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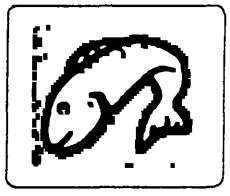
"SUSTAINABLE AQUACULTURE DEVELOPMENT - THE ROLE OF FINANCE INSTITUTIONS IN COMMON PROPERTY RESOURCE MANAGEMENT"



.1 State of the art in environmental management systems:

Economics and Ecology comes from the same Greek root: OIKOS, which means house - or rather the development and managing of a household with scarce means and fragile processes. For hundreds of years the sciences of Ecology and the science of Economics have moved further apart in their meaning of core concepts like production, growth, health, resource etc. In our time, in the increasingly global household, a lot of work now goes into the integration of the understanding of the economy of nature with the economy of markets, both by the World Bank, the UNDP, the UNEP, the World Resources Institute and the London Environmental Economics Centre.

Are there any possibilities that these efforts will yield workable results which can be implemented by way of the millions of small decisions in business, in agriculture, in fishing and in other resource-based activities. Are there any possibilities that other sciences - notably the technological sciences and the social sciences - will be able to provide new technologies that use ecosystem processes more effectively and new institutional designs that contain incentives for long term sustainable development? Or are the subsystems of modern society entrenched in their inability to receive signals from a troubled nature and to transform these into actions in the fields of economy, politics and science ? (Luhman 1989, pp 16-21)

In this paper I shall use the troubled marine aquaculture on the North-Norwegian coast as a background for a discussion of the need for new - and workable - paradigms for environmental management. Open marine aquaculture is extremely valuable as an "indicator organism" of fundamental flaws in the working of an economic system and its institutional framework. The major reason for this is that sea-water flows freely between one aquaculturalist's fish pond and another aquaculturalist's fish pond, as well as between these fish ponds and the "wild", natural environment. Sea-water has properties which are very different from those of the atmospheric air surrounding the terrestrial ecosystems. Sea-water carries pollutants and pathogenic agents quite freely - so that any externalities imposed by one aquaculturalist on others - or on the commons, are likely to flow back to the first aquaculturalist within a short period of time. What is deposited in the sea, travels fast and far and stays there for a long time, either in chemical compounds or in complex food chains, before it is deposited on the sea bed. Effects of this kind of modern human activity therefore tend to be rapidly cumulative, producing dramatic - and highly stochastic biological processes. Examples of such are modern algae blooms due to fertilization of the North Sea and accelerate Volterra-Lotka oscillations in wild fish stocks due to heavy single-species fishing strategies (Allan & McGlade 1987). There is no equilibrium in the oceans and economic activities that take as their basis equilibrium solutions (e.g. long term maximum sustainable yield) are likely to fail.

Therefore, in the marine aquaculturalist, the economic subsystem had an opportunity to produce a model for entrepreneurial activity which was responsive to signals from the environment. This opportunity was lost in the first round - an environmentally sound model for aquaculture was not established in Northern Norway. This i not surprising, marine aquaculture had to start where agriculture began - by destroying everything that had grown there before. Still, the properties of sea water makes it different, the overburdening by one aqua-

culturalist of the commons - the clean and healthy coastal sea environment - very quickly hits the same aquaculturalist, not as a marginal deterioration as in Hardin's overgrazing case (Hardin 1968), but as a cumulatively induced and dramatic move by nature. In the second round of aquaculture development in Northern Norway, the stated aim is to strengthen the environmental component of fish fanning (Fiskaren 8/8-91). However, there is no common opinion on how to achieve this, whether by privatized (industrialized) and closely controlled land tanks or by cooperative open systems in the sea, mirroring the natural processes as far as possible. There is also no common opinion on which institutional designs will provide the right incentives for ecologically sustainable aquaculture development.

Approaches to environmental management can be classified in various ways. One particularly useful way is offered by Colby where five broad fundamental paradigms of environmental management in development are identified (Colby 1990):

Frontier Economics

Deep Ecology

Environmental Protection

Resource Management

Eco-Development

Leaving the primordial dichotomy of "frontier economics" versus "deep ecology" aside, the integration of economic, ecological and social systems is increasingly progressive as one moves from the paradigm of "environmental protection" to "resource management" and further to "eco-developmem". Each of the approaches are different in terms of emphasis on empirical evidence, inherent imperatives and problems, and each prescribes different solutions, strategies, technologies, roles for economic sectors, cultures, governing institutions and ethics.

