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SIXTH FRAMEWORK PROGRAMME

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AQUAGRIS

Environmental management reform for sustainable farming, fisheries and aquaculture

Technology Transfer Workshop on
Waste Management in Aquaculture, Fisheries and Farming

4th MAY 2010
Messe Convention Centre

Bremen, GERMANY

aquagris@physiology.unile.it

www.aquagris.org

Second Technology Transfer Workshop on
Waste Management in Aquaculture, Fisheries and Farming

Seminar on
Policies, regulation and governance in Aquaculture, Fisheries and Farming

4th MAY 2010
Messe Convention Centre, Bremen - Germany

Objectives

The aim of the event is to provide an opportunity to discuss and interact with experts on technological solutions for the containment of waste generated in Aquaculture, Fisheries and Farming and its conversion into value added products, thus improving both economic and ecological sustainability of the sectors. A specific session will be dedicated to examine the governance, regulation and policies practiced in EU and Non EU Countries.

Specific objectives of the workshop are:

- To review the theoretical and practical aspects of effluent treatment and waste management in aquaculture systems;
- To introduce economical and environmentally friendly techniques for effective integrated management of aquaculture waste and transfer the different technologies practiced in EU and Non EU countries to the stakeholders;
- To carry out a state of art on available technologies for the valorisation of fisheries by-products and fish processing waste;
- To identify and to evaluate the most promising strategies for managing wastes from farms;
- To review the governance and policies in Aquaculture, Fisheries and Farming in EU and Asian countries.

PROGRAMME

4th MAY 2010

8.30 – 9.00
Registration

9.00 – 09.15
Opening Session: Welcome and objectives of the workshop

9.15 – 10.45
Session 1: Waste management in Aquaculture

Chairman: V. ZONNO Università del Salento (Italy)

- Aquaculture effluent treatment: technology for solid removal and sludge thickening. **R. Acierno (UNILE)**
- Aquaculture waste management: sludge characterisation and reuse. **V. Zonno (UNILE)**
- Integrated systems as an efficient tool for biofiltration of aquaculture waste. **J.L. Pinchetti (ULPG)**
- Fish farming in bag pens: stocking density and oxygen addition. **P. Jokela (TUT)**

10.45 – 11.00
Coffee/Tea Break

11.00 – 12.30
Session 2: Waste management in Fisheries

Chairman: B.M. KURUP Cochin University of Science And Technology (India)

- Marine Protected Areas as a tools for fisheries management and conservation. **M.A. Perez-Ruzafa (UM)**
- Sustainability issue of marine capture fisheries with reference to bycatch discard and other waste generation in the Asian countries. **B.M. Kurup (CUSAT)**
- Waste management in fishery and aquaculture: "Minimization of wastes and by-product valorisation" . **A. Esturo (AZTI)**

PROGRAMME

4th MAY 2010

12.30 – 14.00
Lunch Break

14.00 – 15.30
Session 3: Waste management in Farming

Chairman: H. SPIEGEL Austrian Agency for Health and Food Safety (Austria)

- Manure: important resource versus waste. **L. Rodhe (JTI)**
- Overview of the Spanish situation regarding farm wastes. **A. Esturo (AZTI)**
- N_{min} soil analyses in Austria – a valuable tool to minimise nitrogen losses from agriculture. **H. Spiegel (AGES)**

15.30 – 15.45
Coffee/Tea Break

15.45 – 17.00
Session 4: Policies, regulation and governance

Chairman: F. WEIROWSKI World Fish Center/TNC (Malaysia/Germany)

- Governance for Sustainable Aquaculture: is it fit-for-purpose? **J. Claricoates (Swansea University, TNC)**
- Sustainable Environmental Governance with Codes, Standards and Best Management Practices in Aquaculture and fisheries. **F. Weirowski (World Fish Center, TNC)**
- A review on policies and regulations prevailing in Fisheries and Aquaculture in the context of India and Europe. **B.M. Kurup (CUSAT)**

17.00 – 17.30
Conclusions and recommendations

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Session 1

Waste management in Aquaculture

Aquaculture effluent treatment:technology for solid removal and sludge thickening

Raffaele ACIERNO, Giorgia BRESSANI and Vincenzo ZONNO

Di.S.Te.B.A. - Università del Salento
Via Provinciale Lecce-Monteroni, 73100 LECCE (ITALY)
raffaele.acierno@unisalento.it

Abstract

Land-based fish farms produce effluents that may have, if not properly handled, a negative impact on the quality of water courses, rivers and soil. Waste solids and dissolved substances management is therefore one of the most important topics in the aquaculture industry today. Effective treatments for solids and dissolved nutrients removal rely on a detailed characterisation of the effluent in terms of chemical and physical properties of the particulate. This knowledge allows to design the most suitable and effective system to minimise pollution and to optimise the recovery, disposal and re-use of waste in affordable ways.
The first step of the process consists in a mechanical filtration in which all large settable or suspended particles, both organic and inorganic, are removed from the effluent water. This action produces high flows of filtered water at reduced solid concentration and smaller volumes of concentrated waste water containing up to 3 g of solids per litre. While the first, larger flow can be disposed or re-circulated after bio-filtration, the remaining water needs further treatments to increase the solids concentration up to 100 times by flocculation and coagulation. This operation produces, at the same time, small volumes of water containing high concentrations of mineral and organic soluble substances (in particular nitrogen and phosphorus), which are processed by packed bio-filters, natural or constructed wetlands and algal ponds. The concentrated sludge is then subjected to de-watering and thickening through the employment of settling tanks, geo-tubes and belt filters.
These issues are among the activities and the objectives of two FP6 projects funded by the EU (AQUAETREAT and AquAgriS) which aim, by increasing the knowledge on the polluting potential of production processes and by promoting the awareness of the long-term environmental damages caused by unsustainable farming, fisheries and aquaculture, to the development of sustainable food production systems respecting soil, water, animal and wild stocks welfare and to the enhancement of food safety and consumer health.
Projects supported by EU: contract n° COLL-CT-2003-500305 (AQUAETREAT) and contract n. FOOD-CT-2007-036298 (AquAgriS).

