Methane to Markets

ARGENTINA PROFILE

Animal Waste Management Methane Emissions

Prepared to be presented in the Methane to Markets Subcommittee Meeting (1 st December, UK)

Authors:

Jorge A. Hilbert

Luis A. Panichelli

Laura Finster

Guillermo Berra

Diana Crespo

Eduardo Gropelli

Instituto Nacional de Tecnología Agropecuaria (INTA)

September, 2006

INDEX

1. Characterization of the farming sector

The agricultural sector (agriculture and livestock) contributes with 12 % of the GIP (Gross internal product- 33,000 million U$S of 265,000 millions). The livestock sector participates with 42 % of the agricultural GIP.

Approximately 80% of the beef cattle and 90% of the dairy cattle are established in the Pampas region (Buenos Aires, Santa Fe, Córdoba, Entre Ríos). The systems are characterized by a good management giving advantages in nutrition and sanitary level, genetics and higher production rates. Better agro ecological conditions for breeding and fattening and more technology are available in this region than in the rest of the country.

Meat production is divided into two sectors: Breeding and fattening. The different farm types are shown in table I.

Table I. Meat production farm's types.

Type of farm	Value
Breeding	112'000
Fattening	25'000
Mixed	71'000
Subsistence	24'000
Total	232'000

Source: Berra G. and L. Finster, 2000.

Milk production characteristics are shown in table II.

Table II. Milk production characteristics.

Parameter	Value
National Production (million liters)	8'111
Number of dairy farm	3
Total number of cows	2'050'000
Dairy farm average production (liters)	1'709
Cow productivity (liters)	3'956
Average cows per dairy farm	158

Source: Berra G. and L. Finster, 2000.

2. Livestock characterization

The Argentina's GHG Inventory (2000) gives values for livestock population based on national statistics from the SENASA (Servicio Nacional de Sanidad y Calidad Agroalimentaria, 2000), the ENA (Encuesta Nacional Agropecuaria, 2000) and the CNA (Censo Nacional Agropecuario, INDEC, 2002). These values are shown in table III. A special classification was done for cattle (table IV) as it is the most important species in the national farming activities.

Table III. Livestock population within warm and cold regions.

Species	Population (heads)	Warm region (%)	Cold region (%)
Non dairy cattle	47'000'000	98	2
Dairy cattle	2'000'000	99.6	0.4
Sheeps	13'561'000	40	60
Goats	3'490'000	51	49
Pigs	240'000	98	2
Horses	1'517'000	85	15
Buffalos	1'000	100	
South American camelids	161'000	100	
Donkeys and mules	200'000	87	13
Poultry	60'000'000	83	17

Source: Berra G. and L. Finster, 2000.

Livestock values by province are shown in annex I and II.

Table IV. Cattle population characteristics.

Category	Population (heads)	In stand weight (Kg)	Adult weight (Kg)	Weight increment (Kg/day)	Milk production (Kg/day)	Food digestibility (%)	Gross energy (MJ/day)
Dairy cattle	2'000'000						
Lactating - pregnant dairy cows	*928'000*	*600*	*600*	-	*15*	*65*	*283.33*
Lactating - empty dairy cows	*400'000*	*600*	*600*	-	*15*	*65*	*271.17*
Dry - pregnant dairy cows	*272'000*	*600*	*600*	-	-	*65*	*148.44*
Dry - empty dairy cows	*400'000*	*600*	*600*	-	-	*65*	*136.75*
Non dairy cattle	47'000'000						
Non dairy cows							
Lactating – pregnant non-dairy cows	*6'967'500*	*420*	*420*	-	*3*	*55*	*185.93*
Lactating - empty non-dairy cows	*3'483'750*	*420*	*420*	-	*3*	*55*	*173.91*
Dry – pregnant non-dairy cows	*3'483'750*	*420*	*420*	-	-	*55*	*146.71*
Dry - empty non-dairy cows	*4'645'000*	*420*	*420*	-	-	*55*	*135.16*
Unweaned calves (Up to 1 year old)	7'284'750						
Weaned calves (Up to 1 year old)							
Feed lot female calves	*300'000*	*200*	*420*	*1.1*	-	*75*	*105.01*
Short wintering male calves	*1'100'000*	*213*	*420*	*0.7*	-	*65*	*107.53*
Long wintering male calves	*662'750*	*200*	*420*	*0.444*	-	*60*	*98.55*
Short wintering female calves	*825'000*	*200*	*420*	*0.555*		*65*	*99.01*
Female calves for breeding (young heifers)	*800'250*	*195*	*420*	*0.333*		*55*	*109.26*
Male calves for breeding (young bulls)	*52'250*	*202.5*	*750*	*0.5*		*55*	*137.01*
Young bulls (From 1 to 2 years old)	190'000	495	750	0.5		55	236.05
Young steers (From 1 to 2 years old)							
Short wintering young steers	*2'000'000*	*308*	*420*	*0.7*	-	*65*	*141.79*
Long wintering young steers	*2'410'000*	*300*	*420*	*0.444*	-	*60*	*133.57*
Long wintering steers (> 2 years old)	4'410'000	400	420	0.444	-	60	165.74
Heifers							
Short wintering heifers (1-2 years)	*1'500'000*	*300*	*420*	*0.555*	-	*65*	*134.2*
Breeding empty heifers (1-2 years)	*2'910'000*	*275*	*420*	*0.361*	-	*55*	*145.38*
Breeding empty heifers (+ 2 years)	*1'140'000*	*380*	*420*	*0.296*	-	*55*	*173.56*
Breeding pregnant heifers (+ 2 years)	*1'800'000*	*380*	*420*	*0.296*	-	*55*	*184.28*
Bull	1'035'000	750	750	-	-	55	208.79
TOTAL	**49'000'000**						

Source: Berra G. and L. Finster, 2000.

3. Methane emissions from livestock waste management

Total green house gases (GHG) emissions from the farming sector were estimated using the IPCC Good Practice Guidance and Uncertainty Management in National Greenhouse Gas Inventories (IPCC, 2000). GHG Argentinean farming emissions by categories are shown in table V. The main emissions in the farming sector are generated by methane (CH_4) emissions from livestock enteric fermentation (66.78%), nitrous oxides (N_2O) direct emission from soils for animal shepherding (21.24%) –due to animal's nitrogenous excretions and N_2O indirect emission from soils for animal manure (10.39%) –due to volatilization and lixiviation of nitrogen contained in animal's faeces and urine.

The other sources categories in the sector, namely CH_4 and N_2O emissions from animal manure management represents only 1.40% and 0.19% respectively.

Table V. GHG farming emissions by categories (2000).