Most western legislatures concerned with marine aquaculture development (i.e. the North Atlantic Rim), still adheres to the paradigm of **Environmental Protection,** i.e. a defensive and remedial approach to the effects of human activities. Land and sea "doctoring" is used rather than land and sea "health", and like in human medicine, repairing is usually much more expensive than prevention. In line with a 100 year conservationist tradition, valuable parcels of common property have been convened to state property in the form of national parks or wilderness reserves. Corresponding to this has been the neoclassical belief in the

privatization of property as the principal solution to overuse of resources. This prescription of the environmental protection paradigm is based on Hardins erroneus lumping together of open access property regimes and common property regimes - with the stereotypical "tragic" outcomes.

The **Resource Management paradigm** evolved out of problems in developing countries, where resource depletion is felt more severely than pollution and encroachment on wilderness. It was the basic theme of the Brundtland report and involves a natural theoretical extension of neoclassical economics and a dramatic change in practice. The paradigm demands an inclusion of all types of capital and resources - biophysical, human, infrastructural and monetary - into the calculations of national accounts, productivity and policies for development and investment planning. Climate and its underlying processes are to be managed as are rainforests and future national parks - not for defensive protection, but for their role in climatic regulation and storage of biodiversity for potential use by humans. The term "resource" implies that the final aim of all the management technologies and strategies is the sustainable survival and development of humans. Especially when growth that hurts nature begins to hurt economic man, legislatures are ready for Resource Management strategies. One particular subdiscipline in this respect is "risk management", where various environmental threats are analyzed and prioritized for action (trying to figure out how much can be gotten away with) according to their degree of danger to society.

The greatest difficulties within this paradigm is implementation, in particular of the emerging system of global commons laws, where the existing legal, economic, political and institutional structures and concepts are completely inadequate. Although policies are clear and the measures, in terms of economic costs, are relatively cheap, the conflict of interests and entrenched incentive systems are the main obstacles to sustainable resource management (Pearce 1991).

An interesting development within the Resource Management paradigm is the Global Efficiency approach (Sachs 1989). According to this, not only stocks of physical quantities should be included in national accounts and planning instruments, but more important; ecosystem processes should be considered as resources and should be conserved as well as used more effectively through new technology. Relevant management strategies would be large scale energy efficiency, restoration ecology, ecosystem and social health monitoring as well as internalizing the social costs of pollution (polluter pays principle - rather than mandating particular clean-up technologies). The Global Efficiency approach means that

ecology is being economized; if the "price gets right" of all resources, and correct incentive systems are designed, the market forces can be used for efficient environmental management. Taken one step further, it also means that all "externalities" which had to be cleaned up by others now are "internalized" so that all environmental problems are transformed into "resource problems".