Aquaculture waste management: sludge characterisation and reuse

Vincenzo ZONNO, Giorgia BRESSANI and Raffaele ACIERNO

Di.S.Te.B.A. - Università del Salento
Via Provinciale Lecce-Monteroni, 73100 LECCE (ITALY)
vincenzo.zonno@unisalento.it

Abstract

Fish sludge can be defined as the sediment that leaves the fish holding unit as suspended solids or deposits at the bottom of fish tanks, together with a variable quantity of water, that depends on the system used to separate the solid and liquid fractions. Sludge comprises uneaten fish pellets, faecal material, soluble metabolite products and also any particles that enter the tanks/raceways with the water inflow. As many other organic residues (animal manure, treated sewage sludge, green composts etc), fish sludge contains nutrients and organic matter and has potential for spreading on agricultural land to reduce the amount of inorganic fertiliser required.

However, not all of nutrients are immediately available to plants. For example, most of the nitrogen (N) will be in organic forms and requires mineralisation in the soil before the plants can make use of it. The rate at which this N is released from the organic fraction depends on factors such as the sludge C:N ratio. Because most of the phosphorus (P) in fish sludge is associated with the solids fraction, the drier the sludge, the greater the P concentration. This high P content can limit the application rate to crops in order to avoid P accumulation in the soil.

As well as nutrients the sludge may contain also contaminants, e.g. heavy metals and pathogens. Marine sludge has the additional problem of high levels of sodium (Na), which can cause scorch when applied to vegetation and result in the deterioration of soil structure.

When applying sludge to crops, it is essential to take into account soil nutrient supply as well as the fish sludge nutrient content and availability in order to meet crop demands and reduce the risk of excess nutrients polluting the environment. At the workshop, data from experiments conducted at a range of scales to determine the agronomic value of freshwater (trout) and marine (turbot, sea bass) sludge, generated in land based farms, will be presented and discussed. Results obtained clearly demonstrate that in many cases, and following specific recommendations, fish sludge can have significant agronomic and monetary value in providing major crop nutrients.

Most of the results presented have been achieved thanks to the EU grants COLL-CT-2003-500305 (AQUAETREAT) and FOOD-CT-2007-036298 (AquAgriS).

Integrated systems as an efficient tool for biofiltration of Aquaculture waste

Juan Luis Gómez PINCHETTI

Centro de Biotecnología Marina; Universidad de Las Palmas de Gran Canaria
Muelle de Taliarte s/n, 35214 Telde; Gran Canaria, Canary Islands, Spain
jgomez@dbio.ulpgc.es

Abstract

Integrated multi-trophic aquaculture (IMTA) has been proposed as an environmentally friendly alternative of reusing/recycling wastes, especially those produced through the cultivation of high trophic level species, which require the supply of exogenous energy as food. The main objective of this approach is not "waste dilution" but "conversion".

Increase of intensive fish farms activities produce large amounts of wastes, including mainly solid particles and dissolved inorganic nitrogen and phosphorus forms, which are commonly released into receiving coastal waters without treatment. Concerning the potential adverse environmental effects caused by eutrophication, the fact of reducing negative impacts from aquaculture activities through ecologically-balanced procedures has been considered as an important issue to ensure long-term sustainability of the industry.

New integrated techniques in modern mariculture use multiple species from different trophic levels (molluscs, echinoderms, seaweeds, halophytes, microalgae) to reduce wastes discharge by promoting biofiltration capacity and water recirculation, increasing total productivity with respect to fish/shrimp feed input and pollution output, ensuring the increase overall profits through more efficient resources use and diversification. With the acceptance of this approach and the concern for negative effects on the environment, research into development of integrated techniques has been recently increased, demonstrating how wastewaters from intensive, semi-intensive and open-sea aquaculture activities are a suitable nutrient source for the production of other steps in the trophic scale, thereby reducing the discharge of wastes.

Concerning marine plants, and particularly seaweeds, different species have been cultivated in such polyculture systems being proved to be effective biofilters of effluents containing dissolved nutrients, particularly ammonium, under very different factors and conditions. Interest to produce alternative species (including other groups like microalgae or halophytes) which show interesting yields and biofiltration efficiencies, possible industrial applications and economical value is high, together with the possibility to produce constant year-round biomass. Other basic questions related with efficiency, quality, design and scale of experiments and economy of integrated mariculture have been considered crucial for successful implementation of these techniques.

Fish farming in bag pens: stocking density and oxygen addition.

Petri Jokela and Raghida Lepistö

Tampere University of Technology, Environmental Engineering and Biotechnology
Korkeakoulunkatu 10, FIN-33720, Tampere, FINLAND
petri.jokela@tut.fi

Abstract

Fish farming in net cages may promote eutrophication in water environment due to release of fish excreta and uneaten feed, which are rich in phosphorus (P) and nitrogen (N). An ordinary net cage can be replaced by a bag pen in the farming of rainbow trout. A bag pen is a floating circular basin. There is no free water movement between the bag pen and the surrounding water body, but the water is pumped into the pen and is led out through a vertical pipe by the help of hydrostatic pressure difference. The water is pumped in tangentially, which creates a swirl inside the pen. Solids settle to the bottom and the swirl collects the solids in the centre of the pen. The solids are withdrawn frequently from the bottom by a separate pump. Nutrients bound to the solids are thus prevented from getting to the water body resulting in reduced nutrient emissions. The withdrawn mixture of water and solids can be further concentrated by, e.g., dissolved air flotation to reduce the volume of sludge to be disposed of. In addition to the reduced emissions the use of bag pens improves the control of farming, because the amount of available dissolved oxygen can be adjusted by pumping. The fish swim against the current which can minimize stress and improve the quality of the flesh. The knowledge of the environmental impact of the farming is increased: the emissions can be measured by the end of the pipe. This can improve the general image of fish farming.