Category	Gg of original gas	Gg CO_2eq	Contribution to the sector (%)
CH_4 for enteric fermentation	2739.31	57525.55	66.78
CH_4 for manure management	**57.32**	**1203.7**	**1.4**
N_2O for manure management	0.52	161.2	0.19
N_2O direct emission from soils for animal shepherding	59.03	18299.3	21.24
N_2O indirect emission from soils for animal manure	28.85	8943.5	10.39

Source: Berra G. and L. Finster, 2000.

Emissions estimations were done using Tier1 method of the IPCC Guidelines (IPCC, 2000), using default emission factors for each animal species. As presented in figure I, methane emissions from animal manure treatment (57 Gg CH_4) is not an important source of GHG emissions for the country. This is due to the fact that manure produce by the main animal species are processed with aerobic treatments, generating low methane quantities.

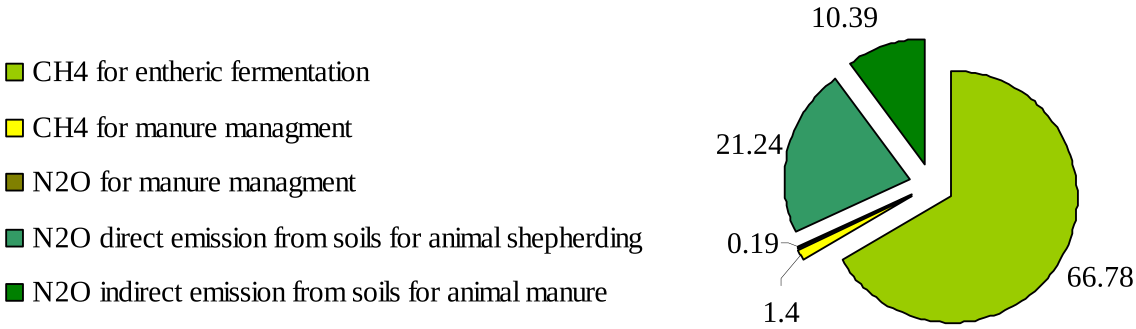


Figure I. GHG farming emissions contribution by categories (%). Source: Berra G. and L. Finster, 2000.

Methane emissions from livestock's manure management by animal species are presented in table VI. As can be seen (figure II), more than 85% of the CH_4 emissions are produced by cattle, being non-dairy cattle the main contributor to GHG emissions from farming activities.

Table VII. Methane emissions from livestock's manure management by species (2000).

Species	Gg CH_4	Gg CO_2eq	Contribution to the category (%)
Dairy cattle	1.99	41.83	3.48
Non-dairy cattle	47	987	82
Sheeps	1.68	35.31	2.93
Goats	0.49	10.26	0.85
Pigs	2.35	49.39	4.1
Horses	2.31	48.42	4.02
Poultry	1.02	21.42	1.78
Buffalos	0	0.02	0
Donkeys and mules	0.17	3.61	0.3
South-American camelids	0.31	6.42	0.53
Total	57.32	1203.7	100

Source: Berra G. and L. Finster, 2000.

.

Emission contributions show that cattle represent 85.48% of the total CH_4 emissions, followed by pigs (4.10%), horses (4.02%), sheeps (2.93%) and poultry (1.78%). The remaining species contributes with 1.68% of the total CH_4 emissions. In conclusion, GHG emissions from farming sector are strictly conditioned by cattle population.

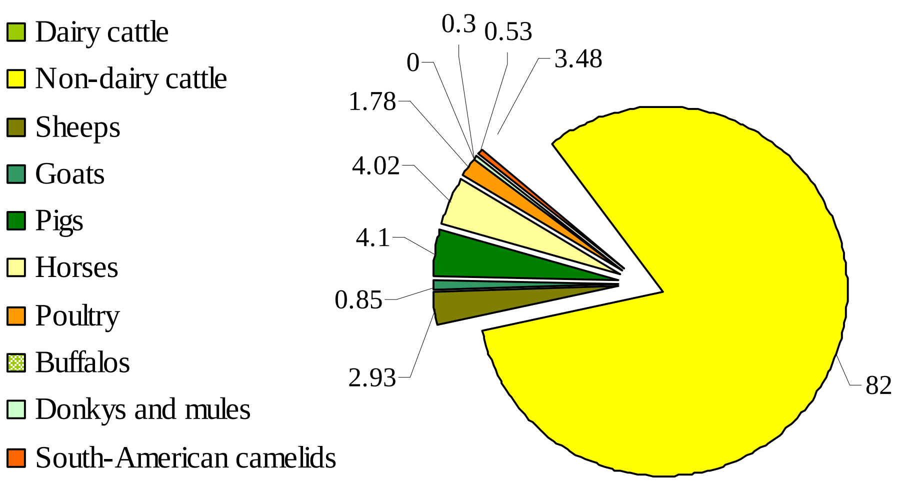


Figure II. Methane emissions contribution by livestock type (%). Source: Berra G. and L. Finster, 2000.

In figure III, CH_4 emissions from animal manure treatment variation from 1990 to 2000 are shown. Emissions changes were directly related to livestock population's variations. The decrease in the number of piggery populations had an important effect due to the fact that this species is the most confined and were anaerobic treatments are applied as wastes management. Decreasing cattle populations had also contributed to obtain lower CH_4 emissions in resent years (Finster, 2006).

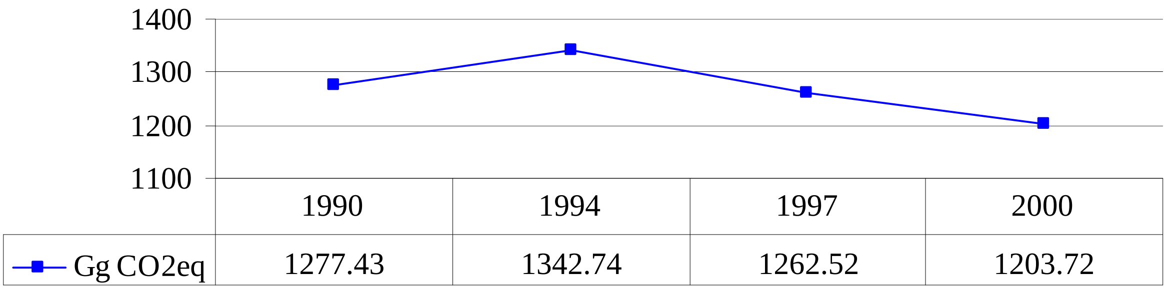


Figure III. Animal manure treatment methane emission variation between 1990-2000. Source: Berra G. and L. Finster, 2000.