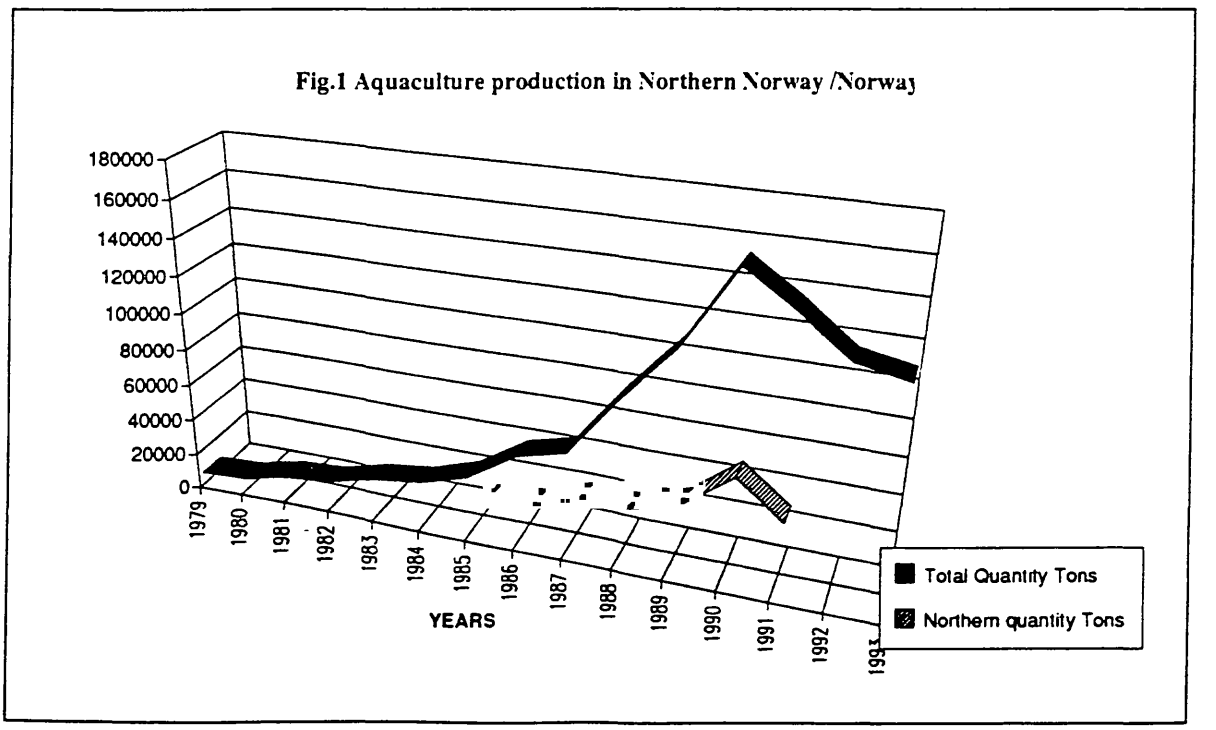
The final paradigm; **Eco-Development,** where Eco signifies the original concept of a house (both Eco-nomic and Eco-logical) is believed to be the paradigm for the longer term future (Colby 1991). Evolved from the limitations of the Environmental Protection or Resource Management paradigm, it seeks to restructure the relationship between society and nature into a "positive sum game". In ecologizing the economy and whole social systems it will attempt to reorganize human activities so that they are synergetic with ecosystem processes and services. This means that biophysical resources (energy,materials and ecological processing cycles) flow from the ecosystem into a thermodynamically open economy, and degraded energy and other by-products flow back out to the ecosystem. By reducing this "throughput", Eco-Development will gradually be able to move from the present "polluter pays" principle" to a "pollution prevention pays" principle". Special importance is connected to risk in this paradigm - the conventional risk analysis of Resource Management will not be sufficient. The fundamental ecological uncertainty needs to be incorporated into the economic modeling and planning mechanisms. These need to contain even longer term management of adaptability and resilience to reduce the occurrence of nonlinear ecological surprises caused by crossing unknown ecospheric stock, flow-rate and process thresholds. The Resource Management strategies of tradable pollution permits and individual transferable harvesting quotas do not incorporate ecological uncertainty, they also create new and sticky property rights which becomes difficult to take away (the right to pollute and the right to deplete). Instead "green taxation" should increase taxes on resource extraction and polluting activities and decrease taxes on activities that should be encouraged : labour, savings, investment, recycling of resources and protection of ecosystem functions.

The most advanced proposals from the Norwegian environmental authorities dealing with marine aquaculture is line with the Resource Management paradigm, although most of the management instruments dates back to the Environmental Protection stage. Taking the step towards a new paradigm of Eco-Development would require a fundamental restructuring of the aquaculture economy, its factor markets, its trade pattern and its design for organized interests. Still there is a lot of deep ecosystem insights among the coastal population in Northern Norway, being exposed to the interdependences and the uncertainties in the marine environment for generations. A gradual movement of marine aquaculture towards the

paradigm of Eco-Development would capitalize on this social capital before it is too late (Coleman 1990).

Rapid growth in North Norwegian Aquaculture - externalities and rigidities.

Marine Aquaculture in Northern Norway started in 1971 - with bold entrepreneurs in a virgin environment. The technology was fresh and untested, the markets were ever expanding and the ecology was perceived as the most resilient in the Atlantic Rim. The recruitment to aquaculture was mainly from fishing villages and fisher families, they brought with them into the new trade the ecological knowledge of the fisher as well as the work habits from the treating large quantities of caught fish in a short period (Sandberg 1983). From 1971 to 1977 - the initial entrepreneurial phase, the volume was rising slowly, but steadily. Shortage of fish fry was the major bottleneck, especially for North-Norwegian aquaculturalists. From 1977, the growth has been substantial and accelerating towards 1990, which was the year of culmination. This was the "frontier economics" stage where, in spite of strict government licensing (size limits of 12.000 m^3), progress in aquaculture was perceived as an infinite growth- both in quantities and in earnings. The open pond technology (net-bags) was also seen as a negligible exploitation of the infinite natural resource of the coastal ecosystem. Fig. 1 gives a significant picture of the growth stage in Norwegian and North-Norwegian Aquaculture:



