Tropentag, October 9-11, 2007, Witzenhausen

Utilization of diversity in land use systems:
Sustainable and organic approaches to meet human needs

# Economic viability of biogas plant use in pig production in Brazilian states of Minas Gerais and Goiás

Alethéia Ferreira da **Cruz**[a], Alcido Elenor **Wander**[abc], Renato Pinto da **Silva Junior**[a]

[a]Federal University of Goiás (UFG)/School of Agronomy and Food Engineering. P.O. Box 131, 74001-970 - Goiânia, GO, Brazil. Email: awander@cnpaf.embrapa.br
[b]Brazilian Agricultural Research Corporation (EMBRAPA)/National Rice and Beans Research Center. P.O. Box 179, 75375-000 - Santo Antonio de Goias, GO, Brazil.
[c]Faculdades Alves Faria (ALFA), Av. Perimetral Norte, 4129 – Vila João Vaz, 74445-190 - Goiânia, GO, Brazil.

***Abstract***

The modern pig production chain delivers the most consumed meat type worldwide. During several decades, the economic profit of the activity was more important than the related environmental issues. From the nineties on the environmental impacts of the swine manure became more evident. Actors of the chain were challenged to adjust their production systems due to the negative externalities. Swine manure was endangering the sustainability of the activity in the long run. Thus, the adoption of new treatment forms of manure became compulsory to reduce environmental impacts and to sustain the activity in the involved enterprises. Among the different treatment forms of manure, this study proposed the adoption of biogas plants of the Canadian Type and the use of their byproducts as to enable environmental adjusts and increase income of the pig keeping farmers. Three systems were analyzed: (1) the "Uberlândia system", located in Minas Gerais State, with biogas use for thermic energy and combustion, as well as for carbon credits generation; (2) the "Rio Verde system", located in Goiás State, with generation of carbon credits, without farmers' investment; and (3) the "simulated Rio Verde system", considering farmers' investment. The main objective was to assess the economic viability of each system. At the end three different studies were considered, using net present value, internal rate of return, benefit-cost-ratio and payback period. Considering these methods, all considered systems were viable and economically attractive. The best economic performance was obtained with the Uberlândia system, influenced by the effective use of byproducts generated at the biogas plant.
Key words: pig production, swine manure, biogas plants, economic viability

## 2 Background and aim of the study

The increased demand for food after the Second World War resulted in increased efficiency in worldwide agricultural and industrial production. The population growth challenged economic sectors to provide goods for human needs and preferences. According to Gama (2003:12), the economic production and the society emerged from this production-consumption relationship

focused mainly on intensive material use and industrialized products. The industry tries do increase production, demanding more raw materials.
In Brazil, after the sixties, the rural sector started developing systems of animal confinement with higher technology, focusing on higher productivity. These confinement systems, based on spreading the pig production in Brazil, contributed to increase productivity as well as to strengthen Brazilian competitiveness and international market integration. However, as efforts focused on productivity increases only, the pig production neglected environmental consequences of its management system, leading to several problems in management, storing and distributing the produced manure.
The untreated manure may generate some negative externalities e.g. air pollution, soil and water contamination, dissemination of diseases, proliferation of flies and pathogens, and bad smell. These aspects generate external costs, which are not internalized through markets. Therefore, the activity does not internalize the external costs of pollution, as it has no economic and financial incentives to do so.
The focus of the whole pig production chain on economic returns without taking into consideration the environmental issues starts moving. The fragility of adopted production schemes shows the urgent necessity for changes in the form of pig production, as its own sustainability chain is endangered. Some ecosystems where pig production is practiced already show exhaustion symptoms.
According to Gama (2003), from the economic point of view, the main objective of environmental planning and management is to allow the supply of resources, goods and services that are compatible with the assimilation of generated waste and manure. This would be ensured through sustainability aiming technologies.
It is easier to solve these problems, with fewer conflicts, if there are technologies to reduce environmental costs, and set-up economically viable and ecologically correct alternatives (Testa, 2004:28).
Among the available environmentally friendly technologies, this study proposed the use of biogas plants of the Canadian Type as an economic alternative and environmental adjustment option. The use of biogas plants is again being recommended, that it allows to aggregate value to the manure, generating biogas and biofertilizer, improving environmental quality. Additionally, the use of biogas plants fulfills one of the strategies proposed by the Kyoto Protocol, capturing methane from manure and transforms it, through combustion, into carbon dioxide, minimizing the air contamination, the smell and the impact on ozonosphere of the planet.
The implementation of biogas plants allows the environmental adjustments of the activity and can become a competitive advantage through organic fertilizer and income generation through the commercialization of carbon credits. Therefore, this study aimed at assessing the economic viability of manure treatment in pig keeping farms.