4. Animal Manure Treatment Technologies

At present, Argentinean livestock sector had applied low costs waste treatment systems, if any. Main applied techniques are:

- Anaerobic-Aerobic Lagoons

Artificial lagoons are the common practice in dairy farms (figure IV). Artificial lagoons are constructed near the dairy farm and the effluent is conducted thought them till it is discharged into a stream in the surroundings of the farm. In some cases, the effluents are directly spilled into the stream. A similar situation is applied to feet-lots. Different wastes compositions are obtained in function of livestock species, feeding and production system.

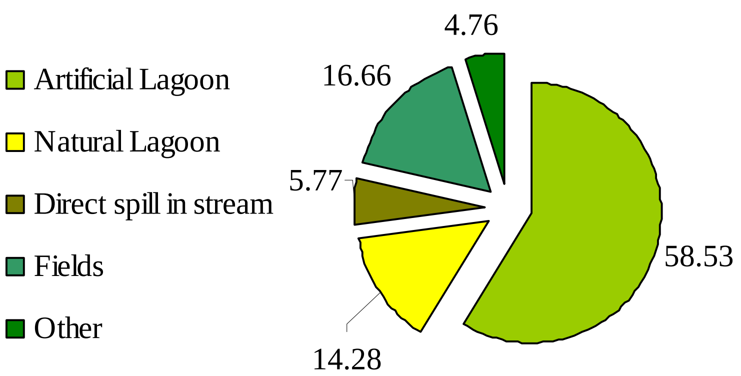


Figure XX. Dairy farms animal waste final disposal. Source: Nosetti *et al.*, 2002b.

Different lagoons designs have been implemented depending on cattle population (between 100 and 400 heads), wastes production (between 200 and 500 kg. of manure- wet basis) and lots surface. Lagoons average volume is 2591.3 m^3, but a strong variability in design and capacity exists (Nosetti *et al.*, 2002a, b). Waste treatment lagoons characterization in function of cattle population is shown in table VIII.

Table XX. Waste treatment lagoons characterization in function of cattle population.

Number of dairy cows	Long		Wide		Deep		Volume	
	Avge	SDv	Avge	SDv	Avge	SDv.	Avge	SDv.
50	87	120.2	3	1.87	1.6	1.29	251	290.61
51 – 100	89.4	73.6	14	20.3	1.78	0.83	1586.6	2049.7
101 – 200	43	34.2	30	40.4	2.5	0.87	3144	4223.3
> 200	98	72.6	25	10	3.6	1.52	6640	2312.6

Source: Nosetti *et al.*, 2002b.

There is no waste management planning in the livestock production. The existing artificial lagoons are a consequence of the land movement of the construction of the dairy installations. So, the dimensions of the lagoon are related with the dimensions of the dairy farm and the number of cows to be treated (Nosetti *et al.*, 2002b).

Similar treatments are applied to piggery farms (Herrero, A., 2006). In intensive concentrated breeding piggery farms, lagoons are the conventional effluent's treatment method. More than 70% of these types of farms have applied this technology. Maintenance operations and lagoon's saturation are variable within the farms. On the other hand, piggery waste treatment did not develop in relation with the productive capacity. In consequence, lagoon tends to be smaller than the optimal side for the respective production capacity. If more restricted legislation is applied, producers will have to adopt new waste treatment technologies, adapt the lagoons to meet the legislation's requirements or optimize the efficiency of the actual systems (Paolera, 2006).

- Land-farming

An alternative technique is to use animal wastes as agricultural fertilizers. But, due to the high water content (90%), the mineralogical content variability, and the presence of harmful seeds in dairy and feet-lot effluents this practice become some difficult (Nosetti *et al.*, 2002).

Liquid animal manure is sometimes spread over the fields as fertilizers, but it's not a common practice as the technology is not adapted and biased results of manure irrigation productivity were obtained (Charlon *et al.*, 2004).

Poultry manure (guano) is removed by shovel 2 – 4 times a year and taken by truck to horticulture farms to be used as fertilizer (Crespo, 2006, Herrero, 2006). Broilers manure is composed of a mix of substrate (rice or sunflower husk) and chickens urine and fecal matter (guano) and follows the final destination as poultry manure (Crespo, 2006).

- Composting

Some farms compost animal wastes. Poultry and feedlots solid manure is composted under low-cost techniques, but no specific use is planned for this product. Generally it is destined for internal use.

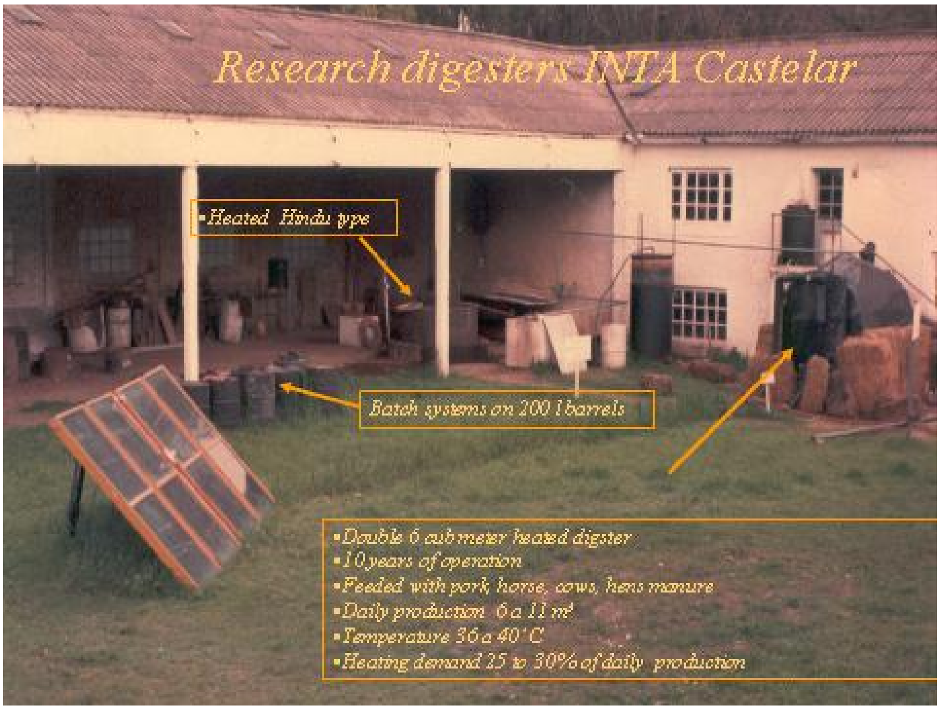
- Others

In feedlots, solid manure is sometime stock over the ground (in piles), remaining unused or is used to fill low lands (Herrero, A., 2006). No added value is seen in this product.

