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THE COASTAL PRODUCTIVITY AND MARICULTURE ACTIVITIES IN TURKEY

TÜRKİYE'NİN KIYI VERİMLİLİĞİ VE DENİZ AKUAKÜLTÜR AKTİVİTESİ

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Key words: Turkish coastal regions, the Black Sea, the Marmara Sea, the Aegean Sea, the Mediterrenean Sea.

Abstract

The Turkish coastal regions where the edge of the seaward continental shelf lies at around the 200 m depth contour constituting a small portion of the sea that over 90 percent of the catch are taken.

In these coastal regions several major distinct biogeographical regions can be identified such as the Black Sea, The Sea of Marmara, The Aegean and The Mediterranean coastal regions.

This is the result of a combination of factors including primarily the influence of the warm, saline waters of the Mediterranean Sea and the relatively cool, less saline rich nutrient water of the Black Sea.

The Turkish Black Sea coastal region has generally narrow continental shelf with a large fresh water input increase the productivity of the area where 80 percent of the coastal shelf annual catch are taken compare with the Mediterranean Sea where the continental shelf and fresh water input are narrow and small respectively where the catch represent about only 4 percent of the total annual catch.

The Sea of Marmara coastal region is a mixing area between these two different seas and represent about 12 percent of the total annual catch.

The increasing demand on living resources is growing recognition of the potential of mariculture with a certain limitations in the coastal regions of Turkey.

This paper attempts to collect existing data to prepare a country report on this subject.

Introduction

Human activities are often concentrated in coastal regions which are often least able to assimilate those activities and where adverse effects are most apparent (Caddy, 1993; Stanners and Bourdeau, 1995).

Therefore, the most of the marine pollution problems lie in the coastal zone, where sewage and industrial wastes are discharged and various developments are changing the configuration of the coastline (Waldichuk, 1974).

Coastal regions are very productive in respect to the open sea and produces about 90 percent of the world catch has only about 10 percent of the total surface area of the world oceans. In addition, the biomass of benthic animals decreases with depth. In the productive shallow seas it can be up to 5500 g/m^2 of benthic biomass. Over the continental shelf this value is around 200 g/m^2 (Cunningham *et al.*, 1985).

Coastal zones are relatively fragile ecosystems and disordered urbanization and development of infrastructure, alone or in combination with uncoordinated industrial, tourism-related, fishing and agricultural activities can lead to rapid degradation of coastal habitats and resources (Odum, 1971).

There is no common or unique definition of what constitutes a coastal zone, but rather a number of complementary definitions, each serving a different purpose. Although it is generally understood what is meant by "the coastal zone" it is difficult to place precise boundaries around it, either landward or seaward. In general, the edge of the continental shelf at around the 200 m. depth contour is regarded as the limit (Stanners and Bourdeau, 1995).

An estimated 200 million of the European population over the total 680 million live within 50 km of coastal area: This number increase and become double in summer during the tourism season.

Coastal management plans need to be designed to solve coastal problems through the achievement of a set of stated sustainability goals which should include the maintenance and improvement of the usefulness of the coastal zone to humankind taking into account its use as habitat for plants and animals (Henningsen, 1991).

The overall goals to integrated coastal zone management need to promote sustainable use and respect the precautionary principles. These principles are the determining human desires for using the coastal zone based on the carrying capacity to meet these desires.

Other more specific goals might relate to particular problems of the individual coastal zones. Goals would have to be set in light of what would be achievable in the short and long terms with the likely monetary and resources available to the responsible authorities.

Piority issues and responsible authorities therefore be clearly defined within each coastal area, identifying those which would give relatively immediate environmental and economic returns and provide the best value for money (Gulland, 1983).

The coastal zone management program provide a watershed basin framework that brings together those government agencies with the authorities necessary to address land use planning, development and restoration issues from an ecosystem perspective. This can help and eliminate costly duplication of effort and provide for better overall watershed management. This most significant benefit is the

maintenance of coastal ecosystem biodiversity and long-term productivity for sustained use.

The Marine Coastal Zones of Turkey

The Turkish marine coastline is. approximately 8333 km long including Islands. This enormous length which includes the Black Sea, the Sea of Marmara, the Aegean and the Mediterranean Seas covers a large variety of geomorphological features, including rocks, cliffs, shingly sandy and muddy shores (Table 1).

The salinity and temperature also show large variability. For example, salinity ranges from almost zero in many river mouths and estuaries with large freshwater input up to sea values of approximately 38 per thousand or even higher in saline Mediterranean lagoons.

Because of the extreme conditions prevailing along the coastal through strong winds, chemical composition of the water, there is a clear zonation of biotopes from the sea landwars and along the Turkish coastline.

