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Conference paper

Food Production and Bioethics

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SUMMARY The subject of this paper are agricultural ethics as a part of bioethics, as a holistic approach to consequences of conventional (industrial) and alternative type of agriculture practice based upon application in practical use the resultats of agricultural research. The problems connected with food production aimed at satisfying the needs of a rapidly growing human population are complex and paradoxical. These problems are in branch of ethics, at first, because ethical laws are entirely different from scientific laws. From the accessible facts, often quite opposite conclusions can be made. The optimists, excited by increased food production based on achievements of contemporary science, neglect the Malthusian forecast of hunger. On the other side, the pessimists insist that environmental pollution and land degradation caused by industrial food production hold dire consequences for the human race. The principles of bioethics are closely connected with the professional ethics of our scientists and decision-makers, which should be recognised as a very serious issue. The final conclusion: our decisions should be based on common sense, knowledge, high ethical standards, and democratic mechanisms to make agriculture a way of life and not simply an investment for corporations. We are responsible to our offspring. This is very important because the methodology of a typical research scientist is based upon scientific reductionism and his or her way of thinking does not include the interdisciplinary, holistic approach. The scientists must begun to look holistically at agricultural research, and on its consequence of past, present and future agricultural practices.

Key words: agricultural ethics, bioethics, holistic approach, typ of agricultural practice.

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Natura, esse cupit, non esse ergo refugit et abhorret.
(Nature desires to be, therefore she shuns and hates not to be.)
Franciscus Patricius, 1581

1. Ethics and agricultural practices

Ethics, the study of the standards of conduct and moral judgement, could be a branch of science or, in its broader sense, knowledge about morality (Čović, 1979). However, ethical laws are entirely different from scientific laws. Ethical laws are prescriptive, not descriptive. They say what should be, not what must be, or even what is. They are normative, asserting a standard or ideal, a goal or principle, not necessarily an actual state of affairs. Every ethical argument can apparently be confronted with an equally strong-sounding counter-argument. This is probably the reason why some practical people have little respect for ethics (Ferré, 1994). Often, most of us see a sense of ethics as something that is good to have but not to deal with in our daily life (Ruehr, 1994).

In this paper, agricultural ethics are considered as a part of bioethics. While we all have a pretty good idea of what agriculture is, agricultural ethics may be a different matter. We can accept that agricultural ethics could be a basis for judging why something in agriculture is good or bad, right or wrong. According to the definition of Hartel (1994), agricultural ethics looks at the philosophical, social, political, legal, economic, scientific, and aesthetic aspects of agricultural problems and provides guidance for decisions about these problems when they involve competing values. The major point in agricultural ethics is that social responsibility goes hand in hand with scientific responsibility (Smith, 1990). Because of its growing importance in agriculture, at least fourteen universities in the USA have offered or are currently offering courses in agricultural ethics (Ruehr, 1994).

According to Hartel (1994), the major conflict between conventional and alternative agriculture in the coming century will involve the concern for environmental degradation. To preserve the integrity of the environment, we should be able to apply a holistic approach (which stresses love, reverence, compassion and respect for nature) instead of utilitarian ("pesticide use increases yields"), or rights-based ones ("we have the right to use water just as we have always done"). The methodology of a typical research scientist is based upon scientific reductionism - attacking a scientific problem by first breaking it into its smallest segments. His or her way of thinking does not include the interdisciplinary, holistic approach. In contrast, agricultural ethics is a holistic way of thinking. Today some scientists have begun to look holistically at agricultural research, and they do not like what they see. Wherever they look, they are witnessing undesirable change, much of it a consequence of our past and present agricultural practices.