Specific discharges of 2.4 gP/kg and 42 gN/kg fish weight gain were achieved in full-scale trials. Compared to net cage farming, the P and N discharges were reduced by roughly 50 % and 10 %, respectively. Final stocking density of 46 kg/m^3 was achieved. When the stocking density increased, the flow into the pen was increased from 630 m^3/h to 800 m^3/h. It was noted that the specific oxygen consumption of the rainbow trout also increased from 3.3 mgO_2/min/kg to 3.5 mgO_2/min/kg. This was due to the increased current in the pen. There is no algal photosynthesis during nights and the oxygen concentration in the sea was then lower compared to day time. However, the oxygen concentration in the pen was higher during night compared to day time, because the fish were fed only during day time.

Tests were conducted to evaluate the feasibility of pure oxygen addition using ceramic diffusers in the pen. Pure oxygen addition can be effective in emergency situations, e.g., in the case of pump breakage. It can also help to maintain good oxygen concentration in the pen and thus increasing fish growth. When automatically controlled it can ease the operation. Periodical pure oxygen addition can be economically justified when increased stocking densities are used: the introduction of dissolved oxygen into the pen can be realized by a combination of adjusted water pumping and periodical pure oxygen addition.

Session 2

Waste management in Fisheries

Marine Protected Areas as a tools for fisheries management and conservation

Angel Pérez-RUZAFA and Concepción MARCOS
Departamento de Ecología e Hidrología. Facultad de Biología.
Universidad de Murcia. 30100 Murcia. España.
angelpr@um.es

Abstract

Fishing is in crisis. While it is recognized as one of the main activities affecting the ecosystem functioning and loses of biodiversity in the Marine ecosystems, at the same time, the general trend showed by FAO reports shows that 76% of the world stocks are depleted, over-exploited or fully exploited, and with some risk of decline if not properly managed. This leads to the reduction in the abundance and mean size of species and to the decreasing in recruitment of larvae and juveniles as a consequence of the biomass reduction of spawners, the loss of potential fecundity, losses of genetic diversity and to an increasing mortality risks for new recruits as a consequence of changes in environmental conditions and therefore to increasing risks of irreversible changes in the community structure and the ecosystems stability.
The traditional measures for the management of coastal fisheries rested on the basis of singled-species models of population dynamics and the concept of maximum sustainable yield. They consists of controlling the catch and recommending a total allowable catch, and to establish seasonal closures and gear specifications to guarantee a minimum size of fished individuals of target species and then, to ensure enough reproductive success and recruitment. However, marine species show complex life cycles with high mortality in pelagic phases (eggs and larvae). To compensate these high mortality rates, most of the energetic resources in adults are devoted to reproduction and there is a strong relation between fecundity and individual size so that a high number of medium sized individuals is needed to compensate the loss of the reproductive effort of only one big individual removed by fishing.
After the failure of traditional fisheries management measures, marine reserves have been strongly advocated as an ideal tool for the management of coastal fisheries. As a consequence, a large number of marine protected areas (MPAs) have been established around the world during the last decades.
The interest of MPAs as fishery management tools resides in their potential to enhance artisanal fisheries production of high-value species in surrounding grounds. The expected benefits of MPAs are that: 1) they will maintain the assemblages structure and the ecosystems equilibrium, 2) preserve the natural size and age structure of populations, 3) preserve the spawners stock, 4) preserve the genetic diversity, 5) facilitate the recovering of over-exploited areas by mean of the exportation of pelagic larvae and eggs, 6) permits the development of research in non impacted ecosystems offering reference and control sites to test ecological hypothesis, and 7) they are an alternative source

of inputs for fishermen and favors the economic development of the area through the establishment of services related to tourism and diving activities.
However, although some proposed benefits have been demonstrated, others require verification or further testing, and the use of MPAs as management tools still has a number of unsolved questions and gaps. Some of them are problems of scientific nature as: 1) the need to clearly establish the specific goals of each MPA; 2) the lack of scientific basis for the selection and design of MPAs; 3) the need for appropriate monitoring and evaluation of the effectiveness of MPAs; 4) the lack of empirical evidence for potentially complex effects of MPAs, e.g. spillover, indirect effect on ecosystems, effects on larval replenishment of commercially and/or ecologically important species, etc; or 5) the need to ascertain the relationship of MPAs with other management tools.
In addition, there also are problems of management nature, including: 1) Insufficient legal system and lack of adequate legislation; 2) interference with human activities (other than fishing) occurring in the coastal zone, mainly tourism; 3) the lack of effective enforcement measures in some cases; and 4) problems of mismanagement of MPAs.
In the last years, the European Commission has underlined the necessity to manage this situation and has promoted policy-oriented research to establish the potential of marine protected areas for marine environmental protection, by investigating the potential of different regimes of protected areas as measures to protect sensitive and endangered species, habitats and ecosystems from the effects of fishing. In this context, EMPAFISH project (European Marine Protected Areas as tools for FISHeries management and conservation), supported by the European Commission 6th Framework, has as general objectives 1) to investigate the potential of different regimes of MPAs in Europe as measures to protect sensitive and endangered species, habitats and ecosystems from the effects of fishing; 2) to develop quantitative methods to assess the effects of marine protected areas and 3) to provide EU with a set of integrated measures and policy proposals for the implementation of MPAs as fisheries and ecosystem management tools.
The main objective of the project was to promote a basis for responsible and sustainable fisheries activity that contribute to healthy marine ecosystems, creating an economically viable and competitive fisheries industry, guaranteeing a fair standard of living for those who depend on fishing activities. At present there are enough evidences to answer some basic questions as,
Are MPAs a tool for biodiversity conservation or for enhance and preserve sustainable fisheries?
Are MPAs useful to recover the abundance of populations?
Are they useful to recover the size structure of populations?
Are MPAs useful to preserve genetic diversity?
Are they effective only inside the protected area or they are useful to maintain the productivity in the surrounding exploited area?
How big must an MPA be?
Are they an engine of socio - economical growth or a source of conflicts?

