock farm. Manures from these "animal factories" may be handled as wastes or surpluses to be disposed of, rather than as valuable soil amendments, and may be applied to the land in quantities far exceeding the nutrient needs of crops. Quantities of liquid waste can be enormous. At a single site in Missouri, one hog factory produces fecal waste equivalent to that of a city of 360,000 people.

Earthen manure storage basins have leaked manure onto cropland and into streams, killing the life in them. Some leaks were found to be deliberate; others were unintentional – minor accidents or widespread catastrophes. Either way, it seems clear that the liquid manure storage technology is fundamentally unsafe.

Besides the plant nutrients nitrogen, phosphorus, and potassium, liquid manure also contains bacterial and viral pathogens, parasites, weed seeds, heavy metals, and even antibiotics, disinfectants, and insecticides, when these are present on the farm. In 1988, an expert panel convened by the World Health Organization identified liquid manure spreading as a critical pathway by which salmonellae and other pathogens are transferred to the natural environment.

Part Three concludes by noting that options exist for safer, more environmentally-friendly hog production using pastures (outdoor production) and deep-bedding (indoor production) that are within the financial range of independent family farmers. Being more management-intensive than capital-intensive, these other options, if mandated, could also allow independent family farmers to compete with larger operations on a playing field that favors hands on husbandry and management over capital.

IV. *Part of the Pig Really Does Fly*

Part Four: Part of the Pig Really Does Fly describes the air quality impacts of animal factories and recommends solutions. Neighbors of hog factories report not being able to go outdoors or let their children play outdoors due to odors from nearby hog factories. Some report lining their windows and fireplaces with plastic to keep the stench from coming into their homes. Animal factories need not be large to create a problem. Increasingly, to save on labor and because the technology is almost exclusively recommended by the industry and land grant universities, smaller farmers have adopted liquid manure handling systems and create the same detrimental effects, albeit on a smaller scale. Recent studies have shown that dusts and gases responsible for hog factory odors are having serious respiratory impacts on nearby residents.

As much as 70 to 80 percent of the nitrogen in a liquid manure storage facility changes from liquid to ammonia gas and escapes into the atmosphere. The gaseous ammonia returns to earth, precipitated from the atmosphere by rain. Nitrogen-enriched rainfall contributes to excessive algae growth and can damage or alter natural habitats, for instance, causing nitrogen-loving plants to replace the existing flora in a given area. Methane is a significant greenhouse gas that is emitted by liquid manure storage.

The most significant contribution to the reduction in greenhouse gasses that farms can make is to change manure management. The change can go in two directions: away from liquid manure and open lagoon storage toward more costly and complex management systems, such as electricity generation from methane, or toward ecologically sound and less complex management systems, such as manure handling incorporating straw or other natural bedding and composting. The latter direction is least costly for small livestock farms and not only reduces greenhouse gases, but replenishes the soil carbon.

V. *Hog Factory in the Back Yard*

Part Five: Hog factories have divided communities, neighborhoods, and families. In most cases the people who feel the strongest impacts from hog factories are people who have lived in their rural homes for most, if not all, of their lives, many of whom farm or have farmed, with livestock, as well.

Part Five describes the ways in which corporate hog factory owners have used the public's sympathy for family farmers to obtain exemptions for their activities from local zoning laws and from county and state regulations. For example, thirty states have enacted laws exempting farm animals from protection under their anti-cruelty statutes. "Strategic lawsuits against public participation," or SLAPP suits, can be brought against citizens who protest siting of animal factories in their communities. In at least 13 states, agricultural disparagement laws, popularly known as "veggie libel laws," protect food products and production processes from "disparagement." The very laws enacted to protect small farmers from frivolous complaints serve to protect corporate hog factories from well-grounded complaints over their much larger impacts on the environment and on public health and welfare. Such laws erode democratic processes.