This, in combination with climatic geological and geomorphological differences along the Turkish coastline, helps to create a large variety coastal biotopes including seabed communities of macroalgal and seagrasses, mud flats, saltmarshes, dune, scrubs and natural dune woodlands.

In Turkey, the coastal resources have inestimable value to the ecological base as well as to the economy. While one can not put a direct price tag on these natural resources, results from several studies of economic values indicate the potential wealth from the coastal areas. This include a $ 1.3 billion sea food industry, a $ 4.0 billion water transportation industry, in addition to these recreational, swimming, fishing and beach attendance activities involving well over million participants annually.

One has estimated that the value of undeveloped coastal wetland is $ 83.000 an acre. Decisions affecting these resources that are so essential to the environmental economic and social well-being of the people, should be based on the most current, best available information. Prevention is far cheaper than restoration after resources have been damaged (Ketchum, 1972 and Stanners and Bourdean, 1995).

In Turkey, increasing coastal populations and the cumulative effects of their activities are the primary threat to the future health and productivity of coastal ecosystems.

Today, over 10 percent of the total population in winter 25 percent in summer live on about 10 percent of the land are defined as "Coastal Zone". In Turkey, Coastal recreation and truism are growing at impressive rates in many coastal areas, but this growth is given indications that the declining environmental quality conditions.

The Coastal Productivity

In general, the abundance of coastal-dependent species of fish and shellfish have been reduced to low levels by over fishing, habitat loss certain extend, flow alterations and pollution in many areas.

Table 1. The Length of the Coastal Zones(*)

The Coastal Zones	Length (km.)	Percent	Catch (tones) in 1994
The Black Sea	1695	20.0	358018
The Sea of Marmara	927	11.0	39820
The Aegean Sea	2805	34.0	58110
The Mediterranean Sea	1839	22.0	35387
Islands	1067	13.0	-
TOTAL	8333	100.0	491335

(*)Acara A., *et al.*, 1994, Fisheries Economics, Productions, Price Variations State Planning Organization, The Prime Ministry of Turkey (in Turkish).

Increasingly, nature is signaling that coastal ecosystems are being stressed beyond their limits. Habitat loss, over fishing and pollution threaten to diminish drastically the diversity of the marine ecosystems. These incidences have serious impacts on commercial fisheries, tourism and human health or may alter the food webs of coastal ecosystems (Battaglia, 1990).

To mitigate this impacts it is necessary to improve management activities in the coastal regions.

Although the production of a natural stock is defined as the total elaboration of new body substance in a stock in a unit of time irrespective of whether of not it survives to the end of that time (Ricker, 1963), in this paper the total annual catch is taken as the production of the coastal zones in comparison with the commercial production in aquaculture lies in that it shifts fish production from the capture to that of sole ownership production. Thus the overexplotation problems of the common property resource disappear and are replaced by the benefits of sole ownership (Cunningham *et al.*, 1985).

In 1993, the production values for each coastal regions compared in Table 2. Production (total annual catch) decreases from the Black Sea to the Mediterranean Sea in the coastal regions.

The average (total annual catch) production of the commercially important species is 25.9 kg/ha in the Turkish Coastal Sea and it is 56.2 kg/ha in the Black Sea, 52.4

kg/ha in the Sea of Marmara, 11.4 kg/ha in the Aegean Sea and 8.0 kg/ha in the Mediterranean Sea (Acara, 1992, 1994, 1995).

Mariculture in Turkey

In general, aquaculture is the farming of aquatic organisms including fish, mollusks, crustaceans and aquatic plants. It can be either freshwater or marine and is increasingly common throughout the world.

Table 2. Production (total annual catch) in the Black Sea, The Sea of Marmara, the Aegean and the Mediterranean Sea (Kg/Ha)

	Total Area (km^2)	Production (*)	
		Total (Ton)	Kg/Ha
The Black Sea	55000	308939	56.2
The Sea of Marmara	11000	57733	52.4
The Aegean Sea	70000	80296	11.4
The Mediterranean Sea	53000	42289	8.0
TOTAL	189000	489257	25.9

(*)Production (total annual catch) is in 1993

In the world oceans, increase in demand can be met by four main strategies. They are 1. increase fishing effort on under utilized stocks, 2. improve management on existing stocks, 3. the development of aquaculture as an additional source of supplies and 4. improve utilization of supplies from all three previous sources.

Aquaculture can be recognized that the term covers a range of activities as: 1. food production from both fish and other organism, 2. enhancement of natural stocks by artificial recruitment and transplantation, 3. production of sport fish, 4. production of aquatic organisms for research or pet-keeping, 5. a means of recycling organic waste and 6. production of industrial commodities (pearls, drugs) (Cunningham *et al.*., 1985).