Sustainability issues of marine capture fisheries with reference to bycatch discards and other waste generation in asian countries.

B.Madhusoodana KURUP
Director School of Industrial Fisheries
Cochin University of Science and Technology - Cochin, India
Advisor to Fisheries Minister - Govt. of Kerala, India
kurup424@gmail.com

Abstract

Fisheries have been important to human and societies ancient times, and for much of that time fish resources were relatively little affected and even considered limitless. In 2004 the global cotch was stagnating at around 120 milion metric tonnes, and it has been estimated that 7 out of 10 of the oceans' commercially exploited fish stocks are fished beyond ecologically safe limits, being either fully exploited or heavily exploited. In the ocean environment, commercial fishing stands as one of the greatest biodiversity threats.

In capture fisheries, waste is generated mainly due to bycatch discards, onboard processing, lost and discarded fishing gear and garbage, waste oil and oily mixtures and emissions from the vessel operations. There is a great diversity in fishing vessels operating around the world, ranging from 2 metre dugout canoes to factory trawlers exceeding 130 metres in length. Bottom trawling being a non selective fishing gear, hauls up all the organisms dwelling at the sea bottom and therefore, its destructive effect to the non target organisms of the sea bottom is a matter of grave concern on a global basis (Jennings and Kaiser, 1998). Global bycatch was estimated at 27 million tonnes in 1994, which decreased to 7.3 million tonnes by year 2004 (FAO, 2004).Trawl fisheries for shrimp and other demersal fishery resources accounts for more than 50% of this estimate of discards on a global basis. Among mechanized boats operating along Indian coast, more than 90% belong to bottom trawl specifically aimed for the exploitation of shrimp resources of the inshore waters. Discards were quantified from onboard participation in mechanized trawlers from 6 major fisheries harbours such as Sakthikulangara, Neendakara, Cochin, Munambam, Beypore and Puthyappa along the southwest coast of India .The discards were grouped into 11 taxa, and the number of species observed under various groups were: finfishes 103, gastropods 70, crabs, 12, cephalopods 7, echinoderms 5, jelly fish 4, and stomatopods 3. Finfish discards were the highest in quantity amounting to 0.95 lakh tonnes followed by gastropods (0.22), crabs (0.68), jelly fishes(0.03), cephalopods (0.029), stomatopods (0.4), juvenile shrimps (0.05), soles (0.03), eggs (0.089) echinoderms (0.018) and sea snakes (0.001).

Around 2.5 lakh tonnes of living organisms were destroyed off Kerala, which comprised juveniles of many commercially important finfishes and shell fishes. The total potential yield from Kerala coast was estimated to be 8 lakh tonnes of which the contribution from the inshore waters was 5.7 lakh tonnes. It would thus appear that the exploitation level of marine fisheries of Kerala is nearing potential stock level, calling for enforcement of strict fishery regulatory measures for the sustenance of stock. Mesh size optimization, bycatch reduction devices and trawl design improvements have been suggested as trawl design related approaches to the reduction of bycatch.

Waste management in fishery and aquaculture: "Minimization of wastes and by-product valorisation"

Susana ETXEBARRIA, Saioa RAMOS, Marta Cebrián, Aintzane ESTURO, Jaime ZUFÍA
AZTI-Tecnalia
Parque Tecnologico de Bizkaia. Astondo Bidea.
Edif. 609. 48160 Derio. Spain
aesturo@azti.es

Abstract

Fisheries and aquaculture provide an important source of proteins to humans. But not all the effort in obtaining the biomass finally is transformed into food due to different reasons. For example catches of little or no commercial value in the case of fisheries are not commercialised, or episodes of massive mortalities in the case of aquaculture cannot enter the food chain and therefore have to be appropriately disposed as wastes. Last but not least, a high percentage of biomass ends up as waste in the fish transforming industries (filleting and canning industries have a yield of about 50% of the raw material, after skinning, degutting and removing heads and spines).
AZTI is involved in various projects to define different strategies to reduce waste and to develop alternatives to valorise the by-products. The strategies range from marketing campaigns to promote low commercial value species among consumers or the implementation of Clean Production strategies in aquaculture sites and fish transforming industries to enhance productivity and use the natural resources with efficiency. The valorisation options are mainly focused on transforming waste, into a "resource", this is obtaining an added value from the by-products. These valorisation options for fish by-products are the production of: (i) high added value foods (surimi, and fish oils), (ii) fish meals and feed for animals, (iiii) agricultural products (compost) and/or (iv) bio-energy (biogas).
Results of the performed research projects reveal that there is a brilliant future for this minimization strategies and valorisation options and technologies.

Session 3

Waste management in Farming

Manure: important resource versus waste

Lena Rodhe, Eva Salomon and Mats Edström
Swedish Institute of Agricultural and Environmental Engineering (JTI), Sweden
lena.rodhe@jti.slu.se

Abstract

Agriculture as well as aquaculture and fishery may harm the water quality in ground water, rivers, lakes and sea. From agriculture there could be vertical leakage of nitrogen (N) and phosphorus (P) through the soil, there could be horizontal run off mainly of P, and there could be emissions of ammonia (NH_3) leading to eutrophication and acidification of the nature. In order to replace the lost of nutrients, This means, that the agriculture sector loose macro-nutrients as N, P and K as well as micro-nutrients valuable for plants. The manure is also a soil improver, by increasing the organic matter content of the soil in the long run. Manure is thereby a plant nutrient resource already present on the farm, which value will be decreased by handling it in a non-professional way and consequently the farmers have to buy commercial fertilisers to replace the lost nutrients.

Spreading of manure is harder than mineral fertilizer, as the manure is a low-concentrated fertiliser (heavy tankers), it has heterogeneous properties and the nitrogen could be volatilised as ammonia. When choosing the best time of spreading, many factors must be taken into consideration. The ammonia emissions increase with temperature. Soil compaction is influenced by the soil moisture. Spreading in growing crop may cause crop damage. Spreading, when there is no crop or no plant need for nutrients may lead to leakage. Also, during wet soil conditions, the nitrogen may be lost as nitrous oxide by denitrification. Nitrous oxide is a very harmful greenhouse gas.