Public policies supporting hog factories and excusing them from bad behavior also help create an illusion that hog farming is industrializing because technological advances have increased the

efficiency (that is, have reduced per-unit costs of production) of larger, more concentrated operations. How many of these efficiencies are based on the ease with which public policies allow hog factory operators to pass off unwanted costs of doing business onto neighbors and society (i.e., make others pay) have not been quantified. It is becoming clear, however, that by helping hog factories avoid the expenses associated with socially responsible practices, such protections give hog factories leeway to grow and squeeze independent family hog farmers out of the market.

Group 3: Readings for the Organic Consumers Association (word count: 3,455):

1. Organic Consumers Association – Background Information (319 words)
2. Cummins, R. “Hazards of Genetically Engineered Foods and Crops” Organic Consumers Association (1,658 words)
3. D’Amato, L. “Enviropig Studies Search for Effects of Meat on Humans” Kitchener Waterloo Record (Aug 3, 2001) (523 words)
4. Kirsch, V. “Tainted Animal Feed Risk Downplayed by Federal Officials” The Guelph Mercury (Feb 19, 2002) (607 words)
5. Council of Canada. “Poll on Attitudes to Genetically Engineered Foods.” (March 31, 2000) (348 words)

Instructions for Organic Consumers Association (Group 3): The OCA is a grassroots non-profit public interest organization which deals with crucial issues of food safety, industrial agriculture, genetic engineering, corporate accountability, and environmental sustainability. You will argue against the Enviropig project on the grounds that Enviropigs, like many other genetically engineered products, have unacceptable food safety risks and goes against consumer preferences.

Background Information: The Organic Consumers Association (OCA)

The OCA is a grassroots non-profit public interest organization which deals with crucial issues of food safety, industrial agriculture, genetic engineering, corporate accountability, and environmental sustainability. We are the only organization in the US focused exclusively on representing the views and interests of the nation's estimated ten million organic consumers.

Our US and international policy board is broadly representative of the organic, family farm, environmental, and public interest community.

The Organic Consumers Association was formed in 1998 in the wake of the mass backlash by organic consumers against the U.S. Department of Agriculture's controversial proposed national regulations for organic food. Through the OCA's SOS (Save Organic Standards) Campaign, as well as the work of our allies in other organizations, the organic community was able to mobilize 280,000 consumers to send in letters and emails to the USDA. In this project the OCA worked in cooperation with hundreds of natural food stores, consumer co-ops, Community Supported Agriculture groups, and farmers markets, as well as thousands of individual volunteers across the country--a relationship which has continued through the present time.

Our political program is the Food Agenda 2000-2010: a three point platform calling for

(1) a global moratorium on genetically engineered foods and crops;
(2) a phase-out of the most dangerous industrial agriculture and factory farming practices; and
(3) the conversion of American agriculture to at least 30% organic by the year 2010.

Our web site, research, and media team are considered by reporters and radio talk show hosts to be among some of the nation's top experts on food safety and organic food. Our media team provides background information, interviews, and story ideas to TV and radio producers and journalists on a daily basis--from national TV networks to the alternative press. Our field organizers provide advice and coaching to grassroots activists across the nation and coordinate our network of 10,000 volunteers.

Hazards of Genetically Engineered Foods and Crops
Why We Need A Global Moratorium
by Ronnie Cummins, Organic Consumers Association

The technology of Genetic Engineering (GE) is the practice of altering or disrupting the genetic blueprints of living organisms-plants, trees, fish, animals, humans, and microorganisms. This technology is wielded by transnational "life science" corporations such as Monsanto and Aventis, who patent these blueprints, and sell the resulting gene-foods, seeds, or other products for profit. Life science corporations proclaim that their new products will make agriculture sustainable, eliminate world hunger, cure disease, and vastly improve public health. However, these gene engineers have made it clear, through their business practices and political lobbying, that they intend to use GE to monopolize the global market for seeds, foods, fiber, and medical products.

GE is a revolutionary new technology that is still in its early experimental stages of development. This technology has the power to break down the natural genetic barriers-not only between species-but between humans, animals, and plants. Randomly inserting together the genes of non-related species-utilizing viruses, antibiotic-resistant genes, and bacteria as vectors, markers, and promoters-permanently alters their genetic codes.