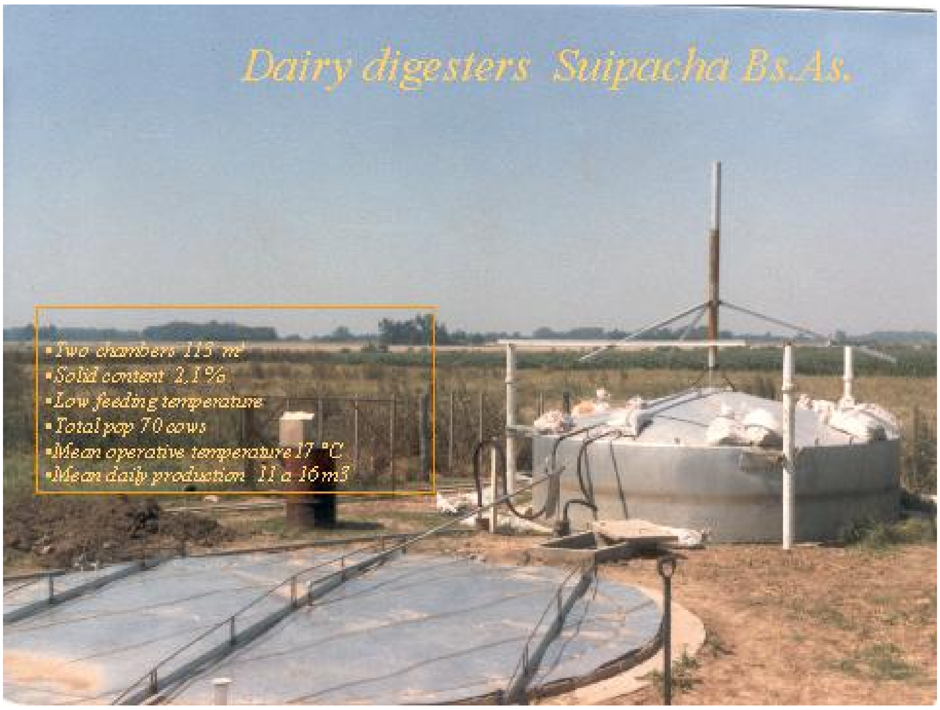
5. Methane recovery and practices in use.

There are no methane recovery practices at present. There are some actions carried over by the private sector related to carbon funds as AgCert. They have several projects under study but none of them are constructed.
Several projects using different types of anaerobic digesters (e.g., Hindu type, batch, plug flow) to handle various types of wastes (e.g., animal manure, urban organic solid wastes) have been implements mainly in the 80's. A regional plan for digesters construction was carried on in integrated farms in the province of Misiones (north east of the country with tropical climate). The digesters were Hindu type with a volume of 6 cubic meters each. (Hilbert J 2006). In overall 26 digesters of different types were constructed.
A regional network sponsored by FAO was implemented. from 1982 till 1990, several anaerobic digesters were constructed in Uruguay, Argentina and Chile on those years with variable results according to the employed technology.

INTA had a national and regional program on anaerobic digestion covering research and extension work. Through this project several professionals were introduced to the technology of the different regions of the country. Several national courses and conferences were done from 1983 till 1987.

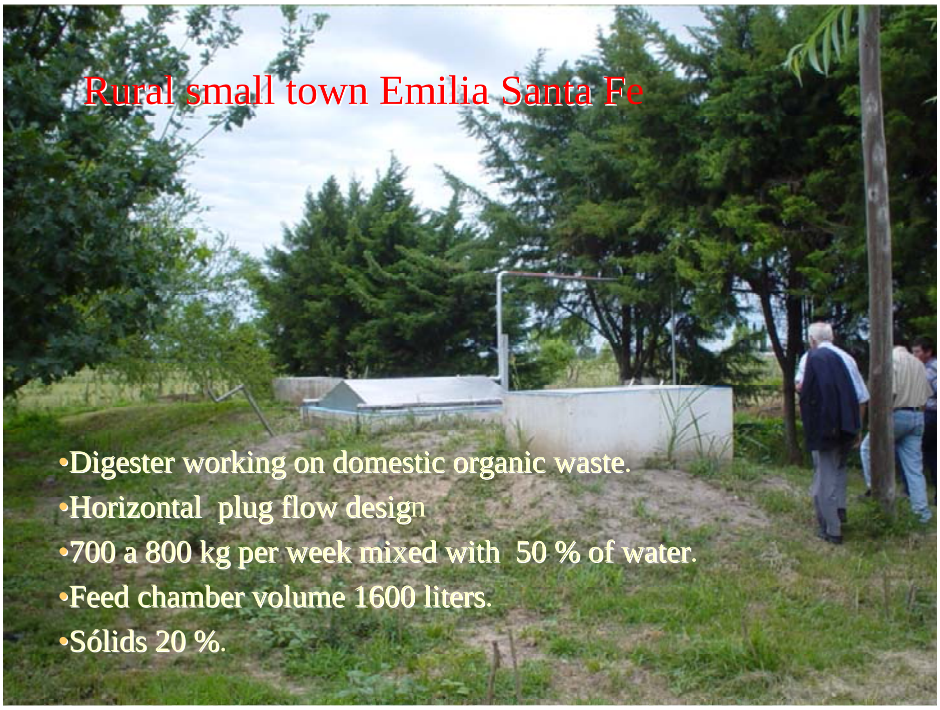


In the region of Bs.As. a pilot demonstrative plant was operated during five years in a dairy farm. The digester had two chambers and a floating gasometer over the second one.



In the agro industry there are also a few plants with local and foreign technologies, providing in some cases up to15 % of the industry energy needs.

At a regional level a constant work has been done by the University of el Litoral group conducted by Eduardo Gropelli. Through Proteger foundation several digesters have been constructed some of the focused on small rural communities anaerobic treatment plants.



One of the most important dairy companies SANCOR in Charlone (Bs.As.) operates a plant receiving 180.000 liters of milk per day and is entirely dedicated to cheese production, processing 150 cubic meters of whey per day. Due to the high organic load (COD ranging 55000 to 60000 ppm) it was decided to adopt a stage of anaerobic digestion using covered anaerobic lagoons. A UASB alternative was chosen with a total volume of 2250 cubic meters, residence hydraulic time of 13, 6 hours and a biogas conversion of 26 m3 biogas/m3 of whey.

There are several practical problems associated with digesters such as the insulation requirements during winter months, available operational time, and volumetric concerns.

At present INTA has launched a national program regarding agricultural and agro industrial waste's treatment. Two demonstrative plants are under construction in the research center of Castelar. One is for anaerobic treatment of solid organic residues of farms and small rural towns and the second is orientated to dairy, and pig farms. They are both insulated and heated.