In Turkey, mariculture has the potential to supplement fish catches and help offset the declining stocks of some fish species.

In Turkish seas, due to the commercial importance of fisheries resources and the limited regulation of catches in the past, many of the marine fish species of the coastal regions are or have been overexploited. This is reflected in the estimates of fish stocks and the statistical data available in the regions (Table 3). The results show

that accept one or two stocks, nearly all commercial stocks are considered almost fully or over exploited (Acara, 1992).

Mariculture has certain intrinsic advantages, production take place in the vertical water column, facilitating high stocking rates per square meter of surface area. While a well managed cattle farm might produce 0.5-1.0 tones/ha live weight, a figure of 3-5 tones/ha is perfectly feasible in fish farming. Additionally as fish float, they tend to use less energy input for producing motion and skeletal material than land animals (Cunningham *et al.*, 1985, Stanners and Bourdean, 1995).

Being cold blooded, they use less input to maintain body temperature. Partly for these reasons the rate at which fish convert food intake to flesh is generally superior to that of land animals, being perhaps twice as high as for cattle and sheep and one and a half times the rate for pigs and chickens. Such advantages are likely to gain increasing significance as energy-cost elements in feed stuff production costs rise.

Table 3. Production (total annual catch) variability in the Regions (1985-1991)

Regions	Commercial species Coefficient of Variation (SD an % of mean between 1985-91) (*)
The Black Sea	61.8
The Sea of Marmara	67.2
The Aegean Sea	70.8
The Mediterranean Sea	59.3
TOTAL	64.8

(*) Acara, A., 1972, Fisheries Economics, Productions price variations State Planning Organization, The Prime Ministry of Turkey (in Turkish).

Probably the most intensive system is that to raise salmonids in recirculating silo systems with heavy feeding, producing amazing yields of up to 6000 tones/ha in the United States (Ackefors and Rosen, 1979). In Japan, yellow tail farmed intensively yield up to 280 tones/ha while more typically shrimps in tanks produce 2-6 tones/ha and in the United States pond-cage catfish produce 5-6 tones/ha.

Table 4. The Mariculture Activities in Turkish Coastal Seas.

	Total Area (ha)[1]	Number of Cage[2]	Production[3] Total (tones)	Kg/Ha	tones/ha	Wastes[4] (tones)
The Black Sea	0.434	174	435	1.000.000	1.000	435
The Sea of Marmara	-	-	-	-	-	-
The Aegean Sea	8.299	3.310	8.275	1.000.000	1.000	8.275
The Mediterranean Sea	0.025	10	25	1.000.000	1.000	25
TOTAL	8.733	3.494	8.735	1.000.000	1.000	8.735

[1] Mariculture area is in 1994.
[2] Dimension of the cages is 5 m x 5 m x 5 m and the production is 2.5 ton per cage.
[3] Production is in 1994.
[4] Calculated total waste in tones. Conversion factor is taken as 2.0.

In extensive systems yields are typically much lover and often less than 100 kg/ha. Yield figures vary greatly with system from perhaps 1 tone/ha for pond carp to 100 tones/ha for some shellfish culture (Cunningham *et al.*, 1985).

In India, under extensive lake systems yielding 3 tones/ha, trout in Taiwan kept in ponds yields 200 kg/ha while in silos yields are up to 2000 tones/ha.

All these different systems in use throughout the world can be simplified into an analysis under three headings. They are land, labour and energy. These three resources are used in these systems both directly or indirectly (Cunningham *et al.*, 1985, Stanners and Bourdeau, 1995).

In Turkey, the mariculture activities are compared in Table 4. The most commercial mariculture activities are located in the Aegean Sea where about 95 percent of the total are produced.

Table 5. The Average Regional Lagoon Productions in Turkey (1959)

	Total Area (ha)	Total Ton	Production Kg/Ha
The Black Sea	4081	240	58.8
The Sea of Marmara	3454	180	52.1
The Aegean Sea	5150	124	24.0
The Mediterranean Sea	16330	370	22.7
TOTAL	29015	914	31.5

Data from Acara and Gözenalp, 1959, Uyguner and Gözenalp, 1959.

The regional production (total annual catch) of the lagoons in Turkish Seas are compared also in Table 5 and 6.

Table 6. The Average Regional Lagoon Productions in Turkey (1995)

	Total Area (ha)	Coop. Members	Employment Full Time	Part Time	Total	Production Kg/Ha	Kg/Worker
The Black Sea	3139	382	250	15	131.1	41.8	524.4
The Sea of Marmara	2650	102	108	0	12.6	4.8	116.7
The Aegean Sea	19854	1471	1236	103	561.7	28.3	454.4
The Mediterranean Sea	10636	513	506	139	183	17.2	361.7
TOTAL	36279	2468	2100	257	888.4	24.5	42.3

Data from STM Service Technics in Mariculture, 1995.