The gene-altered organisms that are created pass these genetic changes onto their offspring through heredity. Gene engineers all over the world are now snipping, inserting, recombining, rearranging, editing, and programming genetic material. Animal genes and even human genes are randomly inserted into the chromosomes of plants, fish, and animals, creating heretofore unimaginable transgenic life forms. For the first time in history, transnational biotechnology corporations are becoming the architects and "owners" of life.

With little or no regulatory restraints, labeling requirements, or scientific protocol, bio-engineers have begun creating hundreds of new GE "Frankenfoods" and crops. The research is done with little concern for the human and environmental hazards and the negative socioeconomic impacts on the world's several billion farmers and rural villagers.

An increasing number of scientists are warning that current gene-splicing techniques are crude, inexact, and unpredictable-and therefore inherently dangerous. Yet, pro-biotech governments and regulatory agencies, led by the US, maintain that GE foods and crops are "substantially equivalent" to conventional foods, and therefore require neither mandatory labeling nor pre-market safety-testing.

GE food and fiber products are inherently unpredictable and dangerous-for humans, for animals, the environment, and for the future of sustainable and organic agriculture. As Dr. Michael Antoniou, a British molecular scientist points out, gene-splicing has already resulted in the "unexpected production of toxic substances... in genetically engineered bacteria, yeast, plants, and animals with the problem remaining undetected until a major health hazard has arisen". The hazards of GE foods and crops fall into three categories: human health hazards, environmental hazards, and socio-economic hazards. A brief look at the already-proven and likely hazards of GE products provides a convincing argument for why we need a global moratorium on all GE foods and crops.

Toxins & Poisons

GE products clearly have the potential to be toxic and a threat to human health. In 1989, a genetically engineered brand of L-tryptophan, a common dietary supplement, killed 37 Americans. More than 5,000 others were permanently disabled or afflicted with a potentially fatal and painful blood disorder, eosinophilia myalgia syndrome (EMS), before it was recalled by the Food and Drug Administration (FDA). The manufacturer, Showa Denko, Japan's third largest

chemical company, had for the first time in 1988-89 used GE bacteria to produce the over-the-counter supplement. It is believed that the bacteria somehow became contaminated during the recombinant DNA process. Showa Denko has paid out over $2 billion in damages to EMS victims.

In 1999, front-page stories in the British press revealed Rowett Institute scientist Dr. Arpad Pusztai's explosive research findings that GE potatoes are poisonous to mammals. These potatoes were spliced with DNA from the snowdrop plant and a commonly used viral promoter, the Cauliflower Mosaic Virus (CaMv). GE snowdrop potatoes were found to be significantly different in chemical composition from regular potatoes, and when fed to lab rats, damaged their vital organs and immune systems. The damage to the rats' stomach linings apparently was a severe viral infection caused by the CaMv viral promoter apparently giving the rats a severe viral infection. Most alarming of all, the CaMv viral promoter is spliced into nearly all GE foods and crops.

Dr. Pusztai's path breaking research work unfortunately remains incomplete. Government funding was cut off and he was fired after he spoke to the media. More and more scientists around the world are warning that genetic manipulation can increase the levels of natural plant toxins or allergens in foods (or create entirely new toxins) in unexpected ways by switching on genes that produce poisons. Since regulatory agencies do not currently require the kind of thorough chemical and feeding tests that Dr. Pusztai was conducting, consumers have now become involuntary guinea pigs in a vast genetic experiment. Dr. Pusztai warns, "Think of William Tell shooting an arrow at a target. Now put a blind-fold on the man doing the shooting and that's the reality of the genetic engineer doing a gene insertion".

Food Allergies

In 1996, a major GE food disaster was narrowly averted when Nebraska researchers learned that a Brazil nut gene spliced into soybeans could induce potentially fatal allergies in people sensitive to Brazil nuts. Animal tests of these Brazil nut-spliced soybeans had turned up negative. People with food allergies (which currently afflicts 8% of all American children), whose symptoms can range from mild unpleasantness to sudden death, may likely be harmed by exposure to foreign proteins spliced into common food products. Since humans have never before eaten most of the foreign proteins now being gene-spliced into foods, stringent pre-market safety-testing (including long-term animal feeding and volunteer human feeding studies) is necessary in order to prevent a future public health disaster.

