THE PHOSPHATE INDUSTRY IN JORDAN
"Problems and Prospects"

By

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A Thesis
Submitted in Partial Fulfillment
of the Requirements for the Degree
of Master of Business Administration
in the Department of Business Administration
American University of Beirut

August, 1965

THE PHOSPHATE INDUSTRY IN JORDAN

PREFACE

In addition to agriculture, mining is an important base for Jordan's industrial activity. Any progress made in these two fields will, to a large extent, be decisive for future industrial development. Phosphate is the most important mineral exploited in Jordan. Moreover, the phosphate industry in Jordan is on the threshold of a large-scale expansion. Plans have been devised and preparations are underway for quadrupling of volume of production over the next decade.

This study has three purposes. First, it points out and analyzes the most serious problems of the phosphate industry in Jordan, which were found to be marketing problems. Second, the study evaluates various features of the market potential for the expected expansion in production. Third, possibilities for processing Jordan's phosphate are probed in the hope of proving the feasibility of establishing a phosphatic fertilizer industry in the country.

The study is composed of five chapters. By way of introduction, chapter one describes the economic background of Jordan and the history and economic importance of the phosphate industry. Chapter two deals with phosphate production methods, shortcomings of these methods, and possibilities for their modernization. The above three issues are included in chapters three, four, and five respectively.

Other features of the industry deserve careful study. These include managerial, financial, and labour problems. Although concentration on the previous issues is of prior importance, the omission of

these features constitutes a limitation to this research.

Another limitation is the lack of published material. Field rather than library research was of greater help. A number of trips had to be made to Jordan in search for necessary data. Many personal interviews and informal talks were conducted with officials of the phosphate industry. Questionnaires were distributed to those who could not be interviewed. Visits to the underground mines were also helpful.

The writer wishes to express his deep gratitude to his advisor, Professor John Cordell, whose close supervision and essential comments were basic to the preparation of this study. Thanks are also due to the staff members of Jordan Development Board and Jordan Phosphate Mines Company who cooperated in data collection.

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August 4, 1965

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CHAPTER I

INTRODUCTION

Economic and Industrial Background of Jordan

A short historical note. The Kingdom of Jordan emerged as a new state in 1950. Prior to that year the area was organized as the Emirate of Trans-Jordan (East Bank of River Jordan) and the British mandate of Palestine. Trans-Jordan was a political entity founded by the British after the First World War and given to Prince Abdullah, one of the sons of Sherif Hussein of Mecca. At the end of the Palestine War Prince Abdullah decided to annex the Arab part of Palestine naming the newly founded country "The Hashemite Kingdom of Jordan" with himself as King. With the annexation of the Arab part of Palestine and the in-flow of refugees the population of the state of Jordan increased, in 1950, from 350,000 to about 1,160,000.[1] Thus when the Kingdom of Jordan was created its population was more than three times as large as the population of Trans-Jordan although the arable land increased only by one third. The refugees did bring with them, however, small amounts of capital and in many cases, skills and experience which have been basic to the economic growth of the country.

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[1] Jordan Department of Statistics, Statistical Yearbook (Amman: 1951), p. 75.

Economic problems. Since the creation of Jordan in her present constitutional form, maximum possible efforts have been put to promote her economic progress. Yet it is unfortunate that many handicaps have been standing in the way. Most important are the consequences of the Palestine war of 1948. The dramatic influx of refugees, who left both their property and jobs, swelled Jordan's unemployed. The country's established trade and transport routes were severed; Jordan found herself with completely dislocated trade relations and channels after her normal Mediterranean gateway, Haifa, was taken by the Israelis. Furthermore, the enlarged population put an added strain on already poor housing and inadequate public services. The Jordan Government was not in a position to undertake large scale relief operations, and, had foreign aid not been forthcoming, the standard of living of one-third to one-half of the population would have fallen below the subsistence level.[1]

Jordan has been perpetually dependent upon foreign aid because she is predominantly an agricultural country in spite of a perpetual scarcity of rain-fall. Also the birth rate in Jordan is one of the highest in the world (three per cent per year). There has been a shortage of technical knowledge and experience necessary for industrial expansion which could have relieved the problem of unemployment. Thus there has been almost nothing to offset these problems which have led to the economic distress of the country. In fact, out of the present total population of 1,750,000 there are 476,000 refugees who receive a monthly ration equivalent

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[1] International Bank for Reconstruction and Development, The Economic Development of Jordan (Baltimore: Johns Hopkins Press, 1961), p. 5.

to not more than one dollar each. A large part of the non-refugee population exists in a similar or even poorer circumstances.

Limited markets have also restricted Jordan's economic development. The optimal output for a firm often exceeds the needs of the market and consequently the firm must operate well below capacity with consequent under-utilization of capital investment and high costs.

Moreover, Jordan's industry has suffered from shortage of raw materials. Jordan lacks coal, oil, water and power. Agricultural products depend on irregular rain-fall, and some minerals (though abundant in the country) are so inaccessible that their exploitation involves considerable cost.

Industrial prosperity in the last decade. Despite all of these unfavourable factors industrial activity in Jordan has progressed during the past decade. Most Jordanian industry a decade ago merely processed specific agricultural crops. The manufacture of soap, flour and cigarettes are major examples. Other industries were limited in number and were usually restricted to small workshops. Most of these industries depended on manual power and therefore contributed little to the country's national income.

In 1954 there were 421 industrial establishments (employing five or more workers) with an invested capital of only JD 4.3 million and a total of 8200 workers.[1] The per capita consumption of electrical energy--an important barometre of economic development--was 7-10 kilowatt units[2]

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[1] Ibid., pp. 205-206.

[2] Ali J. Dajani, The Industry of Jordan (Amman: The Amman Chamber of Industry, 1965), p. 7.

in 1953.[1]

This picture has changed remarkably. Industrial production now accounts for a gorwing percentage of national income. It is estimated that industry contributes, in relative terms, about twenty per cent of national income or an equivalent of JD 18 million.[2] During the last decade many industrial enterprises grew up or came into existence with a consequent increase in capital investment and employment which accounted for 33,218 workers in 1961.[3] This growth, small as it is compared with that in other countries, represents a commendable progress.

Thus the development of industry in Jordan has changed the pattern of general economic activities to a great extent. In Agriculture the change is dramatized by the increased use of agricultural machinery; approximately 1550 tractors were in use in 1963, compared with 350 in 1952.[4] The total number of industrial firms employing five persons or more rose to 1453 in 1963 compared with 421 in 1954.[5] The 1963 figure includes two modern canning factories and an edible oil refinery. The mining industry is among those showing substantial growth; production of of phosphate tripled over the past decade and it is expected to rise spectacularly in the next five years.

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[1] As a comparison, Jordan's per capital consumption of kilowatt units was only four per cent of Germany's during the same year. See United Nations, Statistical Yearbook, 1959, p. 307.

[2] Dajani, op.cit., p. 8.

[3] Jordan Development Board, A Supplement to the Seven Year Plan (Amman: 1964), p. 3. (Mimeographed).

