The Poseidon Adventure

Case study
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This case was written by Professor Fouad el Ouardighi, ESSEC Business School. It is intended to be used as the basis for class discussion rather than to illustrate either effective or ineffective handling of a management situation. The case was compiled from generalised experience.

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Located not far from Europe, a neighbouring country, Poseidon, has considerable fishery resources. In particular, it has, in the seas of the southern zone, pelagic stocks (including mainly sardines, anchovies, tuna, mackerel and sabre) among the largest in the world. Thus, it is the world's largest exporter of sardines. These are also very famous for their unique taste.

The shores of Poseidon extend on two fronts: one side overlooking the Sea (North), and the other (divided into two areas) overlooking the ocean (central zone and southern zone). The northern zone, which used to be extremely fishy twenty years ago, only caters today for a few landings, for all species (pelagic and benthic cephalopods). The central zone, which in the 1980's, constituted the bulk of national catches, has cut down on a very significant portion of its armament activities, particularly for pelagic species. By contrast, the southern zone, recently put into operation, especially through the

construction of new ports, has provided volumes of pelagic samples growing steadily. However, international experts agree that the capabilities of collection, whilst respecting the conditions for natural regeneration of pelagic stocks (for all species), are now almost attained.

For a long time, the national management of fisheries in Poseidon was led irrationally. Fishing licenses have been issued dubiously, regardless of collection limits that ensure compliance with conditions for regeneration of species. This is particularly true for pelagic species. Moreover, diplomatic initiatives, even political and economic pressures, exercised by certain countries bordering Poseidon, themselves major consumers of fish, who also wanted access to the latter's rich fishing resources led to the conclusion of international fishery agreements scarcely respectful of the ecology of submarine populations. In addition, these agreements effectively reduced the volume of national catches, increased the average price of fish, and thus promoted its under-consumption within the population of Poseidon, which now has 26 253 312 inhabitants. But fish is, alongside with agriculture, a major food resource of the country, breeding being hardly developed.

In recent years, however, a national awareness has led authorities to greater vigilance in managing fisheries. In particular, the Ministry of Fisheries (MOF) is willing to reorganize today the fisheries sector. In this context, several measures have been adopted, namely the freezing of the issuance of fishing licenses, the incentives for owners to modernize their fleet, the construction of modern ports with expanded capacity, and the setting up of a two months annual period of biological rest aiming to limit smaller size catches. The main concern of the Public Authorities of Poseidon concerns the sector of the sardine. It is predominant in the fisheries sector, both in terms of landings (over 800,000 tonnes in 2001), and in terms of staff employed, insofar as it employs in total (directly and indirectly) over 180,000 people. Indeed, five branches absorb national sardines landings: canning industries, fish-meal, fish oil, frozen products and fresh products.

The first branch has been subject to significant developments over the past decade, and it contributes to national exports an average of 1.5 billion poseidimes per year. Its annual

handling capacity is currently around 500,000 tonnes of sardines. However, the production capacity use rate of nearly 50% may be a lower limit of under-use of production factors that are possible for the present production units: it makes sufficient profits in order to maintain them in the industry. On the other hand, an average of 90,000 people are employed within the industry.

The fishmeal branch is also important within the sardine industry. In recent years it has grown out of control, almost anarchic. The finished product obtained after manufacturing process will cater the cattle. The handling capacity of this branch is very important, and is around 1 200,000 tonnes per year. In addition, it employs nearly 60,000 people.

The branch fish oil, like fishmeal, is a by-product coming from the processing of sardines. Its development is recent, but the annual handling capacity of the industry has stabilised over the past two years around 40,000 tonnes of sardines, with a total of 6 100 people employed.

The freezing part is totally export-oriented. Its activities are still limited because of the large investments into the cold chain it requires. The handling capacity of the branch is nearly 32,000 tonnes and 1800 people are employed. This is limited because the activity is capital-intensive.

Finally, the fresh sardines branch, whose product is fully absorbed by domestic demand, is merely limited in its distribution capabilities by the size of the local market. However, the average demand of sardines per head is still low with an average of nearly 5 kilograms per year. This sector is employing around 26,000 people.