On the basis of the Energetic and economic matrix calculator for rural digesters (Hilbert 2000) a specific software was design to evaluate the technical and economical feasibility of using manure for biogas generation (Florean *et al.* 2005). Different variables were adapted to the country new conditions, the format and the software support (Visual Basic) were modified, the market values were changed in response to the actual data, the bibliography was reviewed, and some equations and coefficients were modified. A step by step manual which describes the system's operation was developed. Both, the software and the manual, guide the user through the different screens to obtain the biogas demands and production, the operational and economic parameters, the energetic and fertilizer's costs, the incomes derived system's implementation and the financial feasibility of the project.

6. Overview of methane recovery potential

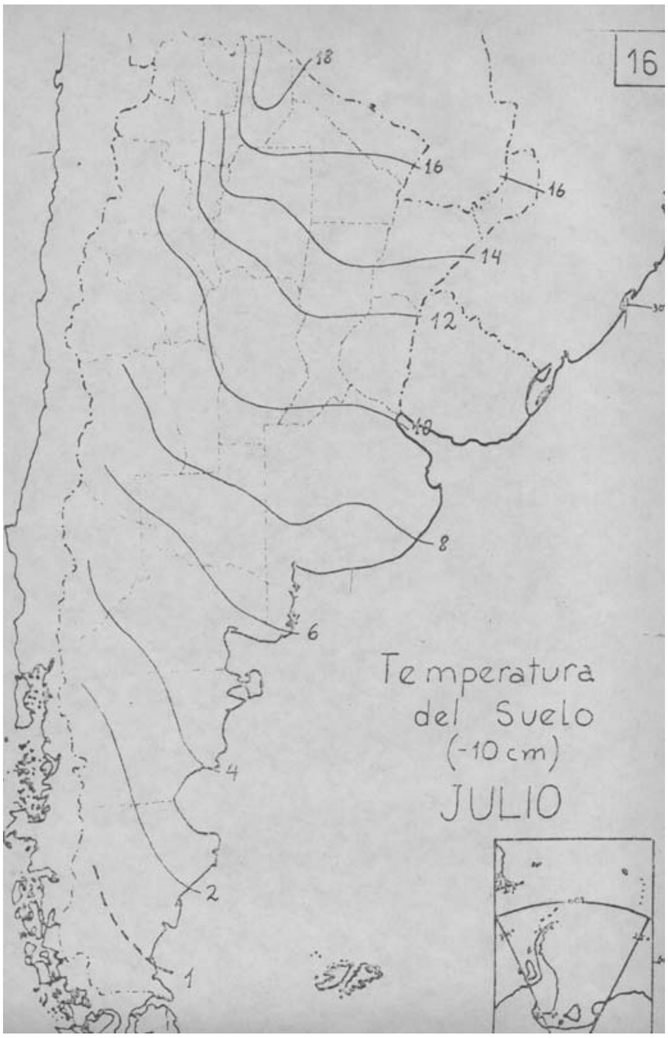
Present available statistics shows there is a technical and economical potential for methane recovery and use from animal waste management systems. There is an increasing awareness regarding this subject in several intensive activities.

The most suitable production systems for implementing methane recovery practices through waste treatment are the intensive pig farms, dairy farms and poultry farms. Feed lots in Argentina commonly use soil floors and the bed used in chicken production (usually rice or sunflower husks) complicates its treatment through anaerobic digestion. Between 100 and 200 thousand pigs in Argentina are produced under intensive breeding systems. It is estimate that between 600-700 thousand ERs are annually available from intensive breeding piggery farms (Paolera, 2006).

Based on present confined animal production (e.g., livestock), a potential capacity for capturing and using 120 million cubic meters of methane per year from the agriculture sector are estimated (Inst. de Ingeniería rural INTA).

At present, 35% (weight basis) of total GHG emissions come from cattle (comprising 60 % CH_4 and 40 % N_2O). From this value, 98 % corresponds to enteric fermentation. (Guillermo Berra 2005).

It important to consider the low winter temperatures in most parts of the country that limits the extension of simple anaerobic digestion practices with no insulation or heating systems (see medium winter temperatures of the soil at a depth of 10 cm in July)



At present there is an increasing trend in the country to increase intensive poultry, pig and cattle production since there are projections of an exponential growth of materials for animal feeding that will be delivered by the biofuels production (biodiesel + bioalcohol) (INTA SAGPYA 2005). The country has an urgent need to industrialize its raw farm production transforming grain into animal protein. (more than 90 % of corn is exported as grain).

The total capacity of converting grains into animal feed and oil is of 150 million tons of grain per day.

7. Challenges and/or priorities to greater methane recovery and use

Key barriers for methane recovery and use projects include:

Institutional barrers:

- Insufficient private and government research and development in the anaerobic digestion domain.
- Lack of international cooperation for alternative energies development.
- Lack of acceptance from the livestock sector of anaerobic digestion technologies as wastes management system
- Low enforcement of mandatory environment and renewable energies proportion's laws at national and provincial level
- Reinforcement of Clean Development Mechanisms strategies.

Technological barrers:

- Low process efficiencies.
- Operation and maintenance limitations (sludge's management, temperature control, gas and liquid leaks).
- Farms infrastructure adaptation's of waste treatment systems.
- Low livestock production under intensive production systems.

Economical barriers:

- Long transport distances that generate significant animal wastes deliver costs to the energy facilities.
- High operation and maintenance costs.
- Lack of Carbon emissions markets at national and international level.

Anaerobic digestion provides a viable environmental and economic solution toward long-term sustainability in both rural and urban settings. We encourage limiting research and development in priority areas where this technology presents the greatest advantages. There is a need for international cooperation to exchange and develop greater process knowledge

8. Existing or planned methane capture and/or use projects

At present no project of methane capture from animal wastes management exist in Argentina. On the other hand, methane capture projects from land fields and other sources have been presented to the Secretary of Environment. A list of accepted and submitted project is available at their web-site (http://www.medioambiente.gov.ar/?idseccion=61).

9. key stakeholders in the animal waste management sector

- Government

  1. Secretary of Energy (SE, http://energia3.mecon.gov.ar/home/).
  2. Secretary of Agriculture, Farming, Fishing and Food (SAGPyA- http://www.sagpya.mecon.gov.ar/).
     - Biofuels program (http://www.sagpya.mecon.gov.ar/new/0/agricultura/otros/biodiesel/index.php).
  3. Secretary of Environment and Sustainable Development (SEDS, http://www.medioambiente.gov.ar/).
     - Climate Change Unit (SEDS, http://www2.medioambiente.gov.ar/cambio_climatico/default.htm).

