FAO European Cooperative
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RAMIRAN

# Recycling of Agricultural, Municipal and Industrial Residues in Agriculture

Network Coordinator: José Martinez, Cemagref, Rennes (France)

# RAMIRAN 2002

**Proceedings of the 10th International Conference of the RAMIRAN Network**

**General Theme: Hygiene Safety**

**Štrbské Pleso, High Tatras, Slovak Republic**
**May 14 - 18, 2002**

**Edited by Ján Venglovský and Gertruda Gréserová**

ISBN 80-88985-68-4

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# PIG PRODUCTION AND WATER POLLUTION IN LA PIEDAD, MEXICO

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## INTRODUCTION

Pig production is the third main livestock sector in the country. In the year 2000 pig stock was 14 million, pork production was 1 million tons. (23% of total meat production) and *per capita* consumption was around 12 kg. (SAGARPA, 2000) Indirectly, pig production uses big extensions of land with sorghum and oil seeds; it also generates a long complex chain of production and commercialization. In Mexico, as in other countries (Scialabba 1994, Steinfeld 1998), pig production has an important impact on environment.

Mexican pig production characteristics are: a) productive heterogeneity, b) dependence from outside on breeds and feeds, and c) it doesn't internalize it's environmental costs. Pork products with an economic value are privately appropriated, but wastes, if not assimilated by nature become an "externality" (Bhom 1997), a cost which society pays, not the producer.

In Mexico, the most important impact of pig waste is in the water, a scarce resource which is badly distributed (Alcocer y Escobar 1996) Pigs are all over the country, but main concentrations are where water has major problems. This is the case of La Piedad, an important pig production region located on the river Lerma Basin.

In Mexico environmental problems are the result of the growing model of pig production:

- Highly specialized; poorly integrated with agriculture
- Concentrating pigs in a small number of big units
- With presence in urban and periurban zones
- Employing inefficient feeding systems
- With no human resources training in waste management
- Lacking specific regulations on environmental issues

Pig producers:

- See only the costs but not the benefits of waste management
- Have poor knowledge of new technologies and their costs; and of fiscal, and environmental legislation as well as actual regulations

La Piedad does not make significant contribution to pollution with heavy metals, but it is supplying high values for zinc, lead and copper on settled sediments, because of high concentrations of organic material produced by pig farms which catch metals (Hansen *et al.*)

The level of pollution of the river in La Piedad section is the cause of gastrointestinal and upper bronchial diseases of which the main vectors are flies and mosquitoes. The water lily, an indicator of phosphorus, is a serious aquatic plague in the part of the river Lerma which surrounds the city.

## METHODOLOGY

A survey was raised on the basis of a stratified sample in 33 farms of La Piedad and Santa Ana Pacueco[1] during the first semester of 1999; pork producers and local officials were interviewed and samples of wastewater (WW) were taken in eleven farms.

Twelve parameters of the Mexican regulation on wastewater[2] were analyzed: 7 physicochemical: hydrogen potential (pH), temperature (T), greases and oils (GyA), total suspended solids (TSS), biochemical oxygen demand (BOD), total nitrogen (TN) and total phosphorus (TP); four heavy metals: arsenic (As), copper (Cu), lead (Pb) and zinc (Zn) and fecal coliformes (FC) It's necessary to pay a fee if maximum permissible limits (MPL) of these parameters are exceeded.

Mexican regulation sets up a compliance calendar based on the quantity of TSS[3] or BOD per day. TSS were selected to classify the farms in terms of that calendar in order to see if the regulation had some influence on management and investing decisions.

Information from the Associations registered 108 farms: 7 producing more than 3.0 tons of TSS/day (complying period on January first 2000); 33 medium farms with TSS/day between 1.2 and 3.0 (complying period January first 2005) and 68 small farms with less than 1.2 TSS/day and period of compliance to first January 2010. Sample size was 35 farms: five big farms (14%), thirteen medium farms (37) and seventeen small farms (49%) They were selected on a random basis.

## RESULTS

*WATER USE AND WASTEWATER QUALITY*

For the design of a treatment system and for the calculation of the fees to pay it's fundamental to know the quantity and quality of the WW. Nevertheless, most of the pig producers do not have that information.

In order to calculate the volume of the WW discharged, 82% of the water used, as some handbooks suggested (Taiganides *et al*. 1997, Generalitat de Catalunya 1995), was applied to the estimation of the total water used by the pig producers. Some of them couldn't estimate how much water they are using.

In small pig farms, the quantity of WW discharged per animal unit is almost three times bigger than in medium and big farms[4]. Their cleaning systems are inefficient, they waste the water and operate without surveillance of the authorities.