Source: FOS:Norwegian Salmon Facts 1990 (1991-93 are projections)

The value to the aquaculturalist of the traded salmon and trout has increased from 216 Mill NOK i 1979 to 4.792 Mill NOK in 1990 and the real prices increased steadily to a peak in 1985, after that prices have been falling, from 1989 dramatically. Norway has had close to 70% of the world market for Atlantic salmon and must shoulder the main responsibility for the collapse in the market. The dramatic increases in produced quantities were partly stimulated by the high prices in the mid-eighties, partly chosen as a survival strategy when prices started to fall. At the time, such a strategy might have been rational on the level of the individual aquaculturalist - however, the collective result was tragic. Overproduction and dense stocking of the fish in ponds limited by size permits, has led to overflow in sensitive markets, charges from the US and EEC of price dumping and an increased probability of stress-induced diseases. A large number of aquaculturalists have gone bankrupt because of market failures or ecological uncertainty - or as a consequence of an interaction between the two.This is also typical for the post-entrepreneurial phase where epigones imitates the successful entrepreneur, but by way of their volume of production - and their greed - they bid up the prices in the factor markets and flow the product market with cheap and often poor fish. The losses incurred by individual aquaculturalists are passed on to banks and other finance institutions in the aquaculture regions, these have as a consequence been shaken in their foundations - to the point where they either have been incorporated into larger banks or have been salvaged by the national government.

The central government is aware of the fact that the size-limited licence system is itself producing externalities, both in product markets and in the local production ecosystem. Much effort has therefore been used to craft a new licensing system, based on number of farmed fish or weight of such fish. But because organized interests have vested so much in existing systems, government is forced to move much slower than the situation demands, consequently it looses whatever control it might have had in the new and emerging trade. From a Resource Management point of view, an aquaculture licence has become an entrenched individual property right that carries with it the right to flood product markets and pollute coastal ecosystems. The licence is in effect also made transferable, so that a bankrupt aquaculturalist can capitalize on his licence by selling his empty fish pond equipment with a considerable mark-up.

The result is that licences cannot be taken away from those who fail, instead they are being accumulated on fewer hands - business concentrations of up to 10 licences are now quite common. The idle industrial capital which the licence system was designed to protect the

smallholder aquaculturalist against, is now buying up Norwegian aquaculture and the availability of capital is now the crucial factor in business decisions regarding volume of production - or whether to produce at all. Unable to manage the development of aquaculture - or the total ecosystem resources it depends on, a frantic government has reverted to the Environmental Protection paradigm. New and complicated rules and regulations for protecting the wild marine environment from the "emissions" of aquaculture are now being issued from various government agencies, both from veterinary, environmental and fisheries departments. And smallholder aquaculturalists are complaining that they, barred from employing specialized administrative staff, have no chance of complying with - not even understanding all the regulations.

Although the most obvious future strategy for government would be to do away with all licensing and design incentive systems and tax systems that "internalized" all the present externalities in marine aquaculture, this is not likely to happen. The entry of industrial capital into an area of limited access with ample opportunity for strategic alliances with few actors, will most probably make these former critics of licence limitations its strongest defenders. Through various forms of rent seeking and appeals to "national interest" and "market power", these stronger concentrations in aquaculture will protect themselves against competition from new and emerging aquaculturalists in coastal communities. A fair projection is that the rigidities of the future industrialized aquaculture will be no less than those of the former smallholder aquaculture.