[4] Dajani, op.cit., p. 9.

[5] Ibid.

Some of these accomplishments were achieved solely by private individuals; others were guided by the Government which confines its guidance to encouragement and protection of industrial enterprises within the framework of a generally free economic system. The Government of Jordan has decreed, however, that certain controls are necessary. These controls include: preservation of foreign exchange, non-duplication of those industries which are capable of supplying local needs, enforcement of the labour compensation law, and determination of prices of manufacture protected by a tariff.[1]

Role of government in industrial prosperity. The Government of Jordan has taken certain measures to encourage industrialization. The first of these measures was the establishment of institutions to provide long-term industrial credit at low rates of interest. Another measure was the participation of the government itself in selected industrial projects. A third measure stipulated granting facilities to industries particularly in the field of taxation. Newly established industries were to be exempted from all customs duties, from all income tax liability for three years and fifty per cent of the income tax liability for an additional three years.[2] In addition to these measures many exchange control regulations were relaxed for foreigners who invest their capital in Jordanian business firms. Foreign investors were given the right to invest and withdraw funds with minimal restrictions.

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[1] Ibid., p. 11.

[2] These measures were enumerated by Professor Paul Klat in his lecture on "The Economy of Jordan" delivered to his students at the American University of Beirut on March 21, 1963.

These measures do not represent the end of the journey for industrial expansion and promotion. There is still much to accomplish in this field. The previous decade has paved the road for the next decade. In spite of limited resources and lack of technical and managerial know-how Jordan hopes to achieve an annual three per cent increase in national income so as to be at least at par with the annual three per cent increase in birth rate. Obviously the growth in national income should be higher than population growth if any rise in the standard of living is envisaged.

History of the Phosphate Industry in Jordan

The discovery of phosphate in Jordan. Phosphate ore is a mineral which was formed as a result of sedimentation of organic matter. Ever since it was discovered a century ago, it has been used as a fertilizer both in its processed and ground form. In addition to its use as a fertilizer, phosphate enters in its purified form into the manufacture of some medicines, detergents, hide colouring and some kinds of iron and steel sheets.

Phosphate was first discovered in Jordan after the outbreak of the First World War during the construction of the Hedjaz Railway Line that connects Jordan with Saudi Arabia. It may be found in many areas in the country but mineable deposits have been found at Russeifa (eight miles to the north of Amman), Salt Road (twelve miles to the west of Amman), and El-Hasa area (170 miles to the south of Amman). For more than fifteen years after the discovery of this mineral in Jordan nobody

seemed to care about its utilization. However, in 1934 a Jordanian entrepreneur, Amin Kawar, obtained a concession for mining phosphate in the Russeifa area. He formed the "Trans-Jordan Phosphate Company" but produced only small amounts because of the primitive mining methods employed. In the 1930's the Palestine War created conditions which forced the Trans-Jordan Phosphate Company to stop operations. The same was true in the period 1939-1945 when the Second World War absorbed the labor force through compulsory military service.

Post-War industry development. Shortly after the war ended the Trans-Jordan Phosphate Company wasliquidated and a new company was founded by Mr. Kawar and others. The new company was named "Jordan Phosphate Mines Company." New by-laws were devised and a total of 250,000 Palestinian Pounds was contributed as the company's paid-in capital.[1]

After its foundation it took the new company about four years to produce phosphate ready for sale. The delay was caused by extensive preparations including the purchase of equipment, the recruitment of experienced engineers and skilled labor and the installation of various facilities at the mines. Moreover, the shortage of sufficient capital and the general economic situation delayed the realization of the company's program. Thus, not until 1951 was the first phosphate exported by this company through the Port of Beirut.[2]

In 1953 the phosphate industry in Jordan experienced another

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[1] At that time equal to £ 250,000 or $ 1,025,000.00.

[2] Local sales of Jordanian phosphate were negligible; all production was for export. Export shipments of phosphate were made through the Port of Beirut until 1954 when the Port of Aqaba, Jordan's only port, was opened.

change. The company monopolizing the extraction of Russeifa phosphate was again liquidated and newly organized as a limited company, but keeping the same name. The capital of the Jordan Phosphate Mines Company was increased to JD one million divided into one million shares. The Government of Jordan encouraged this expansion by reserving one half of the shares for itself and paying for one third. In 1960 the Government held 188,000 shares still unpaid. However, later in that year the government paid for those shares and became one-half owner of the Jordan Phosphate Mines Company (referred to subsequently as JPMC). In 1961 the capital of the company was increased to JD 1,200,000. The Government of Jordan subscribed to this increase and became a majority stockholder with 50.4 per cent ownership.

In 1962 the Jordan Development Board (a government organization) sponsored a study conducted by Parsons Corporation, an American consulting firm, to determine whether it would be economically feasible to extract phosphate from the previously mentioned El-Hasa area. After conducting its study, Parsons concluded that it would be quite profitable to expand mining operations to that area. On this basis, the Jordan Development Board decided to adopt Parsons recommendations. In November, 1963, the Council of Ministers declared that although mining operations were to be expanded to El-Hasa, only one company was to be granted the phosphate mining concession. Thus the JPMC became the prospective nucleus of an enlarged company that would utilize Jordanian phosphate in both Russeifa and El-Hasa. In 1964 the Economist Intelligence Unit, a British consulting

firm, was asked to submit an evaluation of the JPMC after making a study of its production and marketing operations.

Preliminary indications seemed to be in favour of keeping the JPMC as the nucleus of the enlarged company. However on the basis of the Economist Intelligence Unit studies, important radical changes are expected to take place in the phosphate industry in Jordan during the coming two years. Aspects of the industry that would be affected by this change will be considered later in this study.

Economic Importance of the Industry

In a developing country, an expanded and improved agricultural produce is one of the pillars on which the promotion of industry rests. Agricultural products are used as raw materials in many industries. "... in fact unless agriculture does modernize substantially, industrial expansion in most undeveloped countries is likely to be cut short by lack of markets, for the great majority of the population will not have the necessary purchasing power."[1]

Employment and Wages: The phosphate industry in Jordan has contributed to the economic welfare of Jordan in a number of ways. It has alleviated, to some extent, the nation's serious unemployment problem. Both the natural increase in population, about three per cent yearly, and the influx of refugees added to the numbers seeking employment. Few of the refugees have been able to find even seasonal employment, and many

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[1] Eugene Staley, The Future of Underdeveloped Countries (New York: Harper & Brothers, 1954), p. 304.