2. Changes in the natural ecosystem

We should bear in mind that all agricultural systems are derived from natural ecosystems. Both systems have inputs and outputs and are characterised by their respective components and processes. The major difference between the two is that the inputs, outputs, and processes that operate in the agricultural system are controlled to a large extent by human decision-making (Mannion, 1995). Now, the main ethical questions arise from the fact that the biosphere of our inheritance, and the technosphere of our own creation are out of balance (Ward and Dubos, 1972). Conversion of natural ecosystems into agricultural ones started 10 000 years ago. In the beginning, this transformation was slow, occurring only in scattered localities and posing no threat to the wider ecosystem. But, in last century the transformation and its disruption of the world-wide environment have become faster and more pronounced. The imbalance is causing changes in natural ecosystems, which are becoming completely new ecosystems with attributes differing substantially from their original ones.

To survive, a human being needs air, water and food. Today it is evident that all of the basic needs are exposed to serious changes:

- ***Air pollution*** - Fermentation of organic matter by ruminant cattle and wetlands such as rice paddies are the main sources of methane. Burning fossil fuel generates carbon dioxide. Use of mineral N-fertilisers generates nitrous oxide. All the three gases are the so-called heat-trapping gases. As a result, we have the greenhouse effect, or global warming. While the increase of global temperatures amounted to 0.45^{o}C in the past hundred and fifty years, a 1- 3.5 ^{o}C increase of ground and water temperature may be expected in the next hundred years.

- ***Groundwater contamination*** - As an example, production of triazines (active components of some herbicides) started in 1955. Today, after four decades of use, the groundwater of the Corn Belt of the USA contains a dangerous amount of this pesticide. Other pesticides, nitrates, nitrites, and selenium are other common contaminants from industrial agriculture. To date, we have no method to rid groundwater of pollutants.

- ***Topsoil degradation*** - Wind and water erosion as a consequence of the low level of organic matter in topsoil; soil acidification caused by mineral fertilisers and acid rain (connected with Al^{+++} toxicity); soil salinity caused by irrigation; and soil contamination by heavy metals (Cd, Pb, Cu, etc.) are all becoming much more common.

- ***Erosion of genetic diversity*** - By growing a small number of highly accumulative plant species in monoculture on a large acreage, or growing a small number of the identical genotypes such as F_1 hybrids or pure-line cultivars,

contemporary agriculture is responsible for narrowing the earth's genetic diversity. Today, out of about 250,000 species of flowering plants on earth, only about 20 constitute the major part of the human diet. And within those 20 species, only a handful of cultivars, out of the hundreds of thousand available, are grown on a large scale.

The World Commission of Environment and Development (1987) defines sustainable development as the kind of development that meets the needs of the present without compromising the ability of future generations to meet their own needs. Seen world-wide, the practice of agriculture today can hardly be considered sustainable.

3. Early forecast of human hunger

One of the most important social or cultural factors affecting agriculture is population growth and its change over time. The prospect of world hunger and human survival makes agricultural ethics a compelling issue. Two centuries ago, the English political economist Thomas Robert Malthus (1766-1834) developed the theory that the human population of the world tends to increase faster than does food production. This was the first forecast of hunger threatening the human race. However, since then the development of agricultural science and technology has been so rapid and so successful that the Malthusian forecast has not been realised. Does it mean that Malthus's forecast of world hunger was wrong, or has the crisis been delayed? In fact, each year, more than 10 million people starve to death all over the world. These people do not die because of an inadequate supply of food, but rather of lack of money to buy it, or in other words because of unequal distribution of food.

According to speculative estimates, at the time of wheat domestication 10 thousands years ago, there were four million inhabitants on earth. Today, world population is increasing by four million every ten days. According to the United Nation Population Fund (UNPFA, 1992) projection, a near doubling of world population to 10 billion might be expected by 2050. Almost all of the predicted population growth will be in Africa, Asia and Latin America. For example, the population of the most populous African country, Nigeria, will rise from 109 to 281 million people (258%) by 2025.

In the first two decades of the 21st century, the same amount of food will be required as was produced during agriculture's first 10 thousands years. At the same time, the world food output is losing its race with population growth. For example, grain production per capita dropped by 6% from 1984 to 1992 (Brown, 1993). These figures are even more drastic for African countries: Angola with a 2.8% average growth rate for the period 1990-1995 has recorded a 52.0% decline in grain production in the period 1970-1985.