Of particular interest to us is the new role of banks and finance institutions. While they during the 1980s went out of their way to have every new aquaculture licence holder as their customer, they are now in charge of the whole aquaculture sector. It is in fact the bank who decides whether an aquaculturalist can start a new age-group of fish in his ponds. In order to minimize their own losses, a bank might refrain from demanding bankruptcy. Instead it might freeze the debt and allow the aquaculturalist go on producing - in a careful and controlled way. It might also decide to suspend fish farming for the coming year, forcing the aquaculturalist to slaughter his fish-stock gradually in order to repay his debts. In reality this means that the aquaculturalists is unemployed, but have to tend his own fish as a tenant to the bank. In the North-Norwegian province of Nordland, which according to a recent analysis has a "sustainable carrying capacity" of 228.000 tons (LENKA 1990), 50 of the 130 licence fish farms are taken out of production by finance institutions. This means that only 18.000 tons (8% of carrying capacity) will be produced in 1991 as against 31.000 tons in 1990. Although the quantities of farmed fish are reduced, there are still fre-

quent instances of poor quality fish being marketed, of diseases and unfortunate chemical and genetic "contamination" of local coastal ecosystems.

This new role of finance institutions has at least 3 interesting aspects which are worth pursuing :

Banks and finance institutions are successful where government and the aquaculturalist's own organizations have failed i.e. they are able to reduce overproduction in relation to markets. However, this is mainly done by excluding certain aquaculturalists, not by controlling the volume of production of the "surviving" aquaculturalist. It still remains to see whether a multitude of competing banks will be able to avoid the typical "Hog-cycles" that this kind of production i susceptible to. While individual aquaculturalist have a tendency to step up production to compensate for lower prices, finance institutions do have instruments (mainly operational credit) that enables them somewhat to govern the volume of production among "their" fish farmers. Depending on bankers willingness to use this instrument to safeguard themselves against losses, the question arises whether banks can act with some sort of "collective rationality".

Banks incur heavy losses when fish-farms are not run in accordance with sound environmental principles, when the greedy aquaculturalist's overstocking of limited sea-volumes results in. stress-induced diseases, forced slaughtering and loss of sales. It should therefore be in the banks own interest that the local or regional "commons" - the clean and healthy coastal ecosystem - is not overexploited and degraded. This raises the question whether finance institutions can be more efficient environmental agents than government agencies ?. An interesting question here is also the relationship between the very high level of real interest rates (4,5 - 5%) since the mid 1970s and the propensity of aquaculturalists to take short-term decisions that degrade the local environment and increase the banker's risk (Lipton 1991).

Banks are not concerned with distribution effects of their lending policies - or preoccupied with ideas of equal treatment of their customers. Will a greater role for finance institutions in environmental management - or in "governing the commons"- create intolerable inequalities and privileges that over time become entrenched and economically and ecologically inefficient. Will the competition between banks make such tendencies stronger or weaker ? Or will privilege holders created by environmentally sound lending operations be more efficient environmental managers or eco-developers than privilege holders generated by government licensing systems or quota systems ?

I do not attempt to answer all the questions raised in this short paper. Especially the problems of market strategies in a growing world market for aquaculture products (projected to

increase from 11 to 30 mill, tons from 1990 to 2010) would require several large volumes. But it is should be self-evident that in the future finance institutions will play a much more active role in the business decisions regarding volume of production and composition of production. This should be the case whether the structure of Norwegian aquaculture moves in the direction of full fledged industry or whether it keeps its smallholder profile. In no case will government agencies be able to adjust the volume of production so as to reap high prices and avoid disrupting and uncontrolled overproduction. Nor will the National Association of Aquaculturalists again reach the organizational strength necessary to discipline it members to act collectively in front of a difficult market. The member-controlled national marketing organization set up to provide coordinated marketing strategies have also been troubled by defecting strategies from individual members and seems to lack the mechanisms necessary to discipline members.

Despite the call from smallholder aquaculturalists that government must play a heavier role in controlling the volumes of produced fish, there seems to be few other options than an increased role for finance institutions coupled with increased vertical integration in the industrialized segments of Norwegian Aquaculture.

Now, let us turn to the inefficiencies in the present resource management system and to what extent new lending philosophies among bankers can provide incentives that effectively prevent overexploitation of the common property resource - the clean and healthy coastal ecosystems that are Northern Norway's main comparative advantage in relation to other aquaculture regions of the world.

Inefficiencies in present resource management system.