Jordanians find nothing better than casual or seasonal employment. The phosphate industry has provided a significant number of jobs; the following table shows the labor force employed by the JPMC over the last eight years:

TABLE 1

LABOUR FORCE EMPLOYED IN THE PHOSPHATE INDUSTRY IN JORDAN
(1957-1964)

Year	Workers		Employees		
Dec. 31st	Russeifa	El-Hasa	Russeifa	El-Hasa	Total
1957	1442	-	112	-	1554
1958	1249	-	102	-	1351
1959	1344	-	90	-	1434
1960	1360	-	88	-	1448
1961	1550	81	114	9	1754
1962	1524	119	113	12	1768
1963	950	263	109	27	1349
1964	686	132	107	25	950

Source: Original records of the JPMC

The table reveals a marked decrease in the number of workers employed in the last two years. Large inventories of unsold phosphate at the end of each of these years brought a decline in production and employment. Furthermore, the introduction and installation of modern machinery and equipment eliminated a number of jobs. This decrease should

not continue, however, for the labor force employed in the phosphate industry in Jordan is expected to more than double with the expansion of mining operations to the El-Hasa area.

Compensation of the phosphate workers compares quite favourably with the compensation of other Jordanian workers. An interview with the fifteen workers in one of Russeifa mines revealed that minimum monthly earnings for each workers averaged about JD eighteen. It was not uncommon, however, for some to earn as much as JD twenty-four.[1] This income range is high if compared with average daily wage that is earned by a Jordanian unskilled labourer (JD 0.390).[2]

To compare the labour force of the phosphate industry with that of other industries Table 2 is reproduced. However, an elaborate comparison is difficult to make because data is available only for 1959, the year in which industrial census in Jordan was conducted.

Foreign exchange earnings: In addition to providing job opportunities for many Jordanians, the phosphate industry in Jordan brings the country considerable foreign exchange earnings needed for her industrialization. The gross contribution of phosphate and other industries to the pool of foreign currency is shown in Table 3.

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[1] A Jordanian Dinar is equal to one sterling or $2.80. Throughout this study the Jordanian Dinar will be used as the unit of measurement where applicable.

[2] Jordan Department of Statistics, Statistical Yearbook (Amman: 1962), p. 241.

TABLE 2

LABOUR FORCE EMPLOYED BY THE MANUFACTURING INDUSTRIES IN JORDAN (1959)

Industry	Number of Establishments*	Number Employed
Food manufacturing	1280	4951
Beverages	17	379
Tobacco	6	796
Textiles	103	1345
Clothing, footwear and made-up textiles	3204	6416
Wood and cork manufacturing	23	109
Furniture and fixtures	817	2453
Paper products	14	84
Printing and publishing	39	710
Leather products	35	122
Rubber products	14	51
Chemicals and chemical products	25	224
Non-metallic minerals products	129	1359
Basic metals and metal products	670	2046
Machinery other than electrical	32	294
Electrical machinery	69	185
Vehicle repair and assembly	190	806
Miscellaneous manufacturing	220	738
Total	6887	23,068

Source: Jordan Development Board, The Five-Year Development Plan for Jordan (Amman: 1961), p. 120.

*An establishment is defined here as that which employs one worker or more.

TABLE 3

JORDAN'S EXPORTS IN 1954-1955 and 1960-1964
(Value in '000 J.D.)

	1954	1955	1960	1961	1962	1963	1964
Agriculture and foodstuffs	2135.9	1741.6	2033.2	1961.9	2012.6	2423.9	3234.6
Phosphate	252.2	646.7	1267.04	1484.8	1393.2	1426.7	2357.6
Cement	-	6.4	17.6	6.2	14.3	63.8	52.7
Marble	7.9	11.2	23.2	18.1	23.5	27.3	27.4
Other minerals	11.4	28.5	9.1	2.6	3.4	22.6	24.8
Printing material	2.8	3.0	5.3	8.0	9.0	11.1	13.3
Worked mother of pearl	43.3	32.5	18.5	21.0	26.4	24.6	24.2
All others	181.3	193.6	53.9	55.3	87.2	125.0	95.5

Source: Ahmed As-Suwayti, "Foreign Trade of Jordan," Unpublished Master's Thesis, Department of Business Administration, American University of Beirut, 1965, p. 148.

The table discloses that exports of phosphate declined in 1962 and 1963 but almost doubled in 1964. Difficulties encountered in marketing phosphate explain the decline during those two years. Yugoslavia, for instance, had intended to import 300,000 tons of rock phosphate in 1963, but the foreign exchange difficulties in that country made it impossible for her to import more than half of this amount.[1] The marked rise in

[1] JMPC Tenth Annual Report, 1963, p. 12.

phosphate sales in 1964 resulted from the improvement of economic and commercial relations between Jordan and phosphate-importing countries such as Italy and Turkey.

Examination of the Jordan seven-year plan reveals the expectation that the contribution of the phosphate industry to Jordan's foreign exchange earnings will rise to about four million Dinars by 1970.[1] This will mitigate the country's heavy reliance on foreign aid which now constitutes a high proportion of the government's budget.

In addition to foreign exchange earnings the phosphate industry contributes to Jordan's international position by promoting economic cooperation and commercial exchange between Jordan and other countries such as Yugoslavia, Czechoslovakia, Ceylon, Bulgaria, Turkey and others. General expansion of exports has been made possible through strengthening such relations. Frequent visits to Jordan made by delegates from these countries have widened the scope of international economic relations of Jordan.

Effect on Jordanian agriculture: The phosphate industry in Jordan supplies Jordanian farmers with two kinds of fertilizers. In 1960 the JPMC established a small plant for the manufacture of superphosphate fertilizer. Only an average of 600 tons annually has been produced in recent years,[2] but this justified the establishment of a permanent operation to

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[1] Development Board of Jordan, A Supplement to the Seven-Year Plan, op.cit., p. 5.

[2] JPMC Annual Reports 1960-1964.

supply the country's needs. Previously Jordanian farmers used to pay JD 23 for every ton of imported superphosphate.[1] The writer's informal survey revealed that, on the average, the farmer now pays JD 12.870 for every ton of superphosphate produced locally; this of course results in a saving of foreign exchange. In addition to superphosphate the JPMC produces the crushed phosphate fertilizer known as "Jorphos". This is a by-product of the process of drying wet phosphate. Responsible authorities in the phosphate industry spent a considerable effort in demonstrating the use of this fertilizer to farmers in villages and agricultural areas. Nevertheless Jorphos is used in limited amounts by Jordanian farmers; in fact no statistical data which show this limited extent of use are available.

Indirect benefits: The phosphate industry in Jordan has helped to increase general commercial and economic activity in areas where phosphate is mined. The Russeifa area, where mining first started, was almost without life. Because of mines now located there, the village (also named Russeifa) has grown substantially during the last fifteen years. Clinics and doctors are now located permanently in Russeifa. Similar changes are developing in the El-Hasa area where phosphate mining operations began in 1961. The prospected expansion of the phosphate industry in El-Hasa may transform that area from an arid desert into a region full of activity.

In evaluating the contributions of the phosphate industry to the

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[1] I.B.R.D., op.cit., p. 192.

economy of Jordan, benefits that accrue to the transportation industry deserve some attention. All the trucks in El-Hasa area and the majority of trucks in East Jordan are engaged in carrying phosphate either to the Port of Aqaba or to the Port of Beirut. Thus,this sector of the economy is kept busy and, simultaneously, trucking charges between Aqaba and Amman have been reduced. For, trucks hauling phosphate to Aqaba ship imported goods on their return from Aqaba to Amman at a cost which is usually less than it could have been had they especially travelled to the port to bring these goods.