In Table 5, the production (total annual catch) values of the Turkish lagoons obtained in 1959 compared with the values in 1995. The results show the productivities of lagoons are comparable with the seas. Their productivities decreases from the Black Sea to the Mediterranean Sea.

The Potential of Mariculture and Limitations

Mariculture can lead to euthrophication caused by discharges of fish food materials and fish excrements from fish farms. Up to this evidence for fish farming having brought about changes in the nutrient status and euthrophication of coastal waters is limited and restricted to regions with distinct hydrographic characteristics such as limited circulation and mixing due to the sea current and assimilation systems.

Organic fish farm waste has been shown to cause enrichment of the sediment ecosystem in the immediate vicinity of the operation. Enrichment also causes changes in the physical structure of the sediment some aspects of sediment chemistry and community structure of the benthic macrofauna. The euthrophication effects are localized to within 30 to 40 m. of the fish farm (Gowen, 1990, Northridge and Di Natale, 1991).

The studies show that the sediment ecosystem can recover from the effects of organic fish farm waste, although this can take several years. Large scale deoxygenating of coastal waters as a result of fish farming is taken place in deep insulated bays or inlets (Lieonart, 1993).

There is increasing concern of euthrophication in the Aegean Sea which can be attributed partly to mariculture. However other factors such as tourism and agriculture can be also responsible for euthrophication in these waters.

Totally, 74 lagoons are located along the Turkish Coasts. The brackish water or the mixing water of saline and fresh water makes the most productive the lagoon environments in the Black Sea, The Sea of Marmara, The Aegean and The Mediterranean Seas (Acara and Gözenalp, 1959, Uyguner and Gözenalp, 1959).

The production (total annual catch) is also the higher and the more convenient in a lagoon system than in the marine environment.

In addition, the production (total annual catch) can be increased two or three times conducting valliculture activities that is the farming of aquatic organisms in a brackish water or in a lagoon system. During this extensive valliculture activity, organic fish farm waste that causes enrichment of the lagoon and sediment system can also be controlled effectively.

Summary

Mariculture with conventional capture fisheries combine are considered as a potentially important source to increase supplies of fish in the future.

Maricultural systems can be categorized as intensive, extensive and intermediate or mixed and these types may be usefully compared on a resources used bases.

Producers taking part in mariculture vary widely in type and objectives.

The essential elements in the economic analysis of the individual profit maximizing unit must be analyzed.

Average revenue will be dependent on the nature of the market for the final product. Farmed fish may be sold under a number of different market structures.

Because of the increasing tourism activities and fishing closures in summer the price of capture fish is rising faster than that of other commodities and mariculture production is looking increasingly attractive in Turkey.

Increased production through mariculture after certain level may create environmental impacts.

Mariculture can compete with coastal land-use, for example, by blocking access to recreational or ecologically sensitive areas. Water pollution can have significant impacts on mariculture.

This study indicates the importance of the lagoons as a closed basins for the mariculture activities to able control organic fish farm wastes.

Özet

Yaklaşık 200 m derinlikte kıta sahanlığı sınırına kadar olan bölge balıkçılığın yaklaşık % 90 lık kısmını oluşturanTürk sahil bölgesi tüm deniz alanının çok küçük bir kısmını oluşturmaktadır.

Bu kıyı bölgelerinde Karadeniz, Marmara Denizi, Ege Denizxi ve Akdeniz çok belirgin biyocoğrafik bölgeleri oluşturmaktadır.

Bu, ılık ve tuzlu bir su kütlesi olarak Akdeniz, kısmen soğuk, az tuzlu ve besi elementlerince zengin Karadeniz etkisi ile bir çok faktörün kombinasyonu sonucu ortaya çıkmaktadır.

Karadeniz kıyı bölgesi, kıta sahanlığı dar ve tatlı su girdisi düşük ve yıllık ortalama balıkçılığın ancak % 4 ünü oluşturan Akdeniz ile kıyaslandığında, kıta sahanlığı dar fakat tatlı su girdisinin fazlalığı ile verimliliği yüksek ve yıllık avcılığın % 80 nini oluşturmaktadır.

Marmara Denizi kıyı bölgesi iki farklı denizin karışım bölgesi olarak toplam avcılığın ancak % 12 sini oluşturmaktadır.

Canlı kaynaklara olan ihtiyacın artması Türkiye sahil bölgelerindeki belirli sınırlamaları ile birlikte deniz canlıları kültürüne ilgi arttırmaktadır.

Bu yayında mevcut dataların toplanması ile bu konudaki ülke raporunun oluşturulmasına çalışılmaktdır.

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