Sustainable Animal Production in Italy

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FAO (Diouf, 2007), declared that over the next 50 years, the world’s farmers and ranchers will be called upon to produce more food than has been produced in the past 10,000 years combined, and to do so in environmentally sustainable ways.
Definition of Sustainability

- Sustainability should be defined as:

“Development that meets the needs of the present without compromising the ability of future generations to meet their own needs” (WCED, 1987).

“A system or procedure is sustainable if it is acceptable now and if its effects will be acceptable in future, in particular in relation to resource availability, consequences of functioning and morality of action” (Broom D.M. 2001, 2010).

- In livestock production systems the concept of sustainability should include (Gamborg and Sandøe, 2005):
  - environmental protection,
  - animal welfare,
  - biodiversity,
  - food safety and quality,
  - social issues and economic competitiveness
Livestock sustainability in Italy

In Italian context,

the livestock sector is based on an high density of livestock unit per hectare of agricultural area in the North, which is similar to the most intensive livestock systems of Central and Northern European countries (EUROSTAT, 2011).

Recent official census of agriculture (ISTAT, 2012) showed a trend toward a very strong intensification system.
Livestock sustainability in Italy

N. livestock farms (x1000)

- 2000: 661,771
- 2010: 209,996

Change: -68%

N. of cattle farms

- 2000: 171,994
- 2010: 124,341

Change: -28%

N. of heads (cattle)

- 2000: 6,049,252
- 2010: 5,677,953

Change: -6%

Heads/farm

- 2000: 35
- 2010: 46

Change: +30%
In 2006 the Nitrates Directives was applied in Italy, with the definition of Nitrate Vulnerable Zones, which included 67% of the utilized agricultural area (UAA) of Po valley (plane area of the northern regions).

In the north part of Italy the livestock density is very high (1.7 livestock unit/ha UAA), for a total of 7 million of livestock units.

The most diffused crop is maize (Zea mays L.), which represents the main source of on-farm fodder (Grignani et al., 2007).

The adaptation to the new limits imposed by the Nitrates Directives may become critical for maintenance of acceptable levels of dairy and beef production in the most intensive farms. For this particular situation, European Commission accorded a derogation to the farmers of Po valley regions and its authorized* to have a limit of 250 kg N/ha per year, instead of 170 kg N/ha per year.

*with an individual request, accompanied by detailed documentation on farm management and manure storage and use, farms should
Nutrient surplus and Land use

It’s important to develop strategies to:

- Optimize efficiency of livestock sector
- Reduce the environmental impact
- Utilize low protein diets
- Reducing the nitrogen surplus.

Commercially a dietary CP concentration of 130–150 g/kg DM is commonly used, but constraints introduced by the Nitrates Directive of the European Economic Community (EEC, 1991), and the high cost of soybeans, are inducing farmers to use lower CP diets.

Schiavon et al. (2012) showed that low protein diets and rumen-protected conjugated linoleic acid increase nitrogen efficiency (N retained/N consumed) from 0.17 to 0.23, reducing the N excretion of 30%, and this strategy did not exert any influence on carcass and meat quality, as on growth performance, ensuring the economic sustainability of low protein diets (Schiavon et al., 2011).
The impact on sustainability of cattle farming should be monitored with different integrated approaches, such as Life Cycle Assessment (LCA) or ecological footprint (EF) (Cuček et al., 2012).

LCA is a structured, comprehensive, internationally-standardized tool for quantifying the environmental impact associated with processes, products or activities (EC, 2010).

‘Footprint’ should be defined as a quantitative measurement describing the appropriation of natural resources by humans (Hoekstra, 2008).

De Vries and De Boer (2010), in a recent review aimed at comparing the environmental impact for livestock products, obtained the following results:

- for beef cattle the land used to produce 1 kg of meat ranged from 27 to 49 m²
- for dairy cows the estimated value ranged from 1.1 to 2 m² per kg of FCM
Nutrient surplus and Land use

In general, it is assumed that intensification increases the efficiency of the use of resources, but we must consider that the traditional low input livestock systems of marginal areas are able to maintain ecosystems with high natural value and rich of biodiversity.

For example, mountain livestock farms play a fundamental role for the conservation of area included in Natura 2000 network.

This kind of multifunction services are in line with the ‘greening’ reform of the EU, which will sustain the farms able to maintain permanent meadows and protected areas.

On the other side, the abandonment of traditional cattle farms caused grassland degradation and forest re-growth, with a consequent loss of biodiversity (Cocca et al., 2012; Marini et al., 2011).
Enteric methane and Global warming

The mitigation of **enteric methane** (**CH\(_4\)**) emitted by ruminants has become a recent and important area of research in animal science.