The nitrogen loss after spreading depends on spreading time and spreading technology. Spreading pig slurry before sowing of winter wheat in autumn increase the losses as NO_3 by leakage through the soil compared to spring application before sowing of spring wheat.

The ammonia losses are higher when band spreading of slurry on soil surface (no incorporation) compared to incorporation with harrow, injected into soil or trenching (open slot injection). More than 50% of the nitrogen is lost in most cases when spread in autumn, when you summarize nitrate leakage, ammonia losses and nitrous oxide emissions!

There are five main factors influencing the size of the ammonia losses:

1. Meteorological factors like temperature, wind speed.
2. Manure properties, like how easy the slurry infiltrate the soil (DM-content) but also pH
3. Soil parameters: soil structure (how easy the slurry infiltrate), moisture content.
4. Application rate (if too much the manure/slurry will not get a good contact with the soil)
5. And spreading technology. Incorporation directly at spreading could be done with an injector.

The nitrogen could also be lost as ammonia also during storage of manure. Covering the slurry storage is an efficient way to reduce ammonia volatilization.
Different cover materials may be used in reducing ammonia emissions from storage. As a roof is an expensive solution, other cheaper materials which sometimes are available on the farm could be of interest to use.
As temperature is an important factor when looking at the ammonia losses, composting of manure could give high ammonia losses caused by the temperature rise (up to 65°C). About 30 to 40 % of the ammoniacal nitrogen could be lost as NH_3 when composting straw litter manure from young cattle. With a higher C/N-ratio, the ammonia could be reduced at least in the start of the storage period. Even if the losses of ammonia during storage is kept low, it could be lost later after spreading if it is not incorporated and spread at conditions promoting ammonia volatilisation. For example, the ammonia losses during seven month storage of broiler litter manure and the losses during the four hours after spreading was of the same size in an experiment. It shows how important it is to incorporate the manure directly after spreading, or as best with a technique that spread and incorporate the manure/slurry simultaneously.
It is also very important to dose the manure to the plants need of nutrients and to spread manure even over the soil surface. The spreader must distribute the manure even both transversal and longitudinal, and this could be investigated in farm machinery tests of spreaders. The tractor driver must also be able too keep the right distance in the field between the driving tracks.
Band spreading slurry means that the slurry is placed in strips on soil surface (not wind sensitive), and when there is a crop, in between plants. The best spreading distance is known (the same as the boom width). The technique makes it possible to spread in growing crops, and thereby prolong the spreading period in spring and in for season.
The farmers' motive for using shallow injection is in the first hand to save nitrogen. Also, when spreading on grassland, the motive is to reduce the bacterial contamination of the grass and thereby ensure the grass fodder and milk quality. If you could incorporate the slurry directly after spreading into the upper soil level (and here you need especially devices on grassland) you could reduce these problems.

However, you need more energy for draught force and thereby the working width of the spreader is often smaller (about 6 m) and it will take longer time for spreading. There are technologies for helping the farmers to place the manure on arable fields with a high precision. With GPS the dose could be adjusted to the production capacity of the spot on the field (earlier documented during harvest together with soil data).

The authorities in European countries use legislations, extension services and information,

financial instruments and research and development (R&D) in order to reduce harmful effects of manure handling on farms.

Another argument for manure being a resource is that it could be used as an energy source. For instance, digestion of manure produces energy as biogas, while the fertilizer value is maintained. A energy balance for a farm with power – heat production from biogas, shows that the produced biogas energy on a pig farm (2600 pig places) could be converted to electricity (30%), heat for warming the digester (22%) and heat for buildings (28%), while about 20% is lost as heat from the gas-engine (Edström et al., 2008). Another method for gaining energy from manure is to incinerate it. This is practiced for manure with high dry matter content and low fertiliser value, as horse manure with plentiful amounts of bedding material (wood shawings, straw). However, incineration will lead to nutrient losses, mainly nitrogen, and there is a need for filters for cleaning the out-let air.

The potential of energy production by digestion of all manure in Sweden (20 10^6 tonnes per year) is 4.2 TWh/year or about 1% of the energy demand of Sweden per year. If all biogas is used for vehicle, it will be a reduced use of fossil-based fuel with 5%. With heat and power production, the net production of heat and power is approx. 3TWh.

In summary, manure is a resource as fertilizer, already existing on animal farms. The profitability of manure handling depends on scale, management (timing, technique), and prices on inputs. Manure is also a resource as energy, for example when digested for biogas production.

The profitability of biogas production depends on scale, energy price, market, political actions as subsidies. Digestion reduces GHG emissions from slurry storages.

Reference:

Edström M., Nordberg Å., Nordberg U., Jansson L-E. & Lanz M., 2008. Farm scale biogas production. JTI-report Kretslopp & Avfall nr 42, Swedish Institute of Agricultural and Environmental Engineering. In Swedish, English summary.

Overview of the Spanish situation regarding farm wastes

Aintzane ESTURO , Sandra PÉREZ, Marta CEBRIÁN
AZTI-Tecnalia
Parque Tecnologico de Bizkaia. Astondo Bidea. Edif. 609. 48160 Derio. Spain
aesturo@azti.es

Abstract

Farms produce important quantities of wastes. These wastes are mainly organic wastes, e.g. manure, and slurry. Spain has an important farming activity and as consequence of that also produces important quantities of wastes and manure. These wastes have several managing problems: odour, putrefaction, nitrogen content and emission of global warming gases (methane and CO_2).

The most popular alternative for farm waste management is the use of manure and slurry for land fertilization, but this measure has also certain limits, such as the land area to be fertilized, the type of crop, the chemical composition of manure, the soil composition and the previous fertilizations of the land. Very often the demand of these kinds of natural fertilizers is much smaller than the offer. Therefore other uses of treatments have to be found.