- Research and Development

  1. Rural Engineering Institute (IIR- National Institute of Agricultural Technology-INTA- http://www.inta.gov.ar/iir/).

2. Department of Chemical Engineering-Litoral National University (http://www.fiqus.unl.edu.ar/).

- Non-governmental organizations and Associations

1. PROTEGER foundation (http://www.proteger.org.ar).
2. BIOSFERA Foundation (http://www.biosfera.org/).
3. ASADES (Asociación Argentina de Energías Renovables y Ambiente- http://www.asades.org.ar/)
4. IICA (Inter-American Institute for Cooperation on Agriculture- http://www.iica.int/).

- Manufacturers

Although at present there are no organized manufacturers that construct anaerobic digesters on a current basis, there is a great interest in participating. Some experimental models have already been constructed by private manufacturers dedicated to PHRVC (reinforced plastic tanks).

There is plenty of national capacity and know how of construction of tanks of different sizes and materials that could be transformed to anaerobic digesters with few modifications. Regarding masonry construction there is plenty of experience placing septic tanks in suburban areas. Large scale digesters have been constructed using local engineering expertise.

- Consultancy

There are few groups capable of giving complete consultancy in anaerobic digestion. INTA has launched a national program on agricultural and agroindustrial waste's treatment. The principal scope of this national project is improving local technology and study the effluents impacts on the environment.

There is also a research group at the Littoral University with relevant experience in anaerobic digestion technologies and biogas production through waste treatment.

Some works are being conducted in the private sector concerning greenhouse gas emissions reduction in livestock farms by implementing practical changes in Animal Waste Management Systems (**AgCert, 2006)**.

Under this framework, agricultural producers have new revenues from the sale of emission's reduction quotes. Additional benefits include odor reduction, organic fertilizer's improvements, prevention of ground or surface water contamination and more efficient plagues control (flies population's reduction). As an example, AgCert's activities have allowed to reopen a farm that had previously been closed by local authorities due to environmental pollution. http:www/agcert.com

Emission reductions (ERs) are created as the difference between an amount of emissions and a defined baseline. Specifically, ERs are created by improved manure handling practices such as:

- Covering a lagoon or earth basin with a biocover or non-permeable cover,
- Using deep pit confinement buildings
- Construction anaerobic digesters.

These practices reduce the amount of methane and nitrous oxide that would have been normally be produced in the baseline environment. The ERs that can be marketed by this ISO standardized process are calculated by complex algorithms, unprecedented transparency of data, and rigorous quality controls.

AgCert aggregates ER supply not only from multiple farms, but multiple farm systems, and manages the verification, registration and liability issues. This simplifies the process for livestock producers, who ultimately reduce their risk to zero, provided they verifiably adhere to the practices that result in emission reductions. The multiple farm system aggregation process also simplifies transactions for buyers (ER customers), as they are able to confidently purchase large quantities of ERs from a single seller. At present there are several cases under study in the provinces of Santa Fe and Buenos Aires and the company is adapting the anaerobic technology technique that they have implemented in tropical countries to Argentina's temperate climate.

Contacts in Argentina

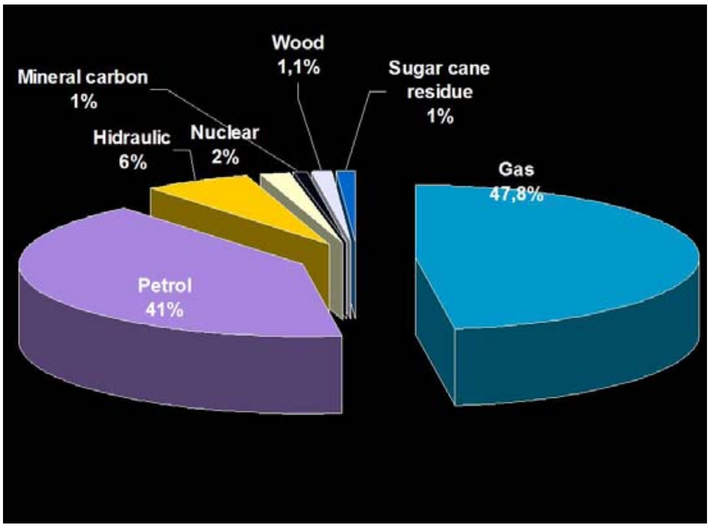
- Ing. Eduardo Gropelli, Tel-Fax: Tel.Trabajo: (0342) 457 1164 - Interno 2507 C.P. 3000 /Tel celular: 156- 313737 Dirección: San Lorenzo 3424 email: grop@ssdfe.com.ar boletín proteger Telfax: 0342-4558520. Celular: 0342-155-016-363.
- Proteger foundation : email: comunicacion@proteger.org.ar; jcproteg@arnet.com.ar
- Ing. Jorge Hilbert Instituto de Ingeniería Rural INTA 54 11 4665-0495 0450 email: hilbert@cnia.inta.gov.ar; web: http//www.inta.gov.ar/iir.
- Dr. Miguel Angel Rementería Comisión Interdisciplinaria de Medio Ambiente-CIMA Presidente calle 14 n° 106 (6600) Mercedes, Bs. As. Argentina telefax 02324 421042 email: marem@lq.com.ar, web: www.cima.org.ar.
- Guillermo Andrés Varela, Coordinador Secretaria del Medio Ambiente: 4348-8311 / 4348-8241 / 8254 / 8356 email: gvarela@medioambiente.gov.ar, web: http://www.medioambiente.gov.ar / http://www.medioambiente.gov.ar/buenas_practicas/default.htm.
- Ing. Rodríguez, tratamiento de efluentes, 4552-3228 4555-3991, email: sertecarg@netizen.com.ar, web: http://www.sertec.arg.com.ar
- Arquitecto Carlos H Levinton. Museo del Reciclado, email: hlevin@fadu.uba.ar; arcagrup7@hotmail.com; amielli@hotmail.com, web: www.arcagrup.shorturl.com; www.arcagrup.shorturl.com.
- Ing. Diana Crespo. Instituto de Microbiologia y Zoologia Agrícola INTA c.c. 25 (1712) Castelar, email: dcrespo@cnia.inta.gov.ar.
- Ing. Juan Carlos Ferrero. Secretaría de agricultura ganadería y pesca SAGPYA, email: jferrero@agro.uba.ar.

10. Market assessment and reform issues

Looking at present energy prices Argentina has a cheap internal value in order to support internal inflation rates and international competitively. Market energy prices are no a good indicator to promote the development and use of alternative energy sources as biogas.