Mandatory labeling is also necessary so that those suffering from food allergies can avoid hazardous GE foods and so that public health officials can trace allergens back to their source when GE-induced food allergies break out.

In fall 2001, public interest groups, including Friends of the Earth and the Organic Consumers Association, revealed that lab tests indicated that an illegal and likely allergenic variety of GE, Bt-spliced corn called StarLink, had been detected in Kraft Taco Bell shells, as well as many other brand name products. The StarLink controversy generated massive media coverage and resulted in the recall of hundreds of millions of dollars of food products and seeds.

Damage to Food Quality & Nutrition

A 1999 study by Dr. Marc Lappe published in the Journal of Medicinal Food found that concentrations of beneficial phytoestrogen compounds thought to protect against heart disease and cancer were lower in GE soybeans than in traditional strains. These and other studies, including Dr. Pusztai's, indicate that GE food will likely result in foods lower in quality and

nutrition. For example, the milk from cows injected with rBGH contains higher levels of pus, bacteria, and fat.

Genetic "Bio-Invasion"

By virtue of their "superior" genes, some GE plants and animals will inevitably run amok, overpowering wild species in the same way that exotic species, such as kudzu vine and Dutch elm disease have created problems when introduced in North America. What will happen to wild fish and marine species, for example, when scientists release into the environment carp, salmon, and trout that are twice as large, and eat twice as much food, as their wild counterparts?

Socioeconomic Hazards

The patenting of GE foods and widespread biotech food production threatens to eliminate farming as it has been practiced for 12,000 years. GE patents such as the Terminator Technology will render seeds infertile and force hundreds of millions of farmers who now save and share their seeds to purchase evermore-expensive GE seeds and chemical inputs from a handful of global biotech/seed monopolies. If the trend is not stopped, the patenting of transgenic plants and food-producing animals will soon lead to universal "bioserfdom" in which farmers will lease their plants and animals from biotech conglomerates such as Monsanto and pay royalties on seeds and offspring. Family and indigenous farmers will be driven off the land and consumers' food choices will be dictated by a cartel of transnational corporations. Rural communities will be devastated. Hundreds of millions of farmers and agricultural workers worldwide will lose their livelihoods.

Ethical Hazards

The genetic engineering and patenting of animals reduces living beings to the status of manufactured products. A purely reductionist science, biotechnology reduces all life to bits of information (genetic code) that can be arranged and rearranged at whim. Stripped of their integrity and sacred qualities, animals that are merely objects to their "inventors" will be treated as such. Currently, hundreds of GE "freak" animals are awaiting patent approval from the federal government. One can only wonder, after the wholesale gene altering and patenting of animals, will GE "designer babies" be next?

What Can You Do?

The OCA advocates the following Food Agenda 2000-2010 as the foundation for our local-to-global campaign work:

- A Global Moratorium on all Genetically Engineered Foods and Crops. These products have not been proven safe for human health and the environment and they must be taken off the market.
- Stop Factory Farming. Begin the phase-out of industrial agriculture and factory farming-with a goal of significantly reducing the use of toxic chemicals and animal drugs on conventional farms by the year 2010. This phase-out will include a ban on the most dangerous farm chemicals and animal feed additives (antibiotics, hormones, and rendered animal protein) as well as the implementation of intensive Integrated Pest Management Practices (decrease the use of toxic pesticides and chemical fertilizers through natural composting, crop rotation, cover crops, use of beneficial insects, etc.).
- Convert American Agriculture to at least 30% organic by the year 2010. We demand government funding and implementation of transition to organic programs so that at least 30% of US agriculture is organic by the year 2010-with a strong emphasis on production for local and regional markets by small and medium-sized organic farmers.