The biogas production seems to be a plausible alternative and it is a proved technology and well established in several European countries. In fact, Spain is one of the main European producers of biogas (methane).The biogas is mainly produced in the several landfills across the country, but very few farms do produce biogas with their wastes, as they do in Germany, Austria, and Denmark. The existing plants in Spain take the wastes from various farms to produce biogas. The production of biogas to generate heat and electricity for own consumption is not a popular option in Spain, due to the legislative restrictions and low economical feasibility. Nevertheless, being Spain a country with an important food industry that generates important volumes of food waste, co-digestion seems to be an alternative to improve the energy generation via biogas. Previous studies prove that a co-digestion of manure with a 25% of food wastes can improve the biogas yield in 75%, and when substrates are mixed at 50% the yield improves up to 150%.

A certain number of research activities are on going, most of them financed by central and local governments. AZTI in particular is involved in some research projects dealing with alternatives for massive aquaculture fish mortalities and valorisation of cattle manure, food industries wastes, sheep cheese whey and glycerine produced in the biodiesel plants.

The implantation of the biogas production in Spain is very low compared to other European countries, because biogas production is not a main renewable energy source when compared to the photovoltaic and wind power potential in Spain. But there are possibilities to use this technology to adequately manage the farm wastes and to valorise animal wastes with local agro-food wastes through co-digestion.

N_{min} soil analyses in Austria – a valuable tool to minimise nitrogen losses from agriculture

Heide SPIEGEL, Johann ROBIER[2], Josef SPRINGER[3], Thomas ÜBLEIS[4], Georg DERSCH[1]
Austrian Agency for Health and Food Safety - AGES
Institute for Soil Health and Plant Nutrition
[1] Institute for Soil Health and Plant Nutrition, AGES, Wien; [2] Versuchsreferat der Steirischen Landwirtschaftsschulen, Hatzendorf; [3] Niederösterreichische Landes-Landwirtschaftskammer, St.; Pölten
[4] Oö. Wasserschutzberatung, Linz
adelheid.spiegel@ages.at

Abstract

Optimal fertilizer Nitrogen (N) management practices are crucial for an efficient agricultural production on the one hand and for the mitigation of N losses to the environment (leaching and thus eutrophication of surface- and groundwaters, gaseous losses) on the other hand.
N_{min} soil tests are included in the fertilizer recommendations in Austria to adjust N fertilizer amounts. Based thereon field experiments are carried out in different Austrian provinces (e.g. Styria, Upper and Lower Austria) to take into account regional differences. N fertilization that considers the actual mineral N status (N_{min}) in spring is proved to provide optimal N supply to the crops without a decrease of yields. N_{min} analyses after the harvest may evaluate if N fertilization measures have been conducted properly. Additionally, in late autumn N_{min} analyses indicate the risk for N losses to surface and ground waters. This is of particular importance, when organic fertilizers are applied. Especially with intensive animal production, N is mineralized in spring under favourable soil and weather conditions and can be used for the crop. N fertilization which includes the existing mineral N assures efficiency and water protection. This can also be demonstrated in field experiments that investigate the effects of different agricultural management (tillage, organic and mineral N fertilization) on the N_{min} status at different times. Especially in catchment areas sensitive to nitrate leaching N_{min} monitoring areas have been established in some Austrian provinces.
A considerable working- and organisational effort for taking and transport of the soil samples is necessary. The N_{min} target value system for arable crop production is applied in practice only, if the farmers are delivered from these efforts by agricultural organisations, like the "experimental department" in Styria and the "nitrate information services" in Lower and Upper Austria.
An objective of this presentation is to give an overview, to which extent N_{min} analyses are used in agricultural fertilization practices (advisory systems and individual fertilizer recommendation for farmers) and for scientific purposes in Austria. Results of selected field experiments in Austria will be introduced.

Session 4

Policies, regulation and governance

Governance for Sustainable Aquaculture: is it fit-for-purpose?

Jane CLARICOATES
TNC Partners, Germany
Claricoates@swansea.ac.uk

Abstract

Aquaculture is recognized as a vital industry, not only for providing a significant source of protein in the diets of a growing global human population, but also as a major source of employment and income worldwide. Demand for more supplies has been accompanied by increasing demands for higher quality, safe, and more varied products, and for more reliable sources. Recognition of the importance and untapped potential of aquaculture has driven a substantial – and continuing, though slowing – growth in the industry worldwide during the past three decades, facilitated by attendant technological advances and significant political support. In consequence, the increase in aquaculture supplies now outpaces population growth and is set to provide more food fish than wild-capture sources in the near future.

But such success has come at a price: the growth and, perhaps more accurately, some of the practices the growth has fostered have precipitated a range of negative social, economic and environmental effects. Impacts of aquaculture on water quality and supply, on aquatic habitats and communities, on wild fish populations, and the question of how to manage the complex wastes arising, are just some of the issues which aquaculture gives rise to and to which governance measures have been applied. Furthermore, greater understanding and communication of the issues has contributed to questions about the quality and safety of aquaculture products and has increased pressure to address the negative environmental (including bio-security), animal welfare and socio-economic impacts, leading to the development of increasingly comprehensive – and complex – governance frameworks for aquaculture. Importantly, it is not only the substantive content of the governance instruments that has increased in complexity, but also the social processes by which these are arrived at.

This presentation focuses on the situation in Europe, where the longevity of that region's environmental-governance arrangements enables us to look at the development of governance approaches and their efficacy. Within the context of AquAgriS, the focus is on aspects of governance relating to the environmental sustainability of aquaculture.

The presentation will consider key pieces of EU legislation with a bearing on the environmental sustainability of aquaculture, including the Water and Waste Framework Directives, their evolving aims and the issues arising in relation to their current implementation, based on the AquAgriS study.

Finally, the paper will consider the extent to which the current aquaculture governance arrangements in the EU may be considered fit-for-purpose in terms of achieving environmental sustainability, and what might be done, by whom, to improve the situation. Given the globalised nature of the aquaculture market, it is likely that at least some of the lessons learned may be applicable outside of the EU.