The phosphate industry in Jordan is expected to remain the major mineral industry in the country. Its contribution to the economic welfare of the state will increase along with its growth. The JPMC will continue to employ the biggest number of workers. And sales of phosphate will bring in the largest foreign exchange that could be brought by a single firm in Jordan.

CHAPTER II

PRODUCTION OF PHOSPHATE

The Production Process

Introduction

Jordan phosphate is a type of marine deposits. One of the hypotheses about its origin claims that it was deposited due to chemical reactions under certain conditions of salinity. Another hypothesis states that through a process of transformation phosphate compounds in animal cells became soluble ammonium phosphate. The ammonium phosphate reacts with calcium carbonate present in the sea water (which was supposedly covering the land) giving insoluble Tri-Calcium Phosphate (TCP) or what is known generally as phosphate.

The phosphate ore in Russeifa is divided into four strata the total thickness of which--from the top of the fourth till to the bottom of the first--is about twenty-five metres. In El-Hasa the ore is divided into three horizons with a total thickness of about seventeen metres. In both of these mining areas the horizons are separated by marl, chert and clay bands.

World production of phosphate rock in all marketable forms has been increasing at an average annual rate of about five per cent since 1952 and attained a level of fifty million tons in 1964.[1] Productive

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[1]United States Department of Interior--Bureau of Mines, Minerals Yearbook (Washington: United States Printing Office, 1964), p. 984.

capacity has increased at least as fast as growth in demand and for the foreseeable future capacity is expected to remain at least adequate to supply all needs.

The United States of America, Morocco and Soviet Russia are by far the largest producers of phosphate. They produce together about eighty per cent of all phosphate rock in the world.[1] In 1964 Jordan produced a little bit more than one per cent of the world production and ranked as the twelfth largest producer in the industry. Although production of Jordanian phosphate for commercial purposes started early in the 1930's it was only after 1953 that relatively large quantities were exported.

Methods of Production

At present major mining operations take place in an area of four square kilometres near Russeifa. Small amounts of phosphate are also produced from El-Hasa area. Usually exploration and prospecting campaigns are conducted before mining starts. The campaigns are summarized by digging deep holes, taking samples, knowing the thickness of phosphate beds and then extracting the rock. In both Russeifa in the north and El-Hasa in the south two methods of extracting phosphate are employed: (1) underground mining methodsand (2) open-pit mining method.

1. Underground mining method: The process of mining through this method consists of two stages: The first, called the "development" stage,

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[1]Food and Agricultural Organizations of the United Nations, Fertilizers (Rome: 1964), p. 11.

begins by drilling main transportation and ventilating adits[1] in the phosphate bed. This operation results in forms of phosphate columns with areas ranging between forty to forty-eight square metres.[2]

The actual extraction of phosphate ore occurs with the second stage, called the "stopping" stage. At this point, iron or wood pillars are placed parallel to the phosphate columns formed in the development stage. These pillars are about eighty centimetres apart and support the upper phosphate beds. Hand methods are then employed although air-driven jackhammers are often used to drill holes for the insertion of explosives which blast down the columns of phosphate.

In the underground mines conveyor belts, in addition to mine cars, are used to haul phosphate to storage sheds outside the mines. Another conveyor belt carries the product from the storage shed to a screen, and a third belt carries the screened phosphate to rotary kilns for drying. The moisture in the final product is reduced from twelve per cent to less than two per cent. Sun-drying yards are used in both Russeifa and El-Hasa but their effectiveness is limited especially in winter. The dried product, ready for sale, is transported either to Beirut or to Aqaba.

2. Open-pit mining: The open-pit mining operations are usually conducted by contractors in the southern part of Russeifa area. This method necessitates the removal of the overburden, a layer of rocky and other non-

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[1] Channels.

[2] Interview with the Technical Director of the JPMC, Dec. 27, 1964.

phosphatic earth, which covers the phosphate ore. After the overburden has been removed by bulldozers phosphatic beds are ready for extraction. After extraction, stones and other impurities are removed by first crushing and then screening the product. The impurities are deposited afterwards in a near-by waste dump. Thus phosphate becomes ready for screening after which it is transferred to rotary dryers or sun-drying yards. The diagrams in Figures one and two illustrate the work flow at Jordan Phosphate Mines Company operations in both Russeifa and El-Hasa.

The cost of this method is proportionate with the thickness of the overburden. Open-pit operations are therefore resorted to if phosphate beds are near to the surface of the ground. What determines its nearness is the ratio of phosphate extracted to the overburden and sterile materials excavated. Figure three shows the structure of phosphate beds in Russeifa open-pit operations.[1]

The total thickness of the four phosphate beds is nine and a half metres while the total thickness of overburden and sterile is fifteen and a half metres. The ratio of phosphate to sterile materials is therefore 1:1.63. Hence the cost of extracting one cubic metre of phosphate is equal to 2.63 multiplied by the cost of excavating one cubic metre. In summary the use of open-pit mining is a function of labor costs, machine costs, and volume of sterile excavation

Although the open-pit mining method can be used up to a certain limit only, it has some merits over the underground mining method. The

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[1]Interview with JPMC open-pit mining engineer, Dec. 26, 1964.

