

EMERGING CHALLENGES FOR ANIMAL PRODUCTION, DANGERS AND OPPORTUNITIES

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ABSTRACT

Growing world population, raising income of more than 3000 million people eating more animal products as before, competition for animal feeds by energy sector and packaging material industry are emerging challenges for animal production. The worsening trend in the border conditions negatively influencing potential feed production for animals namely shrinking arable land areas, diminishing ground water resources, reduction of sea fish populations because of over fishing and the negative effect of climate change are summarized. Feed and also water efficiency of animal populations will be more important as at present, while alternative feed resources will gain in importance. Tabulated calculations clearly demonstrate that selection for productivity leads to great reduction of feed, water and manure output per unit of animal product. For example, a broiler chicken of 1978 needed 20 kg feed and 20 000 l water (inclusive feed production), however present type broilers need 7 kg feed and 7 000 l water to produce 1 kg breast fillet meat. In latter case 40 l of drinking water that was required 30 year ago, was reduced to 14 l for the same quantity of product, while manure output was reduced to one third. In the future in those areas of animal production where consumers require large quantities of good quality mass products we have to use high yielding animal populations under well controlled conditions.

Key words: animal production / products / increased demand

NOVI IZZIVI, NEVARNOSTI IN PRILOŽNOSTI ZA ŽIVINOREJO

IZVLEČEK

Čedalje več ljudi in vse višji dohodki več kot 3 milijarde ljudi, ki pojedjo več živalskih proizvodov kot kdaj prej, tekmovanje za živalsko krmo v energetske sektorju in v industriji embalaže pomenijo veliko priložnost za živinorejo. V prispevku omenjamo trende poslabšanja za proizvodnjo krme na mejnih področjih, zlasti krčenje ornih površin, manjše zaloge podtalnice, manj morskih rib zaradi povečanega ulova in spremenjene klimatske pogoje. Izkoristek krme in vode pri živalih bo v prihodnje še bolj pomemben dejavnik kot doslej, alternativni viri krme pa bodo čedalje pomembnejši. Iz izračunov v preglednicah je razvidno, da selekcioniranje na večjo proizvodnjo vodi v zmanjšano porabo krme in vode ter manj proizvedenega gnoja na enoto živalskega proizvoda. Na primer, pitovni piščanec je leta 1978 potreboval 20 kg krme in 20 000 l vode (všteta je proizvodnja krme), današnje vrste pitovnih piščancev pa porabijo 7 kg krme in 7 000 l vode za proizvodnjo 1 kg prsnega fileja. Tako se je 40 litrov porabljene vode iz pred tridesetih let zmanjšalo na 14 l za proizvodnjo enake količine mesa, količina gnoja pa se je zmanjšala za tretjino. V prihodnje bo v tistih vejah živinoreje, od katerih potrošniki pričakujejo največ kakovostnih proizvodov, potrebno rediti visoko produktivne živali v strogo nadzorovanih razmerah.

Ključne besede: živinoreja / proizvodi / povečano povpraševanje

INTRODUCTION

In the last 50 years greater changes occurred in agriculture as in the last 2000 years. It is an undeniable success that considering the facts that the world population increased from 2 500 million to 6 300 million, and at present approximately 3000 million people are supplied with food at a higher level and standard as 1 000 million 50 year ago. In 1950 16% percent of the world population 400 million – suffered severe malnutrition, at present “only” 13% – 800 million – live at the same very low level. The great change was driven mainly by using highly productive breeds, hybrids (both plants and animals) new complex production technologies, further processing methods, new storage and marketing, logistic systems, using and incorporating a huge amount of knowledge and knowhow accumulated in any many fields of science.

In the last few years we are experiencing several new phenomena, deeply influencing, agriculture, food production, and consequently animal production. In the following presentation I try to outline some of the most important factors which we have to consider in the future as animal breeders.

INCREASING COMPETITION FACING ANIMAL FEED PRODUCTION AND RESOURCES

In Table 1. the main new challenging factors are listed, all of them exert a growing pressure in the competition for animal feed resources (Horn, 2005).

Table 1. Factors increasing competition for animal feed resources

Increasing world population	6.5 → 8 billion
Increasing income, increasing food consumption of animal origin	China, India and others
Growing bio fuel industry	USA, EU and others
Bio based packaging material production (starch)	Japan and others
Decreasing fish populations	Many areas worldwide
Decreasing soil reserves	Many areas
Decreasing water available for irrigation	Many areas
Climate change	?

Several surveys conducted, show that if the annual income per family is below 1 500 US \$, the human consumption is restricted to foods of plant origin (Gilbert, 2007).

Meat consumption shows a very close correlation with the per capita GDP, as FAO statistics demonstrate. In Table 2. the data illustrate the nature of the connection (Roppa, 2007).