Sustainable Environmental Governance with Codes, Standards and Best Management Practices in Aquaculture and fisheries

Review Legislative Situation in Aquaculture and Fisheries in the EU

Fred WEIROWSKI
WorldFish Center, HQs, Penang Malaysia
f.weirowski@cgiar.org

Abstract

Codes of Practices, Certification schemes, often called standards, and Best management practices are the link between international Codes of Conducts and agreements, national and regional laws and regulations and the private sector production management. Codes of Practices were developed to improve the management of aquaculture and fisheries sectors , often species depending and within national borders. Globally applicable certification schemes / standards for aquaculture and fisheries are developed or just under development by civil and/or private bodies. Their aim is to create and reassure trust of customers into aquatic products by organizing a sustainable, environmental acceptable production. The legal framework for aquaculture is in many countries still underdeveloped. The increasing market demand for seafood is accused for causing overfishing as well as destruction of the environment pollution of the resources and products particular in developing countries where the major part of production is located. The way out is seen in increase of credibility and trust by certification of the production and products. Certification schemes are aiming to communicate with final consumers about public accessible standards with easy recognizable labels which influence the consumer decision at the counter. Credibility of standards and labels are main driver to maintain a sound quality surveillance system over the production process and the products. Credible certification schemes consist of three main components: (i) standards, means standard setting processes required to develop and review the production process; (ii), accreditation, means systems needed to provide formal recognition to a qualified body to carry out certification and (iii) certification and content means bodies required to verify compliance with certification standards.
AquAgris was analyzing how organic standards and globally applicable certification schemes and standards setting processes are designed to manage the impact of production related waste effluents and in fishery and aquaculture. The project team analyzed a selection of the most used certification schemes according their indicators, (impact audits, policies) procedures (control and maintenance,) criteria, (scientific justified, measurable parameter). The examination were part of the review of the legislative situation in sustainable environmental governance of the aquaculture , fisheries and agriculture sector of the AquAgris project.

A review on policies and regulations prevailing in Fisheries and Aquaculture in the context of India and Europe

B.Madhusoodana KURUP
Director School of Industrial Fisheries
Cochin University of Science and Technology - Cochin, India
Advisor to Fisheries Minister - Govt. of Kerala, India
kurup424@gmail.com

Abstract

In India, fisheries and aquaculture are vibrant economic activities in India , and has been one of the fastest growing food production systems during the last three decades. Their significance and contribution towards agricultural (4.6 per cent GDP) and national economies (1.3 per cent GDP), livelihood and nutritional security, employment generation (11 million people) and foreign exchange earnings (over Rs.8000 crores) have been enormous though understated so far. Thease sectors are governed by various rules and regulation thus ensuring the sustainability. The Ministry of Environment & Forests (MoEF) is the nodal agency in the administrative structure of the Central Government for the planning, promotion, co-ordination and overseeing the implementation of India's environmental and forestry policies and programmes. The primary concerns of the Ministry are implementation of policies and programmes relating to conservation of the country's natural resources including its lakes and rivers, its biodiversity, forests and wildlife, ensuring the welfare of animals, and the prevention and abatement of pollution. While implementing these policies and programmes, the Ministry is guided by the principle of sustainable development and enhancement of human well-being. In 1991 February 9th : based on the EP Act 1986 MoEF issued Coastal Zone regulation notification. The notification imposes restriction on the setting up and expansion of industries, operations or processes in the CRZ. In aquaculture, CRZ Helpful in the orderly development of brackish water aquaculture and To protect the mangrove eco system and interlaid conservation of Biodiversity and fish wealth. The Environment (Protection) Act was enacted in 1986 with the objective of providing for the protection and improvement of the environment. It empowers the Central Government to establish authorities [under section 3(3)] charged with the mandate of preventing environmental pollution in all its forms and to tackle specific environmental problems that are peculiar to different parts of the country. The Act was last amended in 1991.
Enactments of various regulation governing fisheries is essentially having strong bearing on the marine fisheries sector.The various acts governing Fisheries are The Indian Fisheries Act: 1857,Maritime Zones Act (1976),Maritime Zones of India (Regulation of Fishing by Foreign Vessels) Act (1981) and Rules (1982).,MFRAS were first implemented in the States of Kerala and Goa in 1980.

The other related acts are Coastal Regulation Zone Protection Act, (1986),The Environment Protection Act, (2002) and The Biological Diversity Act (2002) Under fisheries section the paper describe the policies and regulations for Inland Fisheries Sector, Declaration of closed season, Protection of endangered species, Establishment of Marine Protected Areas (MPA), Reconciling Conservation Measures with Livelihood Issues, Prohibition of destructive fishing practices, Control of ghost fishing, Monitoring data on fish landings through co-management, Sea safety, Monitoring, Control and Surveillance (MCS) and Maritime Search and Rescue (SAR) systems, Disposal of seized fish from confiscated vessels, Mariculture policy, Conflicts between small scale fishers and large scale mechanised fishers, Deep sea fishing policy etc.

Fisheries exports have registered a tremendous growth during the period 1987-2000, and the export basket of fisheries products has become reasonably diversified. Export of frozen fish recorded the highest annual growth but shrimps and prawns constituted the major category of exports, capturing an impressive 5 per cent of the world export market. Trade reforms of the 1990s seem to have further facilitated the export of fish and fish products from India and the feared import surge after the opening up of the economy is still not visible. Measures of relative competitive advantage reveal that India has become reasonably competitive in recent years but it must vigorously take up various sanitary and phyto-sanitary measures, consistent with WTO guidelines, in order to give exports a further boost. However, there is a concern that these measures are being increasingly promulgated with the deliberate purpose of shielding domestic producers from international competition The quantity of sea food products exports during the period1995-2000 was high. The trade barriers introduced by the European Union have adversely affected the Indian live aquaculture product exports.