Despite the current set-backs, the future for North-Norwegian Aquaculture is very promising - once the new industry is able to handle the problems of market adaptation and environmental management. Compared to traditional fishing on the common property resources of wild stocks of fish that fluctuates stochastically, the purposeful cultivation of the sea carries a potential for prediction and calculation that for hundreds of years has been absent in coastal societies in Northern Norway. With the current species and somewhat improved technologies the total capacity of the coast is calculated to 570.000 tons, of this Northern Norway alone could produce 415.000 tons or 73 % of the national capacity (LENKA 1990). With the development of commercially viable cultivating technologies for 3 - 5

species of cold water white fish in addition to the present anadrome species, it is projected that Norwegian aquaculture alone easily could produce 1 mill tons sometimes after year 2000 (NTNF 1990). With such increased possibilities to switch production between various species, the true market-price mechanism could to a greater extent help the individual aquaculturalist to adjust her volume of production to the projected demands in the various segments of the fish market (Sandberg 1991). A recent analysis of the long-term perspectives of Norwegian aquaculture concludes that these kind of resource-based biological processes will grow into one of the largest export industries in Norway, generating approximately. 30 Bill.NOK and employing around 75.000 people. It argues that necessary requirements for this is development of larger units of production and more vertical integration - or cooperation - throughout the entire industry. It also advocates more market-oriented research to secure uniform quality, regular supplies and a broader specter of products on the international market It projects that better coordination between fewer and larger units in the industry (on quality, information and competence-building) will reduce the environmental problems in aquaculture and that the need for government regulations will be dramatically reduced (NTNF 1990).

In real life, things are more complicated: Here the environmental problems in aquaculture are not merely technical and veterinary problems which can be solved by some more research and some better medicines. Every time Norwegian aquaculturalists have solved one environmental problem or found a cure for a disease, a new one appears. At the moment (1991), the major environmental problems facing Norwegian aquaculture are:

Emissions of nutrients and organic matter are too concentrated.
Too much and indiscriminate medication in connection with outbreaks of diseases.
Genetic mixing of wild fish and runaway farmed fish.
Large sea- and land areas are closed to the general public and traditional fishers .
Too frequent and indiscriminate use of chemicals.
Contamination of wild fish with diseases developed in aquaculture.

As stated earlier, most of the problems are caused by the way aquaculture development in Norway has been governed, i.e. the size limit licensing system. But even if this is removed and replaced with a system of quantity limits, the basic incentive structures remain the same - and it is in most ways the incentive structures that generates the environmental problems.

By stocking the fish densely, the aquaculturalist does of course get the maximum out of his licence. By various limit defeating strategies (deepening the net-bags, moving the fish around and progressive slaughtering), he can get even more out of his licence. There are additional economic rationality connected to a strategy of dense stocking :

The feeding is easier and less of the expensive fodder gets wasted,

The tending, watching and slaughtering of the fish is more convenient and saves labour through possibilities for monitoring and automatization.

The investments and maintenance costs of smaller and simpler structures are lower than those of larger and more elaborate ones.

The medication of fish is easier with denser concentrations.

The smaller structures can more easily be transported to new locations in case of unfortunate self-induced ecological feed-backs from nutrient emissions or externally induced ecological feed-backs like algae blooms.

The existing technology is gradually improved and the trust in this is entrenched with investors, consultants and finance institutions.

The individual aquaculturalist will continue to take these factors into consideration even if the size limit licence system is replaced with a system of limited quantities of fish. The trade-off between the advantages of dense stocking and the risk of diseases is not clear to the individual aquaculturalist, i.e. it seems impossible to calculate. The empirical observations done by aquacultural practioneers also seem to confirm this: diseases and environmental troubles strike randomly - like fate - and those who stock carefully and tend the fish very accurately are just as vulnerable as the more careless practioneer. Thus there seems to be no clear cut individual rational incentive for lesser density in the fish farms.

There is one obvious reason for this. In the open system of present marine aquaculture the sea-water flows freely between ponds (net-bags) and pathogens, nutrients and chemicals are transported horizontally by currents and vertically through food chains. Water is an efficient transmitter and the current state of knowledge in marine biology does not enable us - or the aquaculturalist - to predict what the precise effects of a particular emission will be or where it will appear. At the same time there are hundreds of natural biological and biochemical processes in the sea that are capable of speeding up or slowing down according to ecological impetus. We are currently very far from any exact knowledge of how these numerous feed-back mechanisms work and how they influence cultivation of the seas (Lovelock 1987). Most probably the aquaculturalist is right in assuming environmental

problems to occur stochastically - and his dominant strategy becomes to hope for the best. The individually most rational strategy is to close your fish farm off from the diffuse influences of the other aquaculturalists - and from the unpredictable "wild" processes. Closed land tanks which treat all incoming water and work under sterilized conditions do isolate you from ecological externalities, but with the present overproduction from open marine systems, it is so far too expensive to be economically viable. However, with very stiff government regulations of emission treatment, an eradication of smallholder open marine aquaculture and a total domination of Norwegian sea-farming by large industrial companies, closed systems might be viable in the near future.