Because water is scarce in this region, the volume of water used in farms is reduced: 65% of them generated no more than 10 L of WW/day per stand pig population (SPP);[5] 20% discharge 10 to 20 L/ WW/day*PPP and 15% discharge 20 to 40 L/ WW/day*PPP

The law requires farms to analyze the wellwater and WW; as analysis are expensive and taking the samples complicated, only 42% of pig producers have analyzed the wellwater and 57% WW.

1 A nearby town separated from La Piedad by the river

2 Norma Oficial Mexicana 001-ECOL-1996, Which settle maximum permisible limits of pollutants on wastewater discharges on national water bodies and national land. Here on, only regulation.

3 A pig of average weigh (54 kg) in an average farm excretes around 331 grams of TSS/day (Taiganides *et al.* 1997)

4 Similar results were found in another investigation on the same topic (Drucker *et al*. 1997)

5 Stand pig population (SPP) is an animal with an average weight around 54 Kg.

Different cleaning systems are used in the region; to accurately know the day, hour and place to take a representative sample is quite difficult. It depends, as well, on the pig producer's willingness to allow taking the sample and of his honesty to not alter the discharge by diluting the WW, a process banned in Mexico.

From the results of the analysis of WW it's possible to highlight:

- There are big differences between the results of the analysis provided by the producers and the ones obtained in the investigation. The level of the parameters reported by the producers were always under the level of the parameters found in the investigation,
- All the farms have one or more parameters that exceeded the MPL of the regulation; which means that they will have to pay the correspondent fee. In the case of the farms discharging to crop land, they will have to pay for fecal coliformes,
- Heavy metals concentration were always beneath the MPL of the regulation
- Farms with a "complete" treatment are not removing contaminants as they are supposed to do: a farm with two unitary operations (digestor plus lagoon) removed more BOD than two farms with a "complete" treatment. The reasons being poorly designed systems.

*MANAGEMENT SYSTEMS AND WASTE TREATMENT*

Most of the farms were built more than twenty years ago; since then, they have been expanded, redesigned, closed, opened, etc. according to market signals. Physical infrastructure is a mixture of the old with the modern, the functional and dysfunctional.

Cleaning methods, which use water in abundance for flushing, hosing and "bath pits" (33%) are combined with dry methods with shoveling (33%), plus the combination of all hosing, "bath pits" and shoveling. The infrastructure of farms (drainages, floors, feeders, nipples) does not reflect the scarcity of water in the region.

Seventy per cent of the farms separate solids by mechanical means or by hand; 15% (the small ones) accumulate solids out doors; 42% store solids inside the farm but no one does it under a roof. Forty two per cent have open sky drainage; only 15% have rain drainage. The inappropriate infrastructure and incorrect management of wastes and garbage, makes it necessary to store, collect and treat a volume of WW much larger than strictly necessary with better facilities.

Storage and treatment of WW include pits, ponds, lagoons, digestors, decanters, oxidation ditches, plus associated equipment such as pumps, screening, and different types of separators. Nine per cent of the farms do have any WW treatment; 73% have at least two unitary operations and 48% have a "complete" treatment. All big farms of the sample, 50% of medium farms and 35% of the small have a "complete" system. That could respond to the gradualism of the regulation.

Fifty two per cent of the farms discharge to crop land, 33% to water bodies, 1% to a lagoon of "zero discharge" and 3% to municipal sewage. Farms with no treatment are discharging to water bodies. Eighty two per cent of pig producers are recycling wastes and WW; 30% in agriculture and animal feeding; 75% used solids as fertilizers and WW in crop land; 30% of pig producers sold solids as fertilizers and 15% give WW to neighbors with crop land.

## CONCLUSIONS

Environmental strategy based on "command and control" instruments such as the

6 It was considered as a complete treatment when three unitary operations were found.

Mexican regulation is not the best way to regulate the discharge of WW nor to improve the quality of the WW because:

1ª It's not cost effective; the discharge of a pig farm requires a terciary treatment, not the secondary[7] on which the cost benefit analysis of the regulation is based

2ª Regulation is focused on the manifestation of the problem (the discharge), not the origin

3ª Basing the payment of a fee on the quality of the WW measured on concentrations of contaminants is a difficult, expensive and unreliable process

4ª Authorities do not have the human resources nor the budget for the surveillance of the regulation

5ª Medium farms in the region produce almost 50% of the organic discharge from pig farms; nevertheless, they are obligated to comply with the regulation in the year 2005

6ª Big farms (6% of the total) and small ones (68%) are contributing in the same proportion to water pollution; both provide 23% of TSS from pig farms. Small farms can wait until 2010 to improve their discharge

7ª The regulation is regressive in distributive terms; small producers, in relative terms, would have to invest more than big ones in order to comply with the regulation.

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[7] The cost-benefit analysis of the regulation was based on a secondary treatment to remove pollutants from municipal and industries as petroleum, chemical, paper mills, etc. wastewater.