The EU lays down harmonized requirements governing hygiene in the capture, processing, transportation, and storage of fish and fishery products. EU legislation lays down detailed requirements regarding the landing of fish, structure of wholesale and auction markets and processing facilities (for example, construction of walls and floors, lighting, refrigeration, ventilation, staff hygiene), processing operations, transportation, storage, packaging, checks on finished products (including visual, organoleptic, chemical, and microbiological parameters), laboratories, and water quality. In the case of water quality, for example, parameters are specific for microbial pathogens, chemical contaminants, radioactivity, and various other quality indicators.

These parameters are subject to minimum levels of sampling and testing to monitor and confirm compliance. More generally, the EU requires that fish processing facilities undertake "own checks." Key elements of these requirements include (1) identification of critical points in the processing establishment on the basis of the manufacturing process used; (2) establishment and implementation of methods for monitoring and checking such critical points; (3) taking samples for analysis in an approved laboratory for the purposes of Checking, cleaning, and disinfections methods and checking compliance with the standards established by the Directive; and (4) keeping a written record of these controls for at least two years In developed countries catch certification is practicing since many years and their vessels are using electronic tools or logbooks for collection of fishery data for this purpose. The log-book system was implemented in all EU countries in 1988 itself. These log-books contain detailed data on the spatial and temporal distribution of landings and effort, which partly satisfy the need of fishery scientists. Databases can be developed from this logbook on species level catch, effort and gear used by individual fishing fleet. However implementing catch certification in developing countries like India, where the modern and the traditional systems of fishing co-exist, would be near to impossible. It would be impossible to implement this among numerous country-crafts, which dock with their catches anywhere along the coastline. It is not clear that which authority in India will take responsibility for this provenance issue.

Aquaculture in the new millennium has to meet the challenges in intensification of culture practices, expansion in the area under culture, species diversification, eco-system sustainability, long term productivity, climate change and new diseases, declining fish meal production, competition for increased feed demand, and food safety issues. So Effective policies and regulation is vital for continued growth and sustainability of aquaculture. Under the heading policies and regulations for aquaculture the paper narrates, Regulations relating to quality inputs for aquaculture, Regulations for introduction of exotic species, Compliance of aquatic animal health safeguards with trade related agreements, Standards, testing and certification for fishery products, Policy Framework Freshwater and Brackish water Aquaculture sectors.Fishing and aquaculture are important economic activities in the European Union. While the fishing sector's contribution to the gross national product of Member States is generally less than 1%, its impact is highly significant as a source of employment in areas where there are often few alternatives. In addition, it helps to supply fish products to the EU market, one of the biggest in the world.

The Common Fisheries Policy (CFP) is the European Union's instrument for the management of fisheries and aquaculture. CFP was born in 1983. The Common Fisheries Policy was reformed in 2002 to ensure sustainable exploitation of living aquatic resources.

The Commission has started a review of the Common Fisheries Policy In 2008 to make it more efficient in ensuring the economic viability of the European fleets, conserving fish stocks, integrating with the Maritime Policy and providing good quality food to consumersThe Common Fisheries Policy shall provide for coherent measures concerning: conservation, management and exploitation of living aquatic resources, limitation of the environmental impact of fishing, conditions of access to waters and resources, structural policy and the management of the fleet capacity, control and enforcement, aquaculture, common organisation of the markets, and international relations.

Information:

www.aquagris.org

AQUAGRIS Project Coordinator
DISTEBA – University of Salento
Via Prov. Lecce – Monteroni
73100 LECCE (Italy)

Tel. +39 0832 298684
Fax +39 0832 324220

E-mail: aquagris@physiology.unile.it

In collaboration with:

TECNO.S.E.A.
Spin-off Enterprise of University of Salento

www.tecnosea.it

TECNOSEA
AQUACULTURE INNOVATION

Contacts:
Centro Ecotekne, c/o Di.S.Te.B.A University of Salento
Strada prov.le Lecce-Monteroni
73100 LECCE

Tel. +39 0832 298684
Fax. +39 0832 1830419

E-Mail: info@tecnosea.it

University of Salento

University of Salento is a young, dynamic and fast growing institution with more than 30.000 students enrolled and a choice of 8 faculties, one of the 6 schools of excellence in Italy, and more than 1700 teaching and non-teaching staff, distributed in 19 Departments. The University, and in particular the Department of Biological and Environmental Science and Technology, has an extensive experience of co-ordinating research and development projects: it has been coordinator of the FP6 collective research project AQUAETREAT and is currently acting as coordinator of the FP6 coordination action AquAgriS and FP7 IRSES "PASSA". University of Salento research areas include aquaculture technology, water treatment, fish biology, ecology, oceanography, animal physiology, eco-toxicology, plant physiology, agronomy and biotechnology. Most of the experimental activities are carried out at the Marine Aquaculture and Fisheries Research Centre of Acquatina (Frigole, Lecce), an unique example of research facilities in the Mediterranean area.

Tecno.S.E.A. - Technology and Advanced Services in Aquacolture

Spin-Off enterprise of the University of Salento

TecnoSEA is a spin-off enterprise whose main mission is the valorisation of the results of the research carried out inside of the University of Salento through the development of new products and services in the field of biological sciences and marine sciences, with particular reference to aquaculture and fisheries.

TecnoSEA is established at the Department of Biological and Environmental Sciences and Technologies (DiSTeBA) of the University of Salento and has its headquarters at the Marine Aquaculture and Fisheries Research Centre. Here, TecnoSEA has free access to all research facilities and technological equipment that make the company independent and highly competitive on the local and international market.

TecnoSEA operates mainly in aquaculture sector and the related services by carrying out scientific research and technological development and innovation on the use of innovative systems for the reduction and the control of the environmental impact of aquaculture systems and for treatment and reuse of water and sludge.

TecnoSEA owns two patents:

T.RE.A.T.: system for the treatment and reuse of wastewater of land based aquaculture farm;

S.M.AC.: system for wireless monitoring and control of environmental parameters in aquaculture.

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