<table>
<thead>
<tr>
<th>Source</th>
<th>Agriculture</th>
<th>Livestock Production</th>
<th>Source</th>
</tr>
</thead>
<tbody>
<tr>
<td>USA, % total country</td>
<td>5.8</td>
<td>3</td>
<td>EPA, 2007</td>
</tr>
<tr>
<td>Canada, % total country</td>
<td>8.0</td>
<td>4</td>
<td>Kebreab et al., 2006</td>
</tr>
<tr>
<td>UK, % total country</td>
<td>6.5</td>
<td>2</td>
<td>Gill e coll., 2010</td>
</tr>
<tr>
<td>Italy, % total country</td>
<td>6.6</td>
<td>3</td>
<td>ISPRA 2010</td>
</tr>
<tr>
<td><strong>Global World</strong> % total sector</td>
<td><strong>22.0</strong></td>
<td><strong>18</strong></td>
<td>FAO, 2006</td>
</tr>
</tbody>
</table>

The global warming potential of methane is superior of about 20–25 times that of carbon dioxide (IPCC, 2001; Kebreab et al., 2008), thus, methane is considered a greenhouse gas more potent than carbon dioxide (**CO\(_2\)**) itself.

Among human activities, **agriculture is responsible for about 50% of global production of methane from human activities** (IPCC, 2001), and **the largest source of this gas is being enteric fermentation in ruminants**.
Enteric methane and Global warming

The methane is produced mainly (Murray et al., 1976):

- In the rumen (87%)
- In the intestine (13%)

The methane produced in the rumen is a normal byproduct of the anaerobic fermentation of organic matter, and represents a loss of energy production for the animal.

On a worldwide basis, the enteric methane from ruminants has been estimated at 17–30% of total anthropogenic methane (Beauchemin et al., 2009).

Growing concerns about global warming and the contribution of agriculture to climate change have led many countries to sign the Kyoto Protocol, committing to reduce greenhouse gas emissions to 1990 levels, following the guidelines of the IPCC-Intergovernmental Panel on Climate Change (UNFCCC, 1998).
Enteric methane and Global warming

Many sectors of economy have GHG emissions reduction strategies

A mitigation of Methane emission in livestock species seem to be possible

Methane from rumen fermentation:
- diet manipulation
- rumen modifiers/additives
- rumen microbial genomes
- animal selection

Alford et al. 2006, calculated a 16% of reduction of CH$_4$ in 25 years if Residual Feed Intake will be included in beef selection programmes
Enteric methane and Global warming

Recent forum and scientific conferences have begun to address the potential effect of the genetic component on the emission intensities of methane at the individual animal and farm level (Chagunda et al., 2009).

The variation of the enteric emissions of CH$_4$ has been reported in animals (Hegarty et al., 2007) between the breeds, and over time (Herd et al., 2002), indicating that the mitigation of the emission of methane can also be achieved through genetic selection.
Enteric methane and Global warming

The traits at the moment seems the most promising indirect selection for this is the **RFI or residual feed intake** (Hegarty et al., 2007) or the prediction of methane emitted from the type of diet administered, qualitative and quantitative production by live weight, assuming zero RFI (Ellis et al., 2007; Cassandro et al., 2010).

Very interesting is the approach of **genomic selection** (Meuwissen et al., 2001), a method that may become applicable, if only could be dispose of the emission of methane of at least 4–5000 individuals to be considered as a reference population to developing the genomic selection by means of a chip of thousands of genetic markers to extend to the entire population in selection.
Enteric methane and Global warming

New perspectives and scenarios involving the livestock sector increasingly demanding the attention and responsibility towards environmental protection and major climate changes, such as limiting greenhouse gas emissions.

Limit the concentration of carbon dioxide and other greenhouse gases in the atmosphere requires a technological and economic revolution.

A cost to the issuer of carbon dioxide in the atmosphere will probably be required by society and some people reported values on the order of 15 euro per tons of CO₂ emitted.
Animal Welfare

The importance of animal welfare is well recognized by EU citizens, who assigned, on a scale from 1 to 10, an average rating of 7.8 to the question “How important is to you that the welfare of farmed animal is protected?”.

Specific legislations on animal welfare have been set by the European Union for several categories of farm animals.

In case of cattle, the only regulation in force regards the protection of calves, imposing their group housing and the provision of a small amount of fibrous feeds in addition to the liquid diet (European Council Directives 91/629/EC and 97/2/EC).

There is a common opinion that rearing systems of farm animals with a high stocking rate are negatively related to the animal well being, since for the large majority of urbanized citizens, a positive perception of farm animal welfare is related to animals performing a natural behavior in a natural environment (Webster, 2001).
Bulls aggressive behaviours have shown to increase when cattle are housed with an insufficient space allowance.

Time spent resting, eating and ruminating is also reduced particularly by subordinate animals which cope with more difficulty with the dominant pen-mates (Bouissou and Boissy, 2005).

The outcomes of the risk assessment carried out by the EFSA Panel on Animal Health and Welfare (AHAW, 2012) have shown that overstocking impairs cattle health increasing the likelihood of respiratory diseases.