The relationship between GDP and meat consumption is close up to 80–90 kg meat consumed per capita annually.

In the global context special attention have to be focused on mainly China, India and the fast developing South-East Asian area, with approximately 3 000 million inhabitants where annual GDP increases are large, and where the structure of the human diet rapidly changes favoring more and more foods of animal origin, meat playing a key role. The switch from a vegetarian type of diet to a more balanced mixed structure means that significantly larger quantity of plant product is needed to supply the human needs, as animal products require 4–10 times more plant biomass per unit human food produced.

Table 2. The annual per capita GDP and per capita meat consumption (1961–2030)

Year	GDP/year/person US \$	Meat consumed per person/kg/annum
1961	2 676	23.1
1971	3 610	27.8
1981	4 376	30.8
1991	4 992	34.4
2001	5 611	38.6
2030	7 600	45.3

Considering the very large differences in meat consumption in the various countries and regions (see Table 3) differing in GDP potential, some straight forward conclusions can be drawn.

Table 3. Per capita meat consumption and structure in some selected countries and regions (USDA, 2007)

Countries, Regions	Meat consumed kg/capita/year			
	Beef	Pork	Poultry	Total
China	6	36	9	50
India	2	1	2	5
Hong Kong	16	61	39	116
USA	42	30	53	125
EU 27	16	43	20	79

The consumption data of China and Hong Kong are of special interest, as the Hong Kong population is 98 chinese, GDP is high and meat consumption is close to the USA despite the fact that all food has to be imported for the 5 million population, as they have a negligible domestic agricultural production.

The Chinese consumption – with growing incomes per facility – will follow the same pattern with very high probability. 20 years ago China consumed 20 kg meat per capita annually, by now it reaches 47% of that of Hong Kong due to increased living standards.

Table 4. Per capita annual compound feed production in selected countries (kg/per capita/per annum) (* Lyons, 2007; ** Horn, 2007)

	1980	1996	2006
World average *	82	105	96
USA *			810
Canada *			600
China *			70
India *			10
Hungary **	800		430

Increased meat consumption leads to large increase in feedstuffs needed for meat production. Considering 1 kg increase in per capita meat consumption taking China and India alone in account, means minimally an additional 10–12 million tons of concentrated feed. The magnitude in the per capita compound feed production in the various countries are very large. In Table 4, some data show the differences.

The Hungarian data clearly reflect the dramatic drop of animal production which took place after 1990.

Farrel (2005) referring to FAO data predicted that within 10–15 years to cover the increased meat consumption needs of China and India alone will require an international feedstuff trade five times as large as at present, and a three times larger international meat trade.

A new very strong competitor for animal feeds is the bio energy industry. Calculations from the USA and EU show the magnitude of this recent challenge (Tables 5 and 6).

Table 5. The impact of replacing 10% of USA fuel consumption with ethanol on animal feed resources (Lyons, 2007)

1 ton of corn	400 l ethanol 300 kg DDGS
Corn required for ethanol production	140 million tons (52% of present US production)
Quantity of DDGS (Distillers dried grains with solubles)	47 million tons

To reach the planned targets have a far reaching effect on feed resources. The EU targets of 5.75 replacement is possible, but replacement targets over 10% seem absolutely unrealistic, if the bio fuel production will be based on crops produced within the EU.

The new trend in packaging industry to replace non degradable materials by mainly starch based degradable raw materials will create a new market for cereals used as feed for animals. Japan already have made this decision also legislatively, and others will surely follow this model.

Table 6. The necessary arable land area needed to produce bio fuels in the EU as planned for 2010 and 2030 (Windhorst, 2007)

Arable land area needed (EU 27)	2010 5.75% bio fuel	2030 25% bio fuel
Land area (million ha)	15–18	65–75
In percentage of the total area	13–15	60–70

The briefly outlined – and incompletely listed – confounding global challenges: feeding the hungry world both quantitatively and due to raising incomes also qualitatively at higher levels as before, provide the world with energy, and produce the necessary raw material for the packaging industry, they all exert a great pressure on the animal feed production sector competing for the same basic plant products.

WORSENING BORDER CONDITIONS FOR FOOD PRODUCTION

In supplying the world population with high quality animal proteins fish represents a major source, often overlooked. Fish represent practically the only animal protein food for 1000 million people, in Asia alone (Diamond, 2007, 2007). Fish consumption is very high in many highly developed countries too the annual per capita consumption in Portugal is 59 kg, in Spain 47 kg, in France 31 to give some examples in Europe. Marine fishing plays a key role, catches reach 100 million tons annually at present, and gives a living for 200 million people worldwide. The fishing boat fleet is close to 4 million. Due to the greatly increased catches driven by the very fast increasing demand leads to overfishing to a very dangerous extent. Due to overfishing the collapse of many fish populations is expected. Estimations of over 80% reduction of the active population size for several leading species are not exceptional. The present fishing practices are unsustainable.