At the current productivity level, to meet the needs of the earth's predicted population from now till 2050, a 56% increase in cultivated land area is necessary). However, the limits of arable land have already been approached or exceeded in many parts of the world. Therefore, practically all of the increase in world food production must come from higher yields - increased output per hectare. In the next several decades, growth in food demand arising from population growth will run upwards of 40% per year in many countries (Ruttan, 1993). Furthermore, 26 countries, collectively the home of 1/4 of human population, are today considered water deficient, which is a limiting factor for food production (Postel, 1993). The prospect of world hunger and human survival make agricultural ethics a compelling issue.

4. Biotechnology - How far can we go?

Faced with these overwhelmingly bleak prospects, the agricultural establishment is pinning its hopes on biotechnology. Applied to microorganisms, plants, and animals for food and non-food products, biotechnology is more than just a new productivity-increasing or problem-solving technology. It is said to offer mankind a hope of ending famine and protecting environment through:

- improvement of plant resistance to pests and diseases;
- improvement of the productivity and quality of crops;
- new industrial uses of modified crops; and
- reclamation of polluted sites by microorganisms.

However, the resulting knowledge revolution will have scientific, ethical and social consequences far beyond the economic effects on agriculture and food. Biotechnology offers two remarkable opportunities to plant breeding:

1) genetic transformation (insertion of genes from unrelated species), and
2) DNA marker-assisted selection for more rapid plant and animal breeding.

The first successful single-gene transfer was achieved in 1982. Since then, new discoveries have been made faster than anyone could have expected, and several dozen plant species have been genetically modified with alien DNA. Since 1996, genetically modified crops (cotton, maize, soybean and canola) have been commercially grown in the US and Canada. Acreage under genetically modified organisms (GMOs) has tripled each year since. What is the advantage of GMOs? One example: a gene derived from the soil microorganism *Bacillus thuringiensis* has been transferred to maize. It controls synthesis of a protein in the plant tissue that has an insecticidal effect, and protects the plant against caterpillars, most importantly the European corn borer. A gene derived from another microorganism, *Streptomyces,* transferred to corn, soybean and canola, renders plants tolerant to the broad-spectrum herbicide gluphosinate and glyphosate.

However, serious criticism is being directed at these new activities from all directions. According to Mae-Wan Ho (1998), the long-term efficiency of the new technology is questionable for many reasons.

By recombining genetic material between species that do not interbreed in nature (flowering plants and soil bacteria), completely unpredictable results might be obtained. Do we have the right to play God? How will Nature react? Just remember the words of the Renaissance philosopher Franciscus Patricius (1591): *Aut nihil ociosum fert, aut suffert natura* ("Nature brings forth or tolerates nothing useless.") The stability of the new gene products of biotechnology is still unknown.

Biotechnology cannot substitute for conventional plant breeding methods. Only traits controlled by one or a few genes can be genetically engineered. According to Law (1995), there is little chance for quantitative trait loci (traditional characters of plant breeding, such as grain number, grain weight and yield itself) to be genetically engineered. These are complex traits, for which the level of each gene dose affects the level of the other quantitatively variable traits. Multiple-gene transfer across the species barrier still constitutes a bottleneck.

There is concern that the foreign genes and their products might be harmful to human beings, to organisms in other food chains (e.g., helpful insects like natural pest predators), to the plant species itself, or to its wild-growing relatives to which it may pass the gene. There is, therefore, a strong argument for evaluating the products of biotechnology. Pioneer Hi-Bred International Inc. accidentally transferred an allergen from Brazil nuts into soybean plants in 1996. Soybean is an ingredient of hundreds of food products. Pioneer's genetically modified soybeans were launched after just ten weeks of feeding trials on animals, but their leaflet describes such foods as being "among the most tested foods ever". However, the beans was inedible for many people. When the company discovered the allergy problem, the work was halted and the plants destroyed. Surveys consistently show that the public believes it should be mandatory to label all products containing GMOs or GMO-derived products.