On the aggregate - or collective - level, there is no doubt that an overall improvement in practices in open marine aquaculture would benefit all aquaculturalists. As this is shared knowledge : if everybody refrain from polluting and contamination, everybody will be better off; and as everybody goes on with business as before, we have a typical tragedy in Hardin's sense (Hardin 1968). The difference from the overgrazing environment to the under-water environment is that it seems impossible at the present epistemological stage to calculate **risks** in open marine aquaculture (i.e. how much emissions and contamination can you get away with). What the aquaculturalists are faced with is absolute environmental **uncertainty** - if only one out of 100 has sloppy practices, anyone of the other 99 can be hit - as well as himself. Anything can happen, with full force - and not as a marginal deterioration. This awareness is not limited to Northern Norway, also in other communities around the Atlantic Rim is this common knowledge (Reinert 1990). But how to incorporate ecological uncertainty into economic modelling and planning mechanisms ?

Solutions to this are sought at the collective level: The National Aquaculturalists Association has tried to discipline it members into more environmentally sound aquaculture. Substantial amount of resources have been used for research for vaccines which could replace medication. Well known diseases have been controlled through this kind of technological development, but new diseases have suddenly appeared and the association has not been able to control unsound environmental practices, despite strong appeals to collective interests. The incentives for environmentally sound practices provided by the aquaculturalists' own organization does not seem to work when the price of fish is high, neither do they seem to work when the price is low.

There is a shortage of healthy coastal ecosystems around the world and the price of these kinds of commons will rise steadily. This means that governments will gradually be more

concerned with environmental management in these areas. The Norwegian government is deeply divided as to its strategy for managing the coastal commons and has not been at all successful in either. One pan of the Ministry of Environment sticks to conservationist ideas and tries to regulate so that farmed fish shall not mix with wild breeds of salmon and water from sea farms shall not reach growing areas for fry of marine fish. Recent attempts to regulate emissions of nutrients and organic matters from open marine aquaculture have however met with heavy opposition from smallholder aquaculturalists. Environmental Protection measures are accused of killing off all commercial aquaculture in Norway and have difficulties in maintaining political backing.

Another part of the Ministry of Environment works within the Resource Management paradigm of the Brundtland Commission. The modelling of resources for aquaculture development is a good example of such integration of all kinds of resources into one model: All physical properties of the coast together with existing human usage/ natural reserves is the base-line from which the carrying capacity for open marine aquaculture is projected (LENKA 1990). Of great importance in such an analysis are the assumptions made, like the veterinary based assumption that each smallholder sea farm of 12.000 m^2 ecologically occupies on average 2 km^2, and that *9 % of* the coastal zone has to be set aside to protect the migrating wild salmon. A carrying capacity of 570.000 tons of farmed fish rest on such assumptions - risk management is part of resource management. However, the future development of aquaculture might very well show that the ecological uncertainty is so large that it takes at least 20km^2 to make sure that no externalities reach the next sea-farm, then the carrying capacity of the coast would be considerably lower. All organized interests (fishers, aquaculturalists, leisure groups etc.) are eager and ready to negotiate changes to the parameters of the model - to their advantage. This weakens the LENKA model and no government agency has yet come forward with a a workable model for governing coastal zones based on this kind of area/biology-resource planning. Some son of area-based legal tools is probably the most viable solution, but there will always be a temptation for the individual aquaculturalist to defeat government limits that are difficult to monitor, for instance a limit to the quantity of farmed fish per km^2

When organized interests - and government - both seems to be inefficient as resource managers of a clean and healthy coastal ecosystem, what are we then left with as institutions for governing this commons ? (Ostrom 1990). A number of institutional designs are feasible, but none of them have really been tried:

- The municipality (county) can take over the comprehensive coastal zone environmental management and together with the various user groups work out compromises to conflicts of interests through normal democratic processes. This would require that authority for resource management of all inshore waters is handed down to local government from the central government and that the units of local government are made larger.