Figure 1

JPMC EL HASA OPERATIO. FLOWSHEET

~~19-63~~

Open-Pits
Raw Product 50,000 MT

Underground
Raw Product 25,000 MT

Screen with
19mm opening

oversize
,000 MT

Waste Dump

undersize
60,000 MT
10% H_2O

water & losses
2000 MT

Sun Drying Yards

58,000 MT
73% BPL
4% H_2O

FINAL PRODU

Figure 1

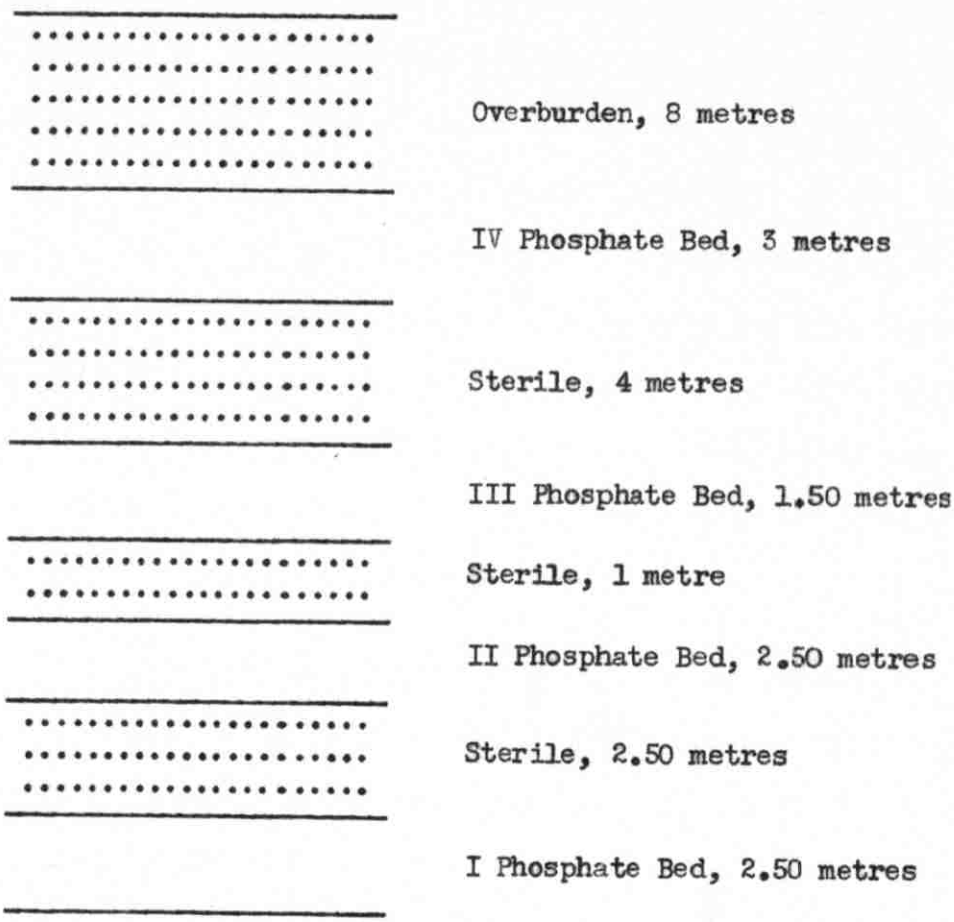

Figure (3)

latter requires a heavier initial investment to obtain the same volume of phosphate. Moreover, the underground method is less flexible than the open-pit operations, If, for instance, a sudden increase in demand arises it is more likely to be met by the open-pit operation rather than by the underground. On the other hand if an opposite situation is faced it is easier and less costly to slacken production in the open-pit mines. To do so in the underground mines costs much in terms of maintenance and other expenses.

Furthermore the kinds of machinery employed in the open-pit mines are developing. New and better equipment for open-pit operations appear every now and then. This gives better chances to improve the efficiency of productivity with the possible reduction of unit costs. Moreover, the margin of safety in the open-pit mines is much higher than in the underground mines. While accidents are very rare in the open-pits, many fatal and non-fatal mishaps occur in the underground minesevery year. However, it has to be remembered that open-pit mining is only feasible if the ratio of phosphate to sterile is 1:3 or less,[1] otherwise the cost of phosphate extraction will become prohibitively high.

3. Evaluation of production methods: In the early stages of mining the company in charge of phosphate extraction knew only one bed of phosphate. It had no previous experience about mining and it did not employ any experts in this field. Thus mining operations were conducted haphazardly without sufficient planning. No studies were made regarding the width of the underground adits or the size of pillars used or any other technical sides of the process of mining. The amount of production turned out was therefore commensurate with the lack of technicality. Although the War years were by no means typical, it is still possible to give an idea about production. The amounts exported during those years are shown in the table below:

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[1] Four cubic metres or less should be excavated to obtain one cubic metre of phosphate.

TABLE 4

EXPORTS OF JORDANIAN PHOSPHATEROCK

1939-1945

Year	Amount	Year	Amount
1939	1 metric ton	1943	5384 metric tons
1940	6 metric tons	1944	5735 metric tons
1941	2 metric tons	1945	4945 metric tons
1942	2819 metric tons		

Source: Merko Lamer, The World Fertilizer Economy (Stanford: Stanford University Press, 1957), p. 307.

With the formation of a new company in 1953 engineers and experts were employed. The contribution of those technicians and the increase in production were not as expected. In 1957, however, the production of phosphate entered a new phase. Early that year the JPMC concluded an agreement with the Yugoslavian Yugometal Company, whereby the latter promised to provide, for a ten-year period, necessary assistance in conducting technical studies by Yugoslavian technicians. Also vital mining equipment for use in both Russeifa and El-Hasa was contributed by Yugoslavia. The Yugometal Company offered to buy large quantities of Jordanian phosphate, thereby relieving the marketing problem. It was on the basis of this agreement that the JPMC obtained a concession to mine phosphate in El-Hasa area.

With the execution of this agreement and with the natural increase in phosphate demand, production started to rise spectacularly. In comparison

with the War period, it is convenient to reproduce in the table below the phosphate rock produced over the last twelve years:

TABLE 5

PRODUCTION OF PHOSPHATE IN JORDAN

1953-1964

(Amounts in metric tons)

Year	Amount	Year	Amount
1953	39500*	1959	337624
1954	74848	1960	391640
1955	163598	1961	444957
1956	208557	1962	681010
1957	261896	1963	615436
1958	293832	1964	603862

Source: JPMC Annual Reports for the Respective Years.

The above amounts represent wet phosphate which contains moisture estimated at ten to twelve per cent. The increase in production as shown in Table 4 was more than proportionate to the increase in production facilities available in 1956. Though this is commendable, mining operations suffer from certain shortcomings some of which are treated in the following section.[1]

[1]Some points are highly technical and therefore deemed by the writer suitable for purely technical studies. Other remarks presented depend basically on the writer's own observations during his visits to the mines and informal talks with technical staff members.

Shortcomings and Improvement of Production Methods

With regard to underground mining these shortcomings could be grouped under the following points:

1. Collapsibility and breakdown: In Russeifa phosphate beds are of the moist type which cannot bear much pressure. Mining operations are carried out on three different levels or floors within a mountain of phosphate. Mobility from one floor to another is possible only through iron ladders. The roofs of the underground adits are supported by boards and pillars which are widely apart. The width of the adits ranges between two and five metres but not enough boards and pillars are installed to support their roofs. This makes it difficult for the boards and pillars to bear the increasing pressure especially when explosives are used in the stopping stage. If, for instance, a phosphate bed is to be blasted down in the second floor the resulting pressure of the explosion frequently causes the collapse of boards and pillarsand the roof of the underground adit below. This collapse would cause the desertion of the mining area with the subsequent loss of its phosphate. In some cases precautions could not be taken and the death or injury of some workers resulted. Moreover the yearly average of reserves lost because of collapses is estimated at 40,000 tons of phosphate while the yearly loss in installations and equipment is estimated at JD 5,000.[1]

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[1] Yusuf an-Nimri, "The Phosphate" (unpublished report, Amman, Ministry of Economy, 1963), p. 15. (Mimeographed).

2. Internal transportation: Transportation within the mines and mining areas is provided by mine cars, rubber conveyor belts, and motorized trucks. Manual methods, however, are used in less accessible areas. Internal transportation represents seven per cent of the cost of production and mining.[1]

The inefficient transportation causes two kinds of losses. The first is the adverse effect upon labour productivity. In Russeifa a team of two workers is assigned two mine cars to load. After loading the workers wait until the mine cars are pulled out of the mine, emptied and sent back for refilling. In addition, the mine cars (which move on rails like trains) cannot reach all parts of the mines because rails do not extend throughout. Therefore, workers transfer phosphate ore to mine cars manually, by one-wheeled carts or rubber baskets, walking on foot thirty to fifty metres.

