FAO European Cooperative
Research Network

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

University of Veterinary Medicine
Research Institute of Veterinary Medicine
Hlinkova 1/A
040 01 Košice
Slovak Republic

STRATEGY FOR LIVESTOCK WASTES TREATMENT IN RUSSIA

Irina A. Arkhipchenko

Research Institute of Agricultural Microbiology (RIAM), Podbelsky Shosse, 3,
St. Petersburg -Pushkin 8, 196608 Russia, tel.:007-812-4763017; fax: 007-812-4761610
E-mail: bamil@atlant.ru

ABSTRACT

Livestock production in Russia can be characterized as one of large farms with great amount of animals. Pig farms can contain 108-216 thousand heads, cattle farms up to 10 thousand heads and poultry farms from 1.5 to 2.5 million poultry. This structure provides for the production of large amounts of wastes and correspondingly allows one to organize a biotechnology for waste processing into microbial fertilizers by microorganisms on farms.

These fertilizers possess considerable advantages in comparison with composts when employed in agriculture. Marketing of microbial fertilizers in the Baltic Region of Russia has been studied. Taking into account their high market price ($260-660/t) the expediency of waste processing into microbial fertilizers has been proved.

LIVESTOCK PRODUCTION IN RUSSIA

Livestock management has a considerable place in the agriculture of Russia. According to the data of 1999 there are 17,381 million cattle heads, 8,575 million pig heads and 210.81million chickens in Russia. Total amount of livestock wastes is 379.l million tons per year: pig farming - 20.5 million tons, cattle farming - 344.1 million tons, poultry farming - 14.5 million tons.

Most livestock farms are concentrated in the Central Region of the European part of Russia, in the Urals and in the Western Siberia.

Unlike most European countries, in Russia husbandry develops on the industrial basis, which allows to keep the animals on large farms. Thus, 23% of pigs are kept on large complexes (54-216 thousand heads).

There are 8 pig-fattening farms for 216 thousand heads, 13 farms for 108 thousand heads and 12 farms for 54 thousand heads. Total production of pork is 218 thousand tons per year. Mean data on their productivity are presented in table l.

Table 1 The pig complex output with different mode of the livestock management (Arkhipchenko, 2000)

Complexes	Pigs, thousand heads	Pork production, thousand ton per year	Daily additional weight, pigs in fattening, g
"Omsky Beckon", Omskaya Region	237	35	636
"Krasnodonskoye", Volgogradskaya Region	84	10,7	588
"Sosnovoborsky", The Tatar Region	56	6,7	476

To remove the wastes they use the method of hydro-washing. So, at the pig-fattening complex with 108 thousand heads more than 1 million cubic meters of wastewater with 1-2% of dry matter content are accumulated annually.

Poultry farms contain from 400 thousand to 2.4 million chickens. This allows to receive from 60 to 360 tons of dung per day. Dry matter content in the dung is from 35 to 55% depending on the method of dung removing. One poultry farm of average capacity (400 thousand hens) produces daily about 60 ton of dung which is an equivalent to 840 kg of nitrogen, 240 kg of phosphorus (P_2O_5), 180 kg of potassium (K_2O). Hence, poultry farms possess a great potential for the establishing of a production process which can provide a new source of income.

On cattle farms there are 300-10000 heads, and dry matter content in manure is 10-15%. About 20% of wastes are mixed with peat and composted. Most part is transported to a deposit and open reservoirs. This fact has a negative impact on the state of ground, surface waters and soil.

ENVIRONMENTAL ASPECTS IN LIVESTOCK WASTE MANAGEMENT IN RUSSIA

There are main problems in Livestock Waste Management in Russia

Absence of ecological legislation
Poor attention to environmental aspects
Special structure for livestock waste management does not exist

Livestock wastes is a highly concentrated organic substrate which causes significant environmental pollution (soil, water, atmosphere), when not treated and utilised properly.

Thus, on fattening pig farms ammonia concentration is 52 mg/m^3 under natural ventilation, and 14 mg/m^3 under forced ventilation. An increase in the air exchange in the modern ventilation systems inevitably leads to the extension of environment contamination.

For example, the air sampled at a 100-m distance from the pig farm contained 3-4 mg/m^3 of ammonia, 0.112 mg/m^3 of hydrogen sulphide, 16.7 mg/m^3 of mercaptan.

Every hour in summer a pig farm for 108 thousand pig heads exhausts into the atmosphere 159 kg of ammonia, 14.5 kg of hydrogen sulphide, 25.9 kg of dust and 1.5 milliard microorganisms.

Gas exhausts from the livestock farms influence not only the atmosphere but also water reservoirs and flora, contaminating the area around the livestock farm in a radius of 15 km.

Complexes with 10-40 thousand pig heads exhaust up to 6.05 kg of dust and 83.4 milliard microbes per hour, under the ventilation system. In complexes with 73 thousand pig heads these amounts are twice as many.