- Groups of aquaculturalists can form local associations with an aim to manage the coastal ecosystem for the benefit of sea-farming. These would have to relate to other organized groups, e.g. local fishers' associations, river owners, sport-fishers' associations etc.. If the emphasis is moved from Resource Management to Eco-Development the objectives of all such groups should be coinciding. Such mutually disciplining aquaculturalist would have to refrain from imposing externalities on each other, i.e. internalize their externalities. They could also be an organizational base for completely new and environmentally more sound sea-farming systems - comprising whole fjord-basins, archipelagos etc. Already small groups of smallholder aquaculturalists are co-operating in a small way by utilizing each others licences to keep the different age-sets of fish apart. Further development along these lines would again require an abolishment of the government's individual aquaculture licence and a break-up of the top-down organized Norwegian Aquaculture Association.

We shall not go further into a discussion of which of these approaches are most feasible or most in line with a paradigm of Eco-Development, usually the approach that is considered the least feasible is the approach that everybody really wants !

Instead we shall see what possibilities for environmental management the current situation holds , where banks and other finance institutions are governing the development of Norwegian Aquaculture.

Recent changes in international banking and development of new lending instruments.

Norwegian banks are today trying to heal their wounds after their losses in the late 1980s and in 1990/91. From aquaculture alone Norwegian banks lost NOK 300 mill, in 1990. Among the most important causes for these heavy losses were the scramble for market shares in the mid-eighties following government deregulation of the finance markets in the

beginning of the 1980s (Reve 1990). Much of the losses are due to poor credit scrutiny of individual projects, but the magnitude of losses are also due to inability to see the cumulative consequences of a number of similar lending operations. The competition between banks has its own logic and makes them sometimes behave like a run of sheep - all going in the same direction at the same time. However, failures are expensive for banks, who as fallible learners are more likely to cooperate with other banks in the next round (Axelrod 1984) - and to have assurances that they can trust the client is doing her best to avoid bankruptcy (Runge 1986).

Having learned their lessons, are the Norwegian banks engaged in aquaculture likely to take on greater responsibility for the environmental effects of the aquacultural activities they finance - or are they likely to revert to more classical approaches of individual responsibility coupled with government responsibility for environmental health ?
My hypothesis here is that with further deregulation and internationalization, finance institutions (banks and insurance companies) will increasingly be forced to monitor both the international market for farmed fish and the local ecosystems of sea-farming. This is a logical consequence both of "economizing ecology" and "ecologizing the economy" so that in competition between banks, those will survive in the long run who are able to use solid environmental insights in their credit scrutinies.

There are many facts to substantiate such an hypothesis. One is the vacuum that is created after the failures of environmental management by organized interest and government. Another is the new lending instruments that are being developed internationally by leading banks - notably by the World Bank:

On the local level the World Bank is developing adjustment lending as a strategy to adjust farming or other environmentally related activities to more sustainable ones. In "Hybrid lending" a rapid disbursement part will usually have a clause requiring the practioneer to shift to more environmentally sustainable practices immediately, while an investment part is designed to sustain long term institution-building. Adjustment lending can also assume environmental adjustment plans on the community level (World Bank 1990)
The World Bank is also aware that the effects of "structural adjustment" on environment can be difficult to generalize and that substantial multidisciplinary effort is necessary to understand the chain of causality. Such adjustment lending might be inappropriate instruments when implementing complex institutional reforms that require many years of close

monitoring. Still the bank sees it as a clear banking responsibility to support the design of viable social institutions for sustainable development.

In larger projects with significant environmental impacts, the world Bank now demands Environmental Assessments. The main objective is to encourage the borrower to develop environmental capabilities and institutions, but the bank makes its own assessment and will demand that environmentally preventive steps are incorporated into the project design. It is also part of banking policy to monitor the environmental effects of projects closely - with a clear objective to avoid heavy losses and damage to the bank's reputation. This way of designing lending instruments has most of its ideas in common with the Environmental Protection paradigm, but the fact that finance institutions are forced to start thinking this way is a long step towards ecologizing the economy - or Eco-Development.

Transferred to the North-Norwegian setting of small struggling banks and troubled aquaculture, it should now be obvious that there is diminishing basis for any trust banks might have had in the ability of government regulations to provide for a healthy coastal ecosystem. It is therefore reason to believe that the new "environmental lending instruments" now being developed in international banking headquarters will be highly interesting for smaller banks directly involved in financing resource based activities. How the banks are able to utilize this kind of new lending instruments remains, however, to be seen.

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