The second kind of loss relates to the incomplete utilization of internal physical means of transportation. It was claimed that fifty per cent of the efficiency of the 594 mine cars used in Russeifa mines is spent without any real productive work.[2] This increases the cost of fuel and depreciation of engines and machinery. Moreover, it becomes necessary to employ more manpower to cover the inefficiency of carrying phosphate within the mines. This is related to the increase in accidents and in-

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[1] JPMC, Statement of Cost of Production and Mining for the Years 1963 and 1964 (in filesof JPMC).

[2] An-Nimri, op.cit., p. 15.

juries in mines. One of the mining engineers reported that almost fifty per cent of the accidents happen to workers engaged in internal transportation. A prominent example would be the case where the mine cars become loose and rush down to the mine at an accelerated speed. The width of the underground adits is, in some cases, only two metres, so if the workers that happen to be on the way are not warned they may receive fatal injuries.

3. Explosives and ventilation: A special technique is usually followed in using explosives in mines. Mining engineers interviewed by the writer explain that blasts or mines should be distributed by a precise method. Their depth and direction in the rock as well as their quantity should be determined accurately. The use of planned rather than haphazard methods can result in a great increase in production. If carefully planned, the use of one kilogram of explosives may extract ten tons of phosphate. The haphazard method does not yield more than half this amount with the same quantity of explosives.

In Russeifa, jackhammer workers were left to do the job alone. Direct contact with them seemed to prove the claim by the assistant to the Chief of Mining Division in the Jordanian Ministry of Economy that only sixty per cent of the amount of explosives used is really productive. Perhaps this is one of the reasons why the cost of explosives per ton reaches as high as 91.80 fils.[1]

The use of explosives under the surface of the ground makes the

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[1]Salih I. Mahmud, "Jordan Phosphate Mines" (unpublished report, Amman, JPMC, 1964), p. 11 (Mimeographed).

problem of ventilation more important. Workers in Russeifa and El-Hasa mines depend on natural ventilation. In areas where little atmospheric air is naturally available it is transferred through special pipes. However, it could readily be noticed upon going deep in the mines that ventilation conditions are not adequate.

Possibilities for Improvement and Modernization

One of the axioms of modernized industrial concerns is to increase productivity and decrease cost of production as much as possible. For such purposes the Jordan Phosphate Mines Company has acquired two thousand metres of conveyor belts, compressors and a fully equipped crushing plant. The JPMC is now operating two rotary drying kilns and a Jorphos plant. A beneficiation plant has been set up and mechanical loading equipment has been installed in the ports of export.

Underground mines: Nevertheless, it would be an exaggeration to consider this to be a mechanized process. In Russeifa and El-Hasa handwork still prevails. Instead of loading mine cars by manual methods for example, a machine such as"Emco 21" could serve the purpose. Emco 21 is a bulldozer that can be employed in an underground adit of only two metres in width. The foreman who suggested the use of this machine said, "... It can load three tons of phosphate a minute and can reach places that conveyor belts cannot. Its price is about JD 800 and its productivity is equal to that of fifty workers. Besides it does not need more than two workers to operate."[1]

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[1]This is a translation of an answer given in Arabic to a related question included in a questionnaire prepared by the writer.

Conveyor belts were installed in order to decrease the cost of labor. These objectives hardly materialized because the conveyor belts were acquired without any spare parts or other accessories which are necessary in the event of breakdown. Stoppage of work has been frequent and the resulting increase in productivity could hardly balance with the increase in mining cost as a result of maintenance and depreciation of the belts. Thus the necessity of acquiring spare parts and accessories usable with the conveyor belts is apparent if full utilization of their use is expected.

Another point deals with the kind of pillarsand supporters used in the underground mines. Presently used supporters consume high maintenance and labour costs. However, in Morocco "Hydraulic Supporters" are used in similar underground mines and under similar working conditions.[1] A unit of these supporters can be undone and constructed in a matter of twenty minutes. In comparison, it takes at least one hour to do the same with Russeifa or El-Hasa supporters under the best working conditions and with four workers engaged.

A fourth point, considered one of the criteria of modern underground mines, is a good system of ventilation. In order to make working conditions more pleasant it is necessary to prepare a detailed study to determine the quantity of air necessary inside the minesand the speed of ventilation current in areas where operations are carried out.

Lighting is as important as ventilation. It has a direct bearing on the rate of production because without light any activity inside the mines would not be possible. In both Russeifa and El-Hasa mines a better

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[1]Mining Journal (London). "Morocco's Phosphate Industry Expands," V. 254, No. 6583, Aug. 1961, p. 4381.

lighting net should be installed in the principal underground adits. This is in addition to supplying workers with a sufficient number of electric torches to be used when the lighting system is hindered or where it is not possible to extend the lighting net.

Open-pit mines: For open-pit mines some improvements could be suggested. Excavators are a major type of capital equipment employed in the open-pit mines; and one of the difficulties met is the need to throw away excavated overburden and sterile materials. At present this is done by trucks. However it is possible to introduce a new machine called "Drag Line Excavator"[1] which is especially suited for soils and rocks. The distinguishable benefit of this machine is its seventy-feet long jib that throws away the excavated rocks and soils saving the trouble of carrying them by lorries.

Since explosives are essential for open-pit operations, lowering their cowt results in lowering the cost of mining. At present gelatine is used as an ingredient in explosives and the cost per ton of gelatine c.i.f. port of Aqaba is JD 130.[2] However, Ammonium Nitrate can well be used to replace gelatine. "What makes Ammonium Nitrate so attractive is its low cost per ton (JD 35) compared to gelatine. But to be able to use it a machine called a "Blast-layer Excavator" must be acquired. This machine drills holes for blasts or mines and fills them with the necessary amount of Ammonium Nitrate."[3] The purchase of the required number of units of this machine, after necessary experiments are conducted to prove its

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[1] Name of machine suggested by the open-pit mining engineer.

[2] An-Nimri, op.cit., p. 19.

[3] Ibid.

effectiveness, may prove to be quite rewarding.

Qualitative Description, Reserves, and Cost Analysis

Qualitative Description

There are three principal types of Jordanian phosphate. The first is described as "higher grade phosphate." It is white to pinkish or yellowish, composed of tiny chalky nodules and mixed with fossil fragments. It is a major type and is commonly known as"phosphorite" or the phosphate rock of commerce.[1] It differs from the "lower grade phosphate" which is harder and much like a limestone. The impurity mixed with the latter is chiefly a fine-grained silica which replaces part of the phosphate. Both of these types are presently mined from Russeifa and El-Hasa. The third brand is greenish in color and represents a greenish crystalline limestone. It occurs in the Salt Road, about nineteen kilometres to the west of Amman.[2] However it is not being utilized mainly because reserves proven are not very sizable.