"Enviropig" Studies Search for Effects of Meat on Humans

August 3, 2001
Kitchener Waterloo Record
Luisa D'Amato

GUELPH - Scientists have, according to this story, made a genetically engineered pig, but no one has quite figured out how to test that pig to make sure it's safe to eat.

The new "enviropigs" -- those genetically modified porkers who carry an extra gene that causes them to have less phosphorus in their manure -- will be the first animals to be tested under Health Canada's guidelines for genetically modified foods.

These pigs, being raised at the University of Guelph, hold the promise of being environmentally friendly. The extra gene causes bodily changes that help them digest the phosphorus in their feed instead of excreting it, which means cleaner, more drinkable lakes, rivers and streams.

But the pigs' arrival also brings science to uncharted waters. Guelph microbiologist Cecil Forsberg, who helped create the pigs, was cited as saying that technology is moving "faster than a slim government agency can move," and it's not clear, for example, how to test the pork to ensure it's safe.

The story says that Forsberg is working with federal government scientists to develop a policy to test genetically modified meat and that currently, a policy exists only for plants, which are biologically less complex. The extra gene causes production of the enzyme phytase, which lets the pig digest phosphorus in its feed. Trace amounts of phytase have been found elsewhere in the pig's body. There's a chance that humans might have allergic reactions to it, and also to the E. coli bacteria and mouse genes that were used to make the extra gene. But it's difficult to test for allergic reactions, especially on a substance that hasn't caused a reaction in humans before. You can't test on mice or rats because their immune systems are so different from humans.

All these questions are part of what concerns other scientists, who say there isn't enough testing on genetically modified foods, and we can't be sure they're safe.

Hugh Lehman, a retired philosophy professor from the University of Guelph, was quoted as saying, "To me, it's very risky. Very small chemical differences can have profound implications. If it's anything people are going to eat, there should be extensive and rigorous testing," The story says that Lehman was among a group of high-ranking scientists who publicly warned earlier this year that our existing food supply could be contaminated by genetically engineered crops that haven't been tested rigorously enough.

In a recent interview, Lehman quoted the work of a Scottish scientist who noticed abnormalities in rats that were fed genetically engineered potatoes. But Doug Powell, a University of Guelph professor of plant agriculture who is scientific director of the Centre for Safe Food in Guelph, was quoted as saying that research "has been largely repudiated" by other academics and that genetically engineered foods are subjected to much higher safety requirements and testing than new foods that are developed by traditional breeding practices.

Meanwhile, Forsberg said the new enviropigs appear to be physically normal, and he believes they'll be declared safe to eat within five years.

Tainted animal feed risk downplayed by federal officials

The Guelph Mercury
February 19, 2002 Tuesday Final Edition
Pg. A1
By Vik Kitsch

Procedures have been modified at the University of Guelph since the carcasses of genetically engineered "enviropigs" were accidentally dumped into animal feed.

Last Tuesday the university told the Canadian Food Inspection Agency 11 genetically modified piglet carcasses were mistakenly taken to a rendering plant.

The CFIA, Environment Canada and Health Canada immediately launched investigations.

The federal health department concluded there was no significant risk to human health, CFIA biotechnology division biologist Louise Laferriere said Monday.

"They said there's no real risk to consumers," said Laferriere.

The CFIA is the lead investigating group on the issue.

Health Canada spokesperson Andrew Swift said the release "represents minimal risk to human health" because of the small quantity of material involved.

But Council of Canadians activist Nadege Adam responded genetic engineering is such a new science that no one can guarantee there's little risk.

"How can they say that it's safe? We don't know that it's safe. What's the risk Canadians are being exposed to?" Adam asked.

The piglets were part of a research project, headed by microbiologist Cecil Forsberg, to create less polluting pig waste.

The pigs carry an extra gene producing an enzyme called phytase. It causes the pigs to excrete less phosphorus in their manure. The aim is cleaner waters near farm operations.

Phosphorus promotes algae, which kills marine life by depleting oxygen.

Laferriere said 11 piglets, which either were stillborn or died shortly after birth, were stored in the freezer of a university research facility and destined for incineration.