New, innovative measures are necessary using artificial breeding, rearing methods, severe fishing practice regulations, strictly protected new areas where regeneration of the fish populations may occur. One of the greatest problem is, that in artificial rearing systems, the fish feeds have to contain high proportions of animal proteins, or fish meat. A vicious circle. Much innovation and research is inevitably necessary, in finding new feed ingredients and formulations.

Diminishing of the soil resources and deterioration of soil quality are of increasing concern to developed and developing countries alike. In China for example it has been estimated that in the last 15 years 50% of the good quality soil area has been lost due to infrastructural developments and other reasons, the potential productivity of grasslands is already reduced by 40% due to overgrazing, and desertification (Diamond, 2007).

Very many other examples could be listed, even Hungary for example have lost over 500 000 ha, of agricultural area (8%) in the last 15 years mainly due to infrastructural developments (Horn, 2007).

To increase the irrigated land area seems potentially important if sustainability is ensured, by using renewable water resources. In many areas of the world (both developed and developing countries) characterized by intensive plant production ground water is used for irrigation. In those areas the fast sinking ground water level is a growing threat and cause of deep concern. In China 50% of the agricultural land area is irrigated. Two-thirds of the irrigated area and many urban areas use ground water resources to provide the water. The ground water level sinks fast, in Peking area for example this exceeded 50 m in the last 50 years (Somlyódy, 2008). Similar tendencies for example apply for several member states of the USA, Australia and some parts of Hungary too.

The briefly listed border conditions potentially determining food and feed production show rather negative developments, and remind us how important sustainable technologies and broadly defined complex measures to be taken seem urgently necessary.

THE ROLE OF PRODUCTIVE ANIMAL POPULATIONS

To satisfy the fast growing human demand for more animal products in the future, the increasing competition for animal feed resources, coupled with the pressure to produce unit animal product minimizing water requirement and manure output representing a negative by product loading the environment, is a multiple goal, which only highly productive animal populations can successfully fulfill.

As an example let me demonstrate this efficiency complex on broiler chicken as one model. Similar calculations were published earlier, regarding milk production and turkey meat production by Horn (2005, 2007) demonstrating the same basic tendencies.

In broiler chicken the most important and valuable product is breast fillet meat, considering the fact that for example in the USA the majority of the per capita annual 53 kg poultry meat consumption consists of broiler chicken and turkey breast.

In Tales 7 and 8 three typical broiler chicken types were compared representing in performance which was typical in 1978, 1998 and 2008.

The successful selection mainly focusing on fast early growth rate and carcass yield led to fast improvements in growth and carcass traits, as a consequence age at slaughter diminished dramatically, breast yield improved significantly (Table 7).

Table 7. Changes in performance of broiler chickens comparing 1978, 1998, 2008 types

Broiler, type, year	Live weight 42 days, kg	Feed kg/live weight, kg	Age at 2 kg live weight, days	Breast fillet meat at 2 kg live weight, g
1978	1.0	2.5	63	250
1998	2.4	1.7	37	320
2008	3.0	1.4	32	400

Table 8. Efficiency of breast fillet production of different broiler types regarding feed and water used, and manure produced

Broiler type, year	Efficiency in producing 1 kg of breast fillet			
	Feed used, kg	Drinking water consumed, l *	Precipitation (rain) used for feed production, l **	Manure produced, kg ***
1978	20	40	20 000	23
1998	11	22	11 000	13
2008	7	14	7 000	8

* 2:1 drinking water:feed ratio, normal rearing temperature

** 5 t/ha crop/ha production, 500 mm annual rainfall

*** Feed quantity \times 1.15

As correlative responses feed efficiency markedly improved and as a consequence of this a linear decrease in manure output resulted. As feed efficiency per unit product production improved, less drinking water was consumed, and feed could be produced on smaller areas, thus less rainwater was necessary to produce the crops used as feed. At present we can say that the high performing broiler of today uses 3 times less feed and water and produces 3 times less manure per unit breast fillet meat as their slower growing ancestors 30 years ago.

Genetically improved animal populations shall play an even more important role in the future, to produce the fast increasing quantity of nutrients of animal origin required by that part of the world population where incomes rise, and the demand rises fast to consume more meat and animal products as at present. Those markets are fast growing and very far from saturation.

Highly productive genotypes use also less water, and produce less manure thus are more environment friendly, and above all need much less agricultural area to produce unit quantity of products compared to their less efficient and productive controls.

There is no doubt however that those populations with increased incomes develop new "niche markets" for special quality products, offering a wide range of possibilities, where special

genotypes and managerial systems may be the tools to produce the special products required, at special premium costs and prizes. Those markets are not cost sensitive.

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