Generally, Jordan's phosphate deposits are of fairly good quality, on a par with the best marketed brands such as Floridon or Moroccan phosphate. The quality of phosphate rock is determined by its content of Tri-Calcium Phosphate (TCP), or, as alternatively called, Bone Phosphate of Lime (BPL). Virtually prices quoted depend on the TCP content, because the higher it is, the more soluble the fertilizer will be in the soil.[3]

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[1] International Bank for Reconstruction and Development, op.cit., p. 184.

[2] Ibid.

[3] However, the kind of soil counts in this respect. The Salt Road deposit was proved to contain eighty-three per cent TCP; yet this rock was found to be insoluble in the citric acid solution, a fact that limits its marketability.

This makes easy the analysis of the fertilizer to its nutritive elements absorbable by plant roots. The TCP content is normally expressed in percentage form. The lowest TCP content in the phosphate ore is around forty-five per cent while the highest may reach as high as ninety per cent.[1] Normally, accepted and marketed phosphate contains at least sixty-two per cent TCP. The best seller has a TCP content that ranges between seventy-five to eighty-eight per cent.[2] But phosphate types with seventy to seventy-five per cent TCP are much on demand because they are suitable for normal super-phosphate fertilizers, the most usable fertilizers.

In Russeifa mines the average TCP content is seventy-two per cent. The high-grade Russeifa phosphate contains seventy-three to seventy-four per cent TCP, but it is possible to up-grade this content to seventy-five per cent TCP. The low-grade phosphate in Russeifa contains fifty-eight to sixty-per cent TCP.[3] Since it cannot be marketed in this form, a beneficiation plant was set up in the middle fifties in order to up-grade this brand to sixty-nine per cent TCP.

The El-Hasa phosphate was confirmed to be of a higher quality than that of Russeifa. Although low-grade phosphate is also available it is not being mined because no beneficiation plant has yet been constructed in El-Hasa. The TCP content of El-Hasa high-grade phosphate ranges between

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[1] Mirko Lamer, The World Fertilizer Economy (Stanford: Stanford University Press, 1957), p. 43.

[2] Ibid.

[3] The Jordan Phosphate Mines Company, A Pamphlet Distributed at the Industrial and Agricultural Fair, Amman, 1961, p. 4.

seventy-two and eighty-three per cent.[1] Such a high quality implies better marketability and is expected to shift major mining operations from Russeifa to El-Hasa. The prospected amount of production, as set in the following table by the mining department of the Jordan Ministry of Economy, emphasizes this tendency.

TABLE 6

FORECAST OF JORDAN PHOSPHATE PRODUCTION
1965-1970
(Amounts in Metric Tons)

Year	El-Hasa	Russeifa	Total
1965	140,000	700,000	840,000
1966	400,000	500,000	900,000
1967	600,000	400,000	1,000,000
1968	800,000	300,000	1,100,000
1969	900,000	250,000	1,150,000
1970	1,000,000	200,000	1,200,000

Source: An-Nimri, op.cit., p. 21

Another factor encouraging this drastic diversion is the saving in transportation cost. Since El-Hasa is much nearer to Aqaba Port than Russeifa, it is more economical to produce from that area amounts exported from Aqaba and to produce from Russeifa amounts exported from Beirut.

[1] Ibid.

Phosphate Reserves

Phosphate reserves are described below according to the area in which they are located. In Russeifa there are six such areas or fields namely: (1) RasEl-Ain Mine, (2) North Mine, (3) South Mine, (4) Greater South Area, (5) Zerqa area (divided into two fields: A and B, (6) Awijan field.

The first four fields are included in the mining and surface lease of the Jordan Phosphate MinesCompany. The Zerqa and Awijan fieldshave not been considered for mining but some prospecting works were conducted there in 1962. Because the biggest proven phosphate reserves are situated in these two fields they should be thoroughly prospected and alloted deep concern.

Phosphate reserves calculated as of December 31, 1962 are shown in Table 7.

The figures in Table 7 are geological reserves; the losses involved in the extraction process should be deducted in order to obtain industrial reserves. Moreover, it is noticed that the third phosphate bed in RasEl-Ain Mine, North Mine and South Mine is neglected because it is not suitable for underground mining method, the only method applied in those fields.

The Greater South Area figures represent reserves for open-pit mining and therefore all four beds are included. The ratio of raw phosphate to sterile in that field is 1:2.4[1] which means that for one cubic

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[1]Interview with the open-pit mining engineer, December 26, 1964.

TABLE 7

PHOSPHATE RESERVES IN RUSSEIFA AREA AS OF DECEMBER 31, 1962

Ras El-Ain Mine

Phosphate Bed	Raw Tons	Screened Tons	TCP%
IV	257,000	180,000	72.0
II	745,000	520,000	71.0
I	584,000	350,000	72.0
Total	1,584,000	1,050,000	71.5

North Mine

Phosphate Bed	Raw Tons	Screened Tons	TCP%
IV	1,315,000	922,000	73.2
II	3,137,000	2,194,000	72.1
I	2,228,000	1,334,000	72.0
Total	6,680,000	4,450,000	72.4

South Mine

Phosphate Bed	Raw Tons	Screened Tons	TCP%
II	75,000	40,000	69.0
I	460,000	320,000	72.0
Total	535,000	360,000	71.6

Greater South Area

Phosphate Bed	Raw Tons	Screened Tons	TCP%
IV	3,013,000	2,100,000	67.2
III	3,571,000	2,500,000	65.0
II	8,517,000	4,266,000	65.0
I	9,974,000	6,480,000	71.2
Total	25,075,000	15,340,000	68.0

Zerqa, Field A

Phosphate Bed	Raw Tons	Screened Tons	TCP%
IV	2,000,000	1,600,000	63.2
III	2,300,000	1,600,000	68.1
II	5,060,000	2,020,000	60.0
I	8,540,000	5,780,000	74.4
Total	17,900,000	11,200,000	69.4

Zerqa, Field B

Phosphate Bed	Raw Tons	Screened Tons	TCP%
IV	16,135,000	12,900,000	74.4
III	8,975,000	6,280,000	60.0
II	19,090,000	7,630,000	68.0
I	31,800,000	22,190,000	64.0
Total	75,900,000	60,000,000	68.5

Source: "Survey of the Russeifa Area" Prepared by the Technical Department of JPMC (Amman, 1963), p. 3. (Mimeographed.)

metre of wet phosphate 3.4 cubic metres should be excavated. The Greater South Area was thoroughly prospected since the beginning of open-pit operations. Reserves for open-pit mining are as noted from the tabulated figures on the previous page, 25,075,000 Raw Tons, and 15,340,000 Screened Tons with an average TCP content of sixty-eight per cent.

As for Zerqa Area, Field A is a direct extension of the Greater South Area and the major part of Field B is occupied by factories. Reserves in Awijan area are roughly estimated at one million tons of raw phosphate with TCP content ranging between seventy to seventy-one per cent.[1]

In summary, reserves of the Russeifa area are presented in Table 8.