In order to apply manure wastes to the fields most livestock farms use transportation of the wastes by a tank mounted on a tractor. 72 million m^3 of wastes out of 150 million m^3 is taken out by tanks. This mode of removal demands considerable power consumption and land areas free of crops. In addition, it causes a negative effect on the agricultural state of land improvement and can be applied only for a limited period of time. The production of compost from liquid manure, peat and straw is costly and demands a continuous source of compounds at a direct closeness to the farm.

Drawbacks of the livestock waste in using it as a fertilizer

There is no possibility for applying it in low doses (10-20 t/ha) evenly over the field surface.
During 2-3 months storage the nitrogen losses are up to 50-60%.
Optimal transportation distance is 3-4 km.
One ton of untreated dung contains up to 12 mln weed seeds.

MICROBIAL FERTILIZERS AND MARKET VALUME

High concentration of wastes on one farm allows to consider them as a new type of organic raw material, which may serve as a consumer product along with the basic product. To achieve this, one should use microbial associations and control their activity in biotechnological schemes during the processing of livestock wastes into biogas, composts and microbial fertilizers. To process wastes it is more expediently to use associations of aerobic microorganisms, which are able to promote plant growth and suppress phytopathogenic microflora. The activity and quality of microbial fertilizers are mainly determined by the type of organic wastes and the method of treatment. It was shown that microbial fertilizers combine positive features of mineral and organic fertilizers and may find a wide application for sustainable agriculture and biological land use (Fisinin, Arkhipchenko, 2001).

In comparison with traditional composts produced from livestock wastes microbial fertilizers possess considerable advantages (table 2).

Table 2 Existing differences between composts and microbial fertilizers

	Biocomposts	Microbial Fertilizers
Moisture	High (60-80%)	Low (10-18%)
C/N ratio	Wide (16-30)	Narrow (7-12)
Heavy metals	Possible	Absent
Application rate per ha	30-40 t	1-4 t
Storage period with the preservation of fertilizer properties	Up to 1 year	2-3 years
Yield increase	By 20-40%	By 70-80%
Aftereffect	2-3 years	2-3 years
Suppression of soil phytopathological microflora	Is provided	Is provided

There are developed technologies and pilot plants with the help of which it is possible to process waste and obtain microbial fertilizers, possessing high market value: Pudret, Omug, Ecud are produced from poultry dung and Bamil is from pig manure (table 3) (Arkhipchenko, Derikx, 2000). Setting up of biofertilizer producing plants at livestock-breeding farms will not only allow to improve livestock-breeding economic situation but also to solve environmental problems within the locations of livestock-breeding farms.

Table 3 Cost of fertilizers produced from livestock wastes, Baltic Region of Russia, 2001

Name	Production technology	Dry matter, %	N_{tot}, %	Price, US$/t
Bamil, Company "NIKA"	Processing of sewage from pig complexes with activated sludge biomass in aerotanks. Drying. Granulating.	90	5	500
"Ecud" Company "NIKA"	Microbial biomass dried and granulated after anaerobic fermentation of poultry manure.	82	1.6	560
"Pudret" Company "NIKA"	Poultry manure after infrared drying.	87	3.5	400
"Omug" Company "NIKA"	Aerobic fermentation of litter poultry manure	85	3.5	400
"Bio-humus" Company "Phart"	Worm-aided processing of cattle waste	58	0.78	400
"Agrovit-Cor" Company "Agrovit-Cor"	Processing of cattle waste and poultry manure	63	2.5	660
Dried poultry manure	Thermal drying	80	1.5	340
Live soil Company "Phart"	Soil with bio-humus –the product obtained by processing the cattle waste by worm-composting method	33	0.28	260

Every year gardening plot owners and farmers (agricultural enterprises) show the ever-increasing interest in organic farming. The range of methods to produce bio-fertilizers and composts from livestock wastes is also expanding.

On the basis of the marketing studies conducted by us in the Baltic Region of Russia it was established that a yearly demand in organo-microbiological fertilizers constitutes 54000t/year. Saturation of the market by different regions varies from 5 to 10%.

The sale of the products will be clearly seasonal. Basic volume of sale will take place in February-June, then there will be a sharp increase in September-October.

Realization of fertilizers will allow us to ensure an additional source of financial means for the development of main production - fattening of animals. Unfortunately, implementation of this program is still being carried out slowly enough. It can be explained by the absence of special investment funds for the development of new promising technologies, by low-developed management and inadequately skilled level of state and local administration.

REFERENCES

Arkhipchenko I.A. (2000) The livestock waste in Russia: current situation. In: Arkhipchenko I.A. (ed.) Program and Papers of International Conference "Microbial ecotechnology in processing of organic and agricultural wastes", St. Petersburg, Russia, August 16-22, 2000, p. 49-53.

Arkhipchenko I.A., Derikx P.L.(2000) Peculiarities of polyfunctional microbial fertilizers from pig and poultry farm wastes. Proceedings of 9th Intern. Conference FAO Network on Recycling of Agricultural, Municipal and Industrial Residues in Agriculture. Gargnano, Italy, 2000, p. 457-459.

Fisinin V.I., Arkhipchenko I.A. (2001) Microbial fertilisers from poultry manure. World Poultry, 17 (2), p. 36-37.