The problem regarding the reorganization of the sardine industry is essentially linked to the use of annual raw material catches and the national interests. The objective of MOF aims to encourage the sector to generate a maximum level of added value at the national level. In addition to limits on the processing capacities of different branches, the public authorities want to submit the achievement of this goal to some constraints, namely:
- Preserving otherwise increase the number of people employed in the sector,
- Maintaining if not increase the volume of consumption of fresh sardines,

- Respecting the volume of catches that allows the regeneration of the species in tolerable ecological conditions, so about 800,000 tonnes per year.

1 / The MOF wonder whether there is a plan for an optimal allocation of resources between the various branches of industry. Based on the above information and statistical data following formulate (please justify your answers), a goal-function and the associated constraints likely to characterize accurately the suggested problematic. In addition, solve the program, and analyze the results obtained in the perspective of establishing the optimal allocation plan. Study the impact of a possible decrease in the volume of catches on the optimal solution, and the influence of a variation of the coefficients of the goal function, for which you will evoke possible causes.

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Branch	CANNING			FISH MEAL			FISH OIL			FROZEN			FRESH		
Year	1999	2000	2001	1999	2000	2001	1999	2000	2001	1999	2000	2001	1999	2000	2001
RM	288	300	305	340	330	342	25,67	26,55	27	16,1	16,5	17	4,5*	4,6*	5*
P	2987473	3111951	3163817	4218956	4094869	4243773	314107	324875	330381	211312	216562	223125	1255827	1283734	1395363
AV	1224864	1275900	1197165	970360	941820	976068	34551,82	35736,3	36342	16905	17325	17850	376748	385120	418609
S	85	98,5	90	59,64	58	60	5,8	6	6,1	1,705	1,752	1,8	23,4	23,92	26

* In kilograms per inhabitant

RM: volume of raw material used (in thousands of tonnes of sardines)
P: production (in kilo-Poseidimes)
AV: added value (in kilo-Poseidimes)
S: staff employed (in thousands of employees)

2 / With a view to strengthening the competitiveness of the canning industry, the MOF of Poseidon wishes to use the results obtained previously (1 /) in order to unify the problem of optimal structure of the production chain and the optimal organization of supply in the canning industry. The MOF uses your skills to assist in the implementation of such an organization.

To this end, you are provided with the following matrix indicating distances in kilometers (south-east corner, at the intersection of each row and each column) between the main sardines national landing ports (sources) and the geographical location of the sites of production units of canned sardines (destinations). In the last row, "Required Quantities" is the respective average proportion (in percentage) of the handling capacities of production units operating in each geographical location in relation to the total processing capacity of the branch. In the last column, "Available Quantities", is the relative average importance (in percentage) of supply capacity of sardines for each port compared to the total supply of the branch.

		DESTINATIONS						
		Bacchus	*Minerva*	*Juno*	*Vulcan*	*Aeolus*	*Apollo*	Available quantities
S O U R C E S	*Juno*	172	330	0	324	649	554	**3 %**
	Vulcan	496	654	324	0	320	878	**40 %**
	Chronos	1360	1518	1188	864	544	1807	**38 %**
	Aeolus	821	979	649	320	0	1208	**12 %**
	Aphrodite	711	869	539	215	105	1097	**7 %**
	Required quantities	**17 %**	**38 %**	**30 %**	**7 %**	**5 %**	**3 %**	**100 %**

Following an agreement between ship-owners and canners, the purchase price of sardines is fixed since December 2000 for a period of two years. However, it differs according to the landing port: in the port of Juno, a kilogram of sardines amounts to 1.85 Poseidimes, while it only costs 1.45 Poseidimes in other ports.

In addition, the unit cost of transport is uniform throughout the territory. For example, the delivery of a tonne of sardines under normal conditions (so-called "reefer-insulated" conditions) between Juno and Aeolus would cost 1,000 Poseidimes.

Having designed the digital model associated with this problem by integrating all the necessary data (including the optimal volume assigned to the optimal branch considered), begin by clarifying the principles in determining a workable solution initial baseline. Then, resolve this problem and analyze the sensitivity of the optimal solution to an increase in the price of sardines.