Incineration is required by law, she said. "It's supposed to be contained. It's not supposed to get out," Laferriere said.

Laferriere said the wrong carcasses were taken to a rendering plant, though she couldn't say when the error occurred. The university discovered it and informed authorities that day, she noted.

The carcasses were added to 675 tonnes of meat cooked at the rendering plant.

The batch was sold to feed mills, where it was made mainly into food for laying hens.

Some became feed for turkeys and chickens destined for the kitchen table.

"We're continuing our investigation into the destination of that feed," said Laferriere, adding the CFIA will try to recall it.

As to the food chickens and turkeys that received the feed, Health Canada has determined the risk to people consuming them is slight, she continued. She said the novel enzyme in the piglets breaks down after five minutes of exposure to temperatures of 100 degrees Celsius.

Laferriere said rendering cooks meat at 120 to 130 degrees C. for two hours.

Therefore, there won't be a recall of the chickens and turkeys, said Laferriere.

Adam argued the poultry products shouldn't be sold. "When in doubt, you don't take a chance."

University of Guelph research vice-president Alan Wildeman said the incident occurred at the university's Ridgetown College campus, where some of the enviropig research is done.

It's not yet clear when the carcasses were taken by a rendering plant employee, but it likely happened in January, said Wildeman.

He stressed the university has relocated the enviropig freezer to another, secure site so such a mistake can't be repeated.

He didn't dismiss the situation, however. "Certainly, we view this as a very important, very serious incident," said Wildeman.

He added the enviropig research will continue, despite the breach. "It is an important research project and is addressing a very serious environmental problem in the agricultural industry."

Laferriere added Environment Canada is seeking ways of ensuring the incident is not repeated.

The Council of Canada
Poll on Attitudes to Genetically Engineered Foods
Results of Environics Poll on Canadian Consumer Attitudes to Genetically Engineered Foods

March 31, 2000

Environics Research Group was commissioned by The Council of Canadians to conduct a national poll on consumer attitudes to genetically engineered foods. The telephone poll, which surveyed 902 Canadians between December 22, 1999 and January 16, 2000, is accurate within 3.3 percentage points, 19 times out of 20.

The following questions were asked of people who said they were somewhat or very familiar with "genetically engineered" or "genetically modified" foods:

- **Q 1. Do you strongly agree, somewhat agree, somewhat disagree or strongly disagree with each of the following statements:**

  - **a. I worry about the safety of genetically engineered foods**
    48% Strongly agree
    27% Somewhat agree
    75% TOTAL AGREE
    13% Somewhat disagree
    11% Strongly disagree
    24% TOTAL DISAGREE

  - **b. Genetically engineered foods should always be labelled as such.**
    87% Strongly agree
    8% Somewhat agree
    95% TOTAL AGREE
    2% Somewhat disagree
    2% Strongly disagree
    4% TOTAL DISAGREE

  - **c. Consumers should be able to buy food that is not genetically engineered.**
    80% Strongly agree
    15% Somewhat agree
    95% TOTAL AGREE
    3% Somewhat disagree
    1% Strongly disagree
    4% TOTAL DISAGREE

  - **d. I would prefer to buy non-genetically engineered foods, even if they were slightly more expensive.**
    45% Strongly agree
    26% Somewhat agree
    71% TOTAL AGREE

15% Somewhat disagree
11% Strongly disagree
26% TOTAL DISAGREE

- **Q 2. How confident are you in the federal government's ability to protect the safety and health of Canadians when it comes to genetically engineered food? Are you…?**
  11% Very confident
  33% Somewhat confident
  44% TOTAL CONFIDENT
  33% Not very confident
  23% Not at all confident
  56% TOTAL NOT CONFIDENT

- **Q 3. Do you strongly agree, somewhat agree, somewhat disagree, or strongly disagree that Canada should be able to refuse to import genetically engineered foods from other countries if there are concerns about health or environmental safety?**
  84% Strongly agree
  10% Somewhat agree
  94% TOTAL AGREE
  2% Somewhat disagree
  4% Strongly disagree
  6% TOTAL DISAGREE