Insufficient space allowance is considered a significant cause of early losses in fattening cattle due to trauma on foot and legs and tail tip necrosis (Groth, 1985).

Negative effects of the overcrowding may be exacerbate by inadequate floor conditions that, besides changing animals’ normal laying/standing and walking behaviours, often cause injuries.
Animal Welfare

From this scenario, we can conclude that simple management decisions, like the reduction of the number of pen-mates could allow a significant improvement of the cattle well-being in the intensive dairy and beef farms on Northern Italy.

Farmers should be aware of the opportunity to increase their net income allowed by the implementation of welfare friendly housing practices.

However a proper consumer education towards the demand of welfare friendly milk and beef meat appears the strongest tool to drive the entire productive chain to the welfare target.
Examples of Livestock Production with a Sustainable approach

Farmer → Animal

Traditional Dairy Chain
- Milk (Meat)
- Processed Products
- Commercial and Marketing

Environmental Chain
- Climate Change/GHG
- Landscapes/Pollution Air and Water
- Tourism/Quality of life

Economy/Profit/AV
Morlacco Cheese of Burlina Cattle Breed

“BURLACCO” PROJECT

- Herd with 100% Burlina cows reared & < 400,000 ml somatic cells count
- Herds multibreed guarantee milk separation & < 400,000 ml somatic cells count
- Population of 300 Burlina lactating cows
- 904,000 kg of milk yield/year -> about 900 tons of milk/year
- 81 ton/year of Morlacco of Burlina cow (11% cheese yield)
- 10,314 wheels of Morlacco of Burlina cow per year (8 kg/wheel)

Funds by Veneto Region, PSR (2007-2013) mis. 124
Morlacco Market Products

- Slow Food Protected
- Traditional process
- Crude Milk
- Chain/Genetic Traceability

- Traditional process
- Crude Milk
- Chain/Genetic Traceability

Morlacco of Burlina by Alpin Pasture

Morlacco of Burlina cow

Morlacco “standard”
Examples of Sustainable approach

<table>
<thead>
<tr>
<th>EU premium</th>
<th>no</th>
<th>200 €/head</th>
<th>200 €/head</th>
<th>200 €/head</th>
</tr>
</thead>
<tbody>
<tr>
<td>Milk valorization</td>
<td>no</td>
<td>no</td>
<td>+ 0,05 €/kg</td>
<td>+ 0,05 €/kg</td>
</tr>
<tr>
<td>Holstein Friesian (HF)</td>
<td>9079 kg</td>
<td>9079 kg</td>
<td>9079 kg</td>
<td>7706 kg</td>
</tr>
<tr>
<td>production in 305d</td>
<td>-€ 766</td>
<td>-€ 566</td>
<td>-€ 321</td>
<td>€ 0</td>
</tr>
</tbody>
</table>

Profit HF – Profit Burlina

Diff. in profit, €/year per cow

-1,000 -800 -600 -400 -200 0 200 400
Examples of Sustainable approach

Reggiana → Parmigiano Reggiano

Italian Brown → Cheese of only Italian Brown

Rendena → Rendena Cheese

Pezzata Rossa → Cheese of only Pezzata Rossa

Valdostana → Fontina Cheese

Burlina → Morlacco Cheese
Examples of Sustainable approach

Veneto Sheep Breeds
Cinta Senese

Pitina
Lardo di Colonnata

Padovana Chicken breed
Chianina-Romagnola Marchigiana-Podolica Maremmana

Pro Avibus Nostris
Consorzi 5R Carne Italiana
Conclusion

Summarizing,

The Nitrates Directive require a strict link between animal husbandry and agricultural land management, and the intensification process developed in the Po valley cause a critical situation for several farms. In the perspective of greening evolution of EU reform, the farms able to offer positive externalities on the environment and to maintain a diversified agricultural landscape will be sustained, and the situation of intensive dairy and beef cattle of Northern Italy is unfavorable.

Different strategies should be applied to improve the sustainability of Italian cattle farms.

In the Po valley the efficiency of livestock sector, in terms of land, nutrient and energy use, should be improved working at different scales:

farm management, local and regional planning, research application (e.g. reduce the enteric methane output).

In the mountain and marginal areas, the main problem is the economic sustainability of farms, and the abandonment of traditional low input farms caused the loss of several positive externalities.
Conclusion

Farm diversification and promotion of high quality products such as PDO cheeses should help to maintain these farming systems, and to preserve the territory.

The strategy to joint traditional milk/meat chain with the environmental chain could be a good opportunity and strategy.

Also the improvement of animal welfare in intensive livestock systems is a strong request from public opinion, playing a central role for social sustainability of livestock farms.

In general, farm management, research approaches, environmental planning and policy, and consumer education must be oriented to improve the sustainability of Italian livestock farms.
Thank you / Grazie