## 3 Methods

This research was based on case studies, focusing on economic analysis of by-products of manure treatment with Canadian type of biogas plants in intensive pig keeping farms in vertical integration to industry in order to provide information to farmers to support their decisions regarding adoption or not of such techniques. Rio Verde (Goiás State) and Uberlândia (Minas Gerais State) were selected as study regions because they represent the vertically integrated pig production and concentrate an important part of it in both states. In each region we looked for a pig keeping farm that already adopted biogas plant for manure treatment and generating additional income through energy generation of value adding. Data collection was done through visits to the farms and semi-structured interviews with the farmers.
Two different systems were characterized and defined in order to enable their economic viability: (a) the “Uberlândia system”, with biogas use for thermic energy generation, combustion and carbon credit generation; and (b) the “Rio Verde system”, with generation of carbon credits and

all investments and running costs being done by a Canadian carbon credit agent. In order to have a third system, a derivation of the “Rio Verde system” was done in order to capture the perspective of farmers and Canadian agent – the “simulated Rio Verde system”, with two different situations. To analyze the economic viability of all three “systems”, the net present value (NPV), the internal rate of return (IRR), the benefit-cost-ratio (BCR) and the payback period (PB) were calculated.

## 4 Results and discussion

### *4.1 The “Uberlândia system”*

The economic viability analysis of the “Uberlândia system” identified an IRR of 120%, a NPV of R$ 5,991,429.00 and a BCR of 6.04, supporting that this investment is economically viable, has excellent returns and high profitability.

### *4.2 The “Rio Verde system” and simulations*

The real “Rio Verde system” did not allow to carry out an economic viability analysis, because there were no investments and running costs from farmer’ side during the considered period. However, an analysis considering the “simulated Rio Verde system”, where the farmer would be responsible for all investments and running costs and would receive all carbon credit benefits, was possible. The “simulated Rio Verde system” was based on the real “Rio Verde system”, where the two biogas plants were set-up to mitigate greenhouse gases and generate carbon credits.

The “simulated Rio Verde system” used the same available infrastructure of the real system and was analyzed from two possible perspectives: (a) farmer’ perspective and (b) Canadian carbon credit agent’ perspective. In the first case, the farmer would be responsible for all set-up and running costs of manure treatment and would retain all revenues. The project would bring out a NPV of R$ 831,188.00, an IRR of 50% and RBC of 2.50, showing its economic viability from the farmer’ point of view. However, the capital availability could limit this option, since not all farmers have own capital or can access credit markets as easy as it would demand. In the second case, the Canadian carbon credit agent would be responsible for all investments and running cost, retaining 90% of all revenues and transferring 10% of the revenues to the farmer. The project would represent an interesting investment option to the Canadian enterprise, since it would have a NPV of R$ 692,749.00, an IRR of 43% and a RBC of 2.25. Additionally, the Canadian enterprise would transfer R$ 120,694.10 of revenues to the farmer. Comparing the results of both situations of the “simulated Rio Verde system”, it can be observed that the Canadian agent benefits a lot of this partnership. The farmer earns R$ 120,694.10 without any efforts. However, if he would carry out the whole project on his own, he would additionally have R$ 710,497.00 of NPV, as the difference between the first and the second case shows.

### *4.3 Comparisons*

Comparing the obtained results with those from Conceição Neto (2004), who considered a time period of 10 years, an IRR higher than 50%, an average NPV of R$ 50,000.00 and a payback period lower than two years, it was possible to identify the economic viability of the cases in both regions. However, the “Uberlândia system” has had higher NPV, IRR and BCR than the “simulated Rio Verde system”, in both variations. The “Uberlândia system” enabled a NPV of R$ 5,991,429.00 while the “simulated Rio Verde system” generated a NPV of R$ 831,188.00. In both cases, the NPV was three times higher than the setup-costs (investment) needed.