Indeed there is an increasing shortage of diesel oil in the agricultural sector that could jeopardize production in the following years.

The country dependence of oil and gas is over 90 % and the proved reserves assure only a 10 years supply of these resources. Looking at the present figures, (SAGPYA 2005)the scenario for the future energy supply is critical and alternative energy strategies must be developed and implemented in the next years to prevent energy bankrupt.



11. Financing Options

The incentives and regulatory framework for biogas promotion in Argentina has recently been developed. In April 2006 the Biofuels Law 26.093 – Regulation and promotion regime for the production and sustainable use of biofuels was approved. A promotion regime for biodiesel, bioethanol and biogas production is described. On the other hand, there is still no regulation of the present law.

12. Current cooperation among countries or non-governmental organizations

There is an urgent need to establish cooperation networks with template and cold climate countries that have already developed suitable technologies concerning heat and insulation solutions at affordable costs.
There are no bilateral agreements yet, but this subject has been aroused in the recent meeting Mexico September 2006 of Energy working group of the EU framework program 7 (http://ec.europa.eu/research/fp7/).

13. Country Priorities

The country anaerobic digestion priorities are related with:

- Process engineering development (temperature control, process design's optimization).
- Methane and anaerobic digestion by products valorization (higher value bio products).
- Wastes characterization studies (produced volumes, physical, chemical and biological parameters).
- Development of efficient technologies for manure collection, transport and reactors filling.
- Development of efficient technologies for agro industry wastes treatment.
- Development of efficient technologies for methane purification and use in high performance engines.
- Development of research and development networks for know-how exchange.
- Reinforcement of the governmental renewable energies promotion strategies.

These subjects could be achieved by the construction of a Project Network intergovernmental cooperation, providing additional opportunities for exchanching information and available tools (e.g., FarmWare).

- Enteric fermentation

Argentina currently uses a process to simulate stomach gas production using raw mineral content (approximately one liter of gas produced from 1 kg of raw mineral content, subjected to diet's composition). Similar results have been achieved by Johnson & Johnson at the University of Washington. Argentina is interested in acquiring the know-how for airtight system's technology development.

14. Conclusions and Observations.

- There is an interesting field for anaerobic digestion expansion in agriculture and agro industry sectors. technical problems must be addressed by integrate research groups.
- Argentina is highly supportive of the Agricultural Subcommittee and its work is in keeping with our commitment to address greenhouse gas emissions from all sources. The international experience which the subcommittee brings will be particularly helpful to Argentina in addressing emissions from the agricultural sector.
- Our past and present research suggests that the technology in this area offers promising opportunities, although there are still further technological advances to be made, in addition to market supply issues. We are keen to learn from other countries' experience and best practice to tackle barriers to implementation. We therefore strongly support the growth of agriculture subcommittee in the work of the Methane to Markets Partnership.
- We are conducting further research and evaluation in this area, particularly in relation to biodigestion technology for cold climates and field evaluation of effluents quality regarding environmental concerns.
- For centralized/community digesters there are challenges around transport, nuisance, health and safety, bio security and planning

- A complete laboratory is being finished in order to correctly characterize feed materials and effluents...
- We think it would be helpful for the Agricultural Sub-Committee, to consider how it will include environmental and social considerations in discussions on market development. For example, large cattle hen or pig units may provide an economically viable biogas plant, but there are potential environmental (and animal health and social) implications of intensive production on this scale.
- Furthermore, in addition to the climate change benefits of any actions to bring about emission reductions, there are likely to be links to a number of other policy areas with potential ancillary environmental benefits, which may also affect the economic viability and overall cost-benefit calculations related to agricultural methane reduction.
- There is also a need to enforce present environmental laws that would facilitate the implementation of treatment plants in the agricultural and agro industrial sectors.
- When considering markets for methane, issues of scale and the opportunity for co-digestion need to be considered, as different challenges will arise depending on whether we are dealing with on-farm or centralized waste management systems.
- There is an urgent need for a consistent and general environmental and energy policy that must take care of the long term sustainability of agricultural and agro industrial sector activities.
-

15. References

1. Berra G. and L. Finster, 2000. Inventario Nacional de la Republica Argentina, de fuentes de emisiones y absorciones de gases de efecto invernadero no controlados por el Protocolo de Montreal. Sector Ganadería. Inventario correspondiente al año 2000 y revisión de los inventarios 1990, 1994 y 1997. Segunda Comunicación Nacional de la Republica Argentina a la UNFCCC.

2. Crespo, D., 2006. Personal communication.

3. Finster L., 2006. Personal communication.

4. Gropelli E. Covered anaerobic lagoons for the treatment of cheese factory whey. Facultad de Ingeniería Universidad del Litoral.
5.
6. Groppelli E. iampaoli OA El Camino de la Biodigestion Ambiente y tecnología socialmente apropiada Ediciones Universidad Nacional del Litoral – UNL PROTEGER - Amigos de la Tierra, Argentina 190 páginas Argentina, Octubre 2001

7. Herrero, A., 2006. Personal communication.

8. INDEC, 2002. Censo Nacional Agropecuario (CNA). Available at: http://www.indec.mecon.gov.ar/agropecuario/cna_principal.asp.

9. IPCC, 2000. Good Practice Guidance and Uncertainty Management in National Greenhouse Gas Inventories. J Penman, D Kruger, I Galbally, T Hiraishi, B Nyenzi, S Emmanul, L Buendia, R Hoppaus, T Martinsen, J Meijer, K Miwa and K Tanabe (Eds) IPCC National Greenhouse Gas Inventories Program. Published for the IPCC by the Institute for Global Environmental Strategies, Japan ISBN 4-88788-000-6.

10. Nosetti, L., Herrero, M.A., Pol, M., Maldonado May, V., Iramain, M.S., Flores, M., 2002a. Cuantificacion y caracterizacion de agua y efluentes en establecimientos lecheros. I. Demanda de agua y manejo de efluentes. InVet. 2002, 4(1): 37 – 43.

11. Nosetti, L., Herrero, M.A., Pol, M., Maldonado May, V., Iramain, M.S., Flores, M., 2002b. Cuantificacion y caracterizacion de agua y efluentes en establecimientos lecheros. II. Calidad de efluentes y eficiencia de los procesos de tratamiento. InVet. 2002, 4(1): 45 – 54.

12. Hilbert J.A. Diseño y construcción de un biodigestor en un tambo de la provincia de Catamarca. Anales IX Reunión de la Asociación Argentina de Energía Solar ASADES. 1985.

13. Hilbert J.A. Estado de la tecnología del biogás en América latina. Anales Primer Congreso Argentino Sobre el Uso racional de la Energía Tomo II pp 1239 - 1260. Bs.As. 1985.