Herbicide-tolerant GMOs will lead to more herbicide being sprayed into the environment, and herbicide resistant weeds are likely to develop with time. Genetic modification allows farmers to spray glyphosate while the plant is growing, which means that its residues will be found in the food - something that has never happened with glyphosate before. Scientists fear that weeds pollinated by engineered plants could pass those new genes to their offspring and on into future generations. One plant species in which the risk has been recognised is canola, because it is closely related to wild mustard. With additional pollination by other engineered plants, this could lead to appearance of weeds resistant to multiple herbicides.

Genes have one characteristic that sets them apart from any other environmental hazard: they replicate, spread and recombine. This means that, in the wrong combination, they could be more dangerous than radioactive wastes.

Most genetic engineering work is done by large multinational corporations. The public worries that companies will use their discoveries to increasingly control the world's food system, squeezing profits from farmers and consumers. Monsanto already requires farmers buying its genetically engineered herbicide resistant corn seed to use *only* Monsanto's Roundup brand of glyphosate herbicide. Monsanto has made huge profits from Roundup in the past, and with its patent having soon to expire, genetic engineering offers a way to keep the Roundup profits flowing.

Another firm, Delta and Pine Land Co. in co-operation with USDA, have developed the so called "Technology Protection System", known also as "Terminator technology". When inserted into the seed, the new "terminator" gene prevents the plant from reproducing by killing its own seed. If farmers should save the seed for the next year, they would end up with empty fields. This is the most powerful seed monopoly developed since the discovery of hybrid corn. The technology was patented in March 1998 and two months later Monsanto bought Delta and Pine Land Co. together with the patent. The patent has no agronomic advantages, and it could have an adverse effect on small farmers of the Third world.

It is obvious that the goal of biotech multinational companies is not to feed the world, but to make profit - as high as possible. Of course, that is the mission of any corporation, but public opinion is coming to the conclusion that the biotech industry has been allowed to go too far, too fast. The price paid by humanity for this is a feeling of helplessness and powerlessness, as well as a fear of danger (Čović, 1997).

5. Conclusion

What is right and acceptable is what produces good consequences - access to basic human needs, sustainability to protect future generations, and protection of biodiversity (Blatz, 1994). The main question is how agriculture can feed the world today and maintain sustainability for tomorrow. According to Hartel (1994), in the coming century, the major conflict between industrialised and traditional agriculture will be the concern for environmental degradation, and industrialised agriculture will be forced to adopt some traditional agriculture practices. We can distinguish two main types of agriculture:

1) ***Agriculture as business, i.e., industrialized agriculture.*** - If we accept agriculture as business, then we should accept all the accompanying phenomena: competitiveness (speed, quantity, profit), centralisation (control of land resources and capital), and specialisation (dependence on science and technology). The

energy that drives agriculture-as-business is profit, and its philosophy is investment of capital in order to get the highest possible profit. It is not primarily concerned with continuing to use the same resources now and in the future. Industrialised agriculture favours goods of human wellbeing over those of ecological integrity and non-human welfare (Aiken, 1984).

2) ***Agriculture as a way of life.*** - Alternatively, we may regard agriculture not as business, but as a way of life. In that case, its characteristics are community (emphasis on permanence, quality, and beauty), decentralization (dispersed control of land, resources, and capital), non-specialization, and emphasis on personal knowledge and local wisdom (Beus et al., 1991). Agriculture as a way of life is labor-intensive rather than capital- and technology-intensive, oriented to the local market, more diverse, and more organic.

It is not hard to understand which of the approaches to agriculture must be followed if we are to survive as a species. According to Freudenberg (1986), the values of agriculture for the next century must be : a) health of the land, b) welfare of future generations, c) social and interspecies justice, and d) integrity in meaningful work and relationships.