The main differences in the investments done in both regions were found in the conversion of biogas into thermic energy, since in the “Uberlândia system” the investment were about double of the investments that would be done in the “simulated Rio Verde system”, but its NPV was seven times higher than the NPV of “simulated Rio Verde system”.

Comparing the IRR of both systems – “Uberlândia system” and “simulated Rio Verde system” – the superior performance of the first is remarkable, reaching 120%, while the second only got 50%. As both had a IRR higher than lowest opportunity rate of 6% per year, they can be considered as viable investments. Comparing the BCR of both systems, the “simulated Rio Verde system” reached 2.50, while the “Uberlândia system” earned a BCR of 6.04. The considered indicators support the better performance of the “Uberlândia system”. If both investments were mutually excludable, the “Uberlândia system” would be the best option. The results of used parameters for both case studies are presented in Table 1.

Table 1 – Economic viability analysis of the systems “Uberlândia” and “simulated Rio Verde”.

| System | Set-up costs (R$) | IRR (%) | NPV (R$) | Payback (years) | BCR |
|---|---|---|---|---|---|
| Rio Verde (real) | - | - | 120,691.10 | - | - |
| Simulated Rio Verde (farmer' perspective) | 324,000.00 | 50 | 831,188.00 | 2 | 2.50 |
| Simulated Rio Verde (Canadian carbon credit agent' perspective) | 324,000.00 | 43 | 692,749.32 | 2 | 2.25 |
| Uberlândia | 794,325.00 | 120 | 5,991,429.00 | 1 | 6.05 |

Source: Field research.

The results show that the biogas plants contribute to improve the economic performance of pig keeping farms. Additionally, the reduction of emissions and bad smell of manure are other environmental benefits of the adoption of this technology. Together, the results represent important information to farmers to take right decisions regarding investments in their pig keeping farms.

## 5 Conclusions

Manure treatment with biogas plants in both considered regions is economically viable and represents an interesting investment option. The pig keeping farm from Uberlândia had the best economic performance. These results may not be generalized, since they focus on two specific cases in two important pig producing states in Brazil. Additional studies to check the replicability of the results are needed and planned.

## 6 References

CONCEIÇÃO NETO, A. A. da. **Impacto Econômico-Financeiro Resultante da Implantação de Tecnologias de Manejo, Tratamento e Valorização de Dejetos de Animais, em Propriedades Suinícolas.** 2004. 115 f. Dissertação (Mestrado em Engenharia Ambiental) - Departamento de Engenharia Sanitária e Ambiental, Universidade Federal de Santa Catarina, Florianópolis, 2004.

EMPRESA BRASILEIRA DE PESQUISA AGROPECUÁRIA (EMBRAPA). **A Suinocultura e a Questão Ambiental**. Concórdia: Centro Nacional de Pesquisa de Suínos e Aves (CNPSA), 2002. Disponível em: <http://www.cnpsa.embrapa.br/>. Acesso em: 10 set. 2004.

EMPRESA BRASILEIRA DE PESQUISA AGROPECUÁRIA (EMBRAPA). **Manejo de Dejetos.** Concórdia: Centro Nacional de Pesquisa de Suínos e Aves (CNPSA), 2004. Disponível em: <http://www.cnpsa.embrapa.br/>. Acesso em: 14 ago. 2004.

GAMA, M. L. da S. **Planejamento e Gestão do Tratamento de Dejetos Suínos no Distrito Federal: Aplicação de Instrumentos de Avaliação Multicriterial.** 2003. 101 f. Dissertação (Mestrado em Planejamento e Gestão Ambiental) – Programa de Pós-Graduação *Stricto-Sensu* em Planejamento e Gestão Ambiental, Universidade Católica de Brasília, Brasília, 2003.

TESTA, V. M. **Desenvolvimento Sustentável e a Suinocultura do Oeste Catarinense: Desafios Econômicos, Sociais e Ambientais**. In: MIRANDA, C. R. da; GUIVANT, J. S. (Orgs). Desafios para o desenvolvimento sustentável da suinocultura: uma abordagem multidisciplinar. Série Debates. Chapecó: Argos, 2004. 334p.