14. Hilbert J.A., Espinosa A, Bogliani M.P. Digestor anaeróbico calefaccionado por energía solar - biogás. Anales Primer Congreso Argentino sobre Uso Racional de la

Energía Organizado por la Asociación Argentina para el Uso Racional de la Energía AAPURE.Tomo III pp 1187 - 1215. Bs.As.1985.

15. Hilbert J.A. Bogliani M.P.Ensayos de producción de biogás con distintos estiércoles en digestores continuos a temperatura controlada. Anales Primer Congreso Argentino sobre Uso Racional de la Energía Tomo III pp 1261 - 1281. 1985.

16. Hilbert J.A. Biodigestor horizontal calefaccionado demostrativo construido en una escuela agrícola. Anales II Congreso Argentino sobre Uso Racional de la Energía Organizado por la Asociación Argentina para el Uso Racional de la Energía AAPURE. Tomo III pp 1187 - 1211 1986.

17. Hilbert J.A. Design construction and operation of a mesophilic fixed bed anaerobic reactor heated by a mixed solar. Workshop on materials science and physics of non-conventional energy sources. 1992

18. Hilbert J.A.; Software para la evaluación técnico económica financiera de biodigestores rurales. VIII Congreso Argentino de Ingeniería Rural. Editado en CD-Rom. 9 al 12 de noviembre de 2005.

19. Espinosa,G. Hilbert,J. Bogliani M. (1983) Biogás energía y biofertilización Publicación INTA 4103 Serie Agricultura y mecanización 45 pp..

20. Hilbert J.A. Manual para la producción de biogás. Instituto de economía energética Fundación Bariloche. Noviembre 1992.

21. Hilbert J.A: et al (2000) Matriz de cálculo energético económico para digestores rurales. http://www.**inta.gov.ar/iir/info/indices/tematico/direnergia.htm**

22. Florean r., Panichelli, L.A., Hilbert J.A. Biogas 2005: Software Para La Evaluación Técnico Económica Financiera De Biodigestores Rurales.

23. Paolera, 2006. Personal communication.

24. Patrik Lamers Emerging liquid biofuel markets Argentina case IIIE 2006.

25. Shafik A; Rémi M. Hilbert J.A. Opportunities for and obstacles to sustainable biodiesel production in Argentina Energy for Sustainable Development Volume X No. 2 June 2006.

26. SAGPYA IICA Perspectivas de los biocombustibles en Argentina y Brasil October 2005

Annex I. Cattle population by province and type.

Province	Female calf <1 year	Calf <1 year	Young cows 1 a 2 years	Young cows >2 years	Cows	Small young bull 1 a 2 years	Young bull >2años	Small bull 1 a 2 años	Bull >2 años	Bullock	Without class	Total
Buenos Aires	2002341	1962882	1522801	861992	7075975	1772965	972948	87364	316463	873	35566	16612170
Catamarca	31673	28184	19645	19601	93163	13272	7587	3117	6761	467	4789	228259
Córdoba	636241	681137	543988	389207	2223581	858248	642111	21003	87205	285	21877	6104883
Corrientes	317928	283952	355350	299196	1795065	202870	191401	23984	80072	2659	61027	3613504
Chaco	206438	196495	161682	169074	872617	171483	127435	18037	43791	1242	13016	1981310
Chubut	15355	17626	8958	5752	65538	7292	1913	751	3476	815	3746	131222
Entre Ríos	427229	415518	321376	202874	1615348	367336	361153	14883	73460	159	7884	3807220
Formosa	140033	137094	115787	115536	588671	98116	64024	15209	31272	5724	29517	1340983
Jujuy	11020	9087	7912	7957	33879	5792	5041	1993	2682	564	569	86496
La Pampa	361528	446452	323179	127216	1331054	621756	398330	11818	68502	342	804	3690981
La Rioja	33400	30931	16359	24688	122735	8242	5840	2331	8378	129	813	253846
Mendoza	51372	42215	20891	32319	223429	8415	8543	2144	14687	36	659	404710
Misiones	42446	35722	24652	25745	129718	19308	16427	5744	11097	29244	5545	345648
Neuquén	16883	11980	12228	10585	77225	6799	3167	1286	4023	789	1372	146337
Río Negro	71546	67575	36153	23751	276009	25644	18599	1170	15203	507	1985	538142
Salta	53270	52399	41900	39057	195061	43914	37500	6236	12663	1653	10151	493804
San Juan	5501	4767	2481	3405	18959	926	1606	593	1333	164	1295	41030
San Luis	177374	165817	124527	74585	603362	88881	63840	7769	33030	57	919	1340161
Santa Cruz	4568	4694	4004	5093	30796	2784	1070	141	1480	105	326	55061
Santa Fe	613409	587596	564117	405630	2330093	777486	729860	19720	94669	322	24685	6147587
Santiago del Estero	122365	119312	78827	85224	423159	76871	77600	6188	22960	839	30824	1044169
Tierra del Fuego	4260	3892	2802	1232	13185	1763	251	271	728	22	632	29038
Tucumán	11943	10843	9492	7384	37573	13221	5480	1008	2440	864	2602	102850
TOTAL	**5358123**	**5316170**	**4319111**	**2937103**	**20176195**	**5193384**	**3741726**	**252760**	**936375**	**47861**	**260603**	**48539411**

Source: INDEC, 2002.

Annex II. Other livestock population by province.

Province	Cattle	Sheeps	Goats	Pigs
Buenos Aires	16612170	1444825	7591	536442
Catamarca	228259	85086	206717	12505
Córdoba	6104883	151245	180258	465295
Corrientes	3613504	879497	9305	26598
Chaco	1981310	103794	238017	109221
Chubut	131222	3890104	104891	4156
Entre Ríos	3807220	352919	8877	56064
Formosa	1340983	82029	148653	89521
Jujuy	86496	453515	152952	9861
La Pampa	3690981	205192	141253	65257
La Rioja	253846	21615	226987	19644
Mendoza	404710	68795	672434	16360
Misiones	345648	7519	3058	135825
Neuquén	146337	165498	678321	4786
Río Negro	538142	1509867	176164	9317
Salta	493804	160782	197347	43853
San Juan	41030	8843	75504	6782
San Luis	1340161	49992	87847	14933
Santa Cruz	55061	2165403	1653	500
Santa Fe	6147587	34364	21431	427294
Santiago del Estero	1044169	175188	706668	116036
Tierra del Fuego	29038	522276	0	404
Tucumán	102850	20556	15474	14150
TOTAL	**48539411**	**12558904**	**4061402**	**2184804**

Source: INDEC, 2002.