References

1. Aiken, W. (1984): Ethical issues in agriculture, in: T. Regan (ed.): **Earthbound : New Introductionary Essays in Environmental Ethic.** - New York : Random House, pp. 247-288.
2. Beus, C. E., R. E. Dunlap, R. M. Jimmerson, and W. L. Holmes (1991): Competing paradigms : The debate between alternative and conventional agriculture. Res. Bull. XB1020. Washington State University, Pullman.
3. Blatz, C. V. (1994): Coming full circle : Ethical issues in traditional and industrialized agriculture, in: P. G. Hartel et al. (ed.): **Agricultural Ethics : Issues for the 21st Century.** ASA Special publication No.57:33-42.
4. Brown, Lester R. (1993): A new era unfolds, in: Lester R. Brown et al. (eds.): **State of the World.** - New York : W. W. Norton & Co., p. 3-21.
5. Čović, Ante (1997): Znanje i moralnost (Wissen und Moralität). - **Filozofska istraživanja,** Zagreb, 17 (1997) 4: 1049-1064.
6. Fenstra, G., C. Ingels and D. Campbell (1997): What is sustainable agriculture? http:/www.sarep.ucdavis.edu/concept.htm

7. Ferré, F. (1994): No hiding place : The inescapability of agricultural ethics, in: P. G. Hartel et al. (ed.): **Agricultural Ethics : Issues for the 21st Century.** ASA Special publication No. 57: 11-17.

8. Freudenberger, C. D. (1986): Value and ethical dimensions of alternative agri cultural approaches : In quest of a regenerative and just agriculture, in K. Dahlberg (ed.): **New Directions for Agriculture and Agricultural Research : Neglected Dimensions and Emerging Alternatives.** - Totowa, NJ : Rowman & Allanheld, p. 348-364.

9. Freudenberger, C. D. (1994): What is good agriculture?, in P. G. Hartel et al. (eds.): **Agricultural Ethics : Issues for the 21st Century.** ASA Special publication No. 57: 43-53.

10. Hartel, P. G. (1994): Overview, in: P. G. Hartel et al. (eds.): **Agricultural Ethics : Issues for the 21st Century.** ASA Special publication No. 57: 1-10.

11. Ho Mae-Wan (1998): The unholy alliance. - **The Ecologist,** 27 (1998) 4.

12. Law, C. N. (1995): Genetic manipulation in plant breeding - prospects and limitations. - Euphytica 85: 1-12.

13. Mannion, A. M. (1995): Agriculture and environmental change : Temporal and spatial dimension. - Chichester : John Wiley & Sons Ltd., p. 405.

14. Martinović, I. (1997): Petrićeva prosudba Aristotelove prirodne filozofije. - **Obnovljeni život,** Zagreb, Zagreb, 52 (1997) 1: 3-20.

15. Martinović, I. (1998): Petrić´s Index Pancosmiae : Further considerations (Uz Petrićev Index Pancosmiae), Paper presented at the 7th International Philosophical Symposium "The days of Frane Petriš", Cres, August 30 - September 4.

16. Postel, S. (1993): Facing water scarcity, in: L. R. Brown et. al. (eds.): **State of the world.** - New York : W. W. Norton & Co., p. 22-41.

17. Ruehr, A. T. (1994): Teaching agricultural ethic, in: P. G. Hartel et al. (eds.): **Agricultural Ethics : Issues for the 21st Century.** ASA Special publication No. 57: 55-61.

18. Ruttan, Vernon W. (1993): Research to meet crop production needs : into the 21st century, in: D. R. Buxton et al. (eds.): **International Crop Science I.** - Madison, Wisconsin : CSSA, p. 3-10.

19. Smith, S. E. (1990): Plant biology and social responsibility. Plant Cell 2: 367-368.

20. Ward, B., and R. Dubos (1972): Only one earth : The care and maintenance of a small planet. - NewYork : W. W. Norton & Co.

Izlaganje sa znanstvenog skupa

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Proizvodnja hrane i bioetika

Sažetak

Predmet rada jest etika poljoprivrede kao dio bioetike, kao holistički pristup posljedicama konvencionalne (industrijske) i alternativne poljoprivrede utemeljene na primjeni i praktičnoj uporabi rezultata poljoprivrednih istraživanja. Problemi povezani s proizvodnjom hrane zadani su zadovoljavanjem potreba ljudske populacije koja se rapidno povećava, te su vrlo složeni i paradoksalni. Ovi su problemi ponajprije etičke naravi, jer su etički zakoni posve različiti od znanstvenih zakona. Iz dostupnih se podataka mogu izvesti često posve oprečni zaključci. Optimisti, oduševljeni porastom proizvodnje hrane temeljem postignuća suvremene znanosti, zanemaruju Malthusovo predviđanje gladi. Na drugoj strani, pesimisti inzistiraju na spoznaji da zagađivanje okoliša i degradacija zemlje, izazvani industrijskim načinom proizvodnje hrane, imaju izravne posljedice po ljudsku vrstu. Načela bioetike tijesno su povezana s profesionalnom etikom naših znanstvenika i aktera koji odlučuju, a to se očituje kao vrlo ozbiljan problem. Zaključak je autora: naše se odluke trebaju zasnivati na zdravom razumu (common sense), znanju, visokim etičkim standardima i demokratskim mehanizmima koji poljoprivredu čine načinom života a ne jednostavnim (unosnim) ulaganjem za korporacije. Mi smo odgovorni za naše potomstvo. A to je veoma važno, jer metodologija tipičnoga znanstvenika/istraživača počiva na znanstvenom redukcionizmu, te njegov, ili njezin, način mišljenja ne uključuje interdiciplinarnost, holistički pristup. Stoga znanstvenici moraju početi holistički pristupati poljoprivrednom istraživanju i istražiti njegove posljedica na prošle, sadašnje i buduće načine poljoprivredne prakse.

Ključne riječi: etika poljoprivrede, bioetika, holistički pristup, način poljoprivredne proizvodnje.

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La production des produits alimentaires et la bioéthique

Résumé

Le sujet de cette étude est l'éthique en agriculture en tant que partie de la bioéthque, en tant qu'approche holistique des conséquences de l'agriculture conventionnelle (industrielle) et alternative, fondée sur l'application et l'utilisation en pratique des résultats des recherches en agriculture. Les problèmes liés à la production des produits alimentaires sont posés par la satisfaction des besoins de la population humaine, qui augmente rapidement, aussi sont-ils très complexes et paradoxaux. Ces problèmes sont tout d'abord d'ordre éthique, car les lois en matière d'éthique sont tout à fait différentes des lois scientifiques. L'aprês les données disponibles, je peux faire des conclusions souvent tout à fait contraires. Les optimistes, enchantés par l'augmentation de la production des produits alimentaires sur la base des réalisations des sciences contemporaines, négligent les prévisions de famine de Malthus. D'autre part, les pessimistes insistent sur la connaissance que la pollution de l'environnement et la dégradation des sols, provoquées par les procédés industriels de production des produits alimentaires, ont des conséquences directes sur le genre humain. Les principes de la bioéthique sont étroitement liés à l'éthique professionnelle de nos scientifiques et acteurs, qui décident, et ceci s'avère comme un problème très sérieux. La conclusion de l'auteur est: nos décisions doivent être fondées sur le bon sens (common sense), la connaissance, les hauts standards éthiques et les mécanismes démocratiques, qui font de l'agriculture un mode de vie et non pas un simple investissement (rentable) pour les corporations. Nous sommes resposables devant notre postérité. Et c'est très important, car la méthodologie du scientifique/chercheur typique repose sur le réductionnisme scientifique et son, ou sa façon de penser n'inclut pas l'interdisciplinarité, l'approche holistique. Les scientifiques doivent donc commencer par une aproche holistique dans leurs rechersches agricoles et rechercher les conséquences sur les méthodes passées, actuelles et futures de la pratique agricole.

Mots-clés: éthique en agriculture, bioéthique, approche holistique, méthode de production agricole.

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