TABLE 8

SUMMARY OF PHOSPHATE RESERVES IN RUSSEIFA AREA
1963

I	Visible Ore	Raw Tons	Screened Tons	TCP %
	Underground	8,801,000	5,860,000	71.9
	Open-pit	25,075,000	15,340,000	68.2
	Total	33,075,000	21,200,000	70.0
II	Probable Ore	Raw Tons	Screened Tons	TCP %
	Zerqa	93,800,000	60,000,000	68.5
III	Possible Ore	Raw Tons	Screened Tons	TCP %
	Awijan	1,000,000	600,000	70.0
GRAND TOTAL		128,676,000	81,800,000	72.4

Source: Table 6.

[1] Survey of the Russeifa Area Prepared by the Technical Department of JPMC (Amman, 1963), p. 4. (Mimeographed).

Russeifa is only one of three major areas in Jordan where phosphate reserves have been proven. Exploration campaigns disclosed that proven El-Hasa reserves are estimated at 30,000,000 tons. This estimate does not include the five million ton reserves which lies in the area under the concession of JPMC.[1] The Salt Road deposit has not yet been prospected as to determine the estimate of itsreserves. In view of the high TCP content an exploration program should be devised in order to determine extent of reserves and thickness and grade of its phosphate ore.

Cost Analysis

Though it is not normally easy for a researcher to obtain cost data it has been possible to reach at figures which serve the purpose of the present study. Cost analysis serves as a means of control as well as price determination.

Since phosphate is produced by more than one method it may be convenient to analyze cost elements by methods of production.

1. Underground mining method: In the underground mines the cost of mining varies with the stage in which phosphate ore is mined. On the average the cost of a ton of phosphate produced in the "developing" stage consists of the following elements:[2]

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[1] An-Nimri, op.cit., p. 1.

[2] Salih I. Mahmud, op.cit., p. 18.

Element of Cost	Amount in fils per ton*
Cost of drilling	12.00
Cost of compressed air	30.00
Internal transportation	30.00
Cost of labor	233.00
Cost of explosives	91.80
Total	396.80
Indirect cost and administrative expenses at mines (10% of the above)	39.68
Track-laying and supplies	100.00
Overhead expenses	83.30
Miscellaneous expenses	41.70
Total cost of mining per ton	661.48 fils

A ton of phosphate produced in the "stopping" stage would cost more. The elements of cost however, are less in number and they rank as follows:

Element of Cost	Amount in fils per ton
Cost of labor	330.00
Technical supervision	100.00
Internal transportation	100.00
Cost of explosives	74.30
Miscellaneous expenses	80.00
Total cost of mining per ton	684.30 fils

* A Jordanian dinar is divided into 1000 fils.

These figures were calculated on the basis of experience in the mines for a number of years. Great care was manifested in allocating quantitative evaluations that resulted in figuresrounded up to the minimum possible fraction of a fils. For instance the cost of explosives above (74.30 fils) was obtained in the following manner: an extraction of a ton of phosphate consumes, on the average, the following explosive materials:[1]

1.	Gelatine 0.322 kg.	@ 438 fils per kg.	=	45.08 fils
2.	Capsules 1.9	@ 4 fils per capsul	=	7.60 fils
3.	Fuse 2.2 metres	@ 7 fils per metre	=	15.40 fils
4.	Steel and wooden supplies			6.22 fils
	Total			74.30 fils

It has been a common experience in Russeifa and El-Hasa to consider administrative expenses at the mines as ten per cent of the major five cost elements. As noticed from the above figures some cost elements of developing stage were not mentioned in the mining cost of phosphate extracted in the stopping stage. The reason is that once the cost element is considered in the former it does not arise in the latter. A good example will be the cost of drilling and track-laying.

The above costs are f.o.b. underground mines. The cost of transportation to ports of export (which will be considered later and which sometimes exceeds double the cost of mining) is not included. Also not included are the costs of preparing the phosphate rock for exportation.

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[1] Ibid., p. 19.

In addition to indirect costs these comprise cost of screening, drying, up-grading, and depreciation.

2. Open-pit mining: It is convenient to figure out now the corresponding cost of mining phosphate by the open-pit mining method. The elements of cost involved here are different from what has just been set forth. The reason is two-fold: in the first place, open-pit mining operations are conducted by contractors employed by the Jordan Phosphate Mines Company. In the second place, mining operations involved in this method differ basically from those of the underground method. Thus cost elements in the open-pit mines include:[1]

1. Amounts paid to contractors, each per his contract.
2. Technical supervision of contractors.
3. Managerial expenses
4. Depreciation of assets used
5. Other indirect costs.

Although the cost allocated to each of the above elements is not available, it is still possible to calculate the cost per ton of open-pit mined ore. The overall cost of open-pit mining operations and the amount of production at the open-pit mines are known. In 1964, for instance, the latter figure was 372,787 tons.[2] The total cost of this quantity

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[1] An-Nimri, op.cit., p. 11.

[2] Mahmud Hawamdeh, "Annual Report of the Technical Department of the JPMC" (Amman: 1964), p. 3. (Mimeographed).

has been calculated as JD 215,289.918.[1] By simple division the cost per ton f.o.b. open-pit mines would be JD 0.577.

Cost of final product at mines: The cost of preparing phosphate for shipment to ports will now be considered. Elements of cost involved in this process are shown in Table 9.

To calculate the cost of phosphate as a final product the amount of phosphate rock produced should be matched against the corresponding portion of the total cost of production and mining. Therefore, from this figure, the cost of superphosphate and Jorphos should be deduced. Table 5 shows that in 1963 production of phosphate was 615,436 tons. The net cost of production and mining of this quantity (after deducting cost of superphosphate and Jorphos, Table 9) amounts to JD 788,036.708. In other words the cost of phosphate as a final product amounted in 1963 to JD 1.281 per ton.[2] In 1964 this figure (calculated by the same procedure) was JD 1.210 per ton.

It might be interesting to compare these most up-to-date unit costs with costs incurred ten years earlier. In 1955 the per ton cost of production and mining at Russeifa was as follows:[3]

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[1]With reference to table 5 and 9 calculations go like this:

Cost of underground and open-pit mining (table 9)	JD 398,422.393	
Total production in 1964 (table 5)	603862	tons
Less: open-pit mines product	372787	tons
underground mines product	231075	tons

On page 20 of the above report it is mentioned that the cost per ton in the underground mines is JD 0.793.

Cost of underground production: 0.793 x 231075 = JD 183142.475
Cost of open-pit mined phosphate JD 215289.918

[2]This figure includes the cost of mining (previously dealt with) in addition to the cost of preparing the product for sale.

[3]International Bank for Reconstruction and Development, op.cit., p. 190.

TABLE 9

JORDAN PHOSPHATE MINES COMPANY COST OF PRODUCTION AND MINING FOR THE YEARS 1963-1964

Cost Item	1963	1964
Direct Cost:	JD	JD
Underground & Open-pit costs at Russeifa	438477.384	360495.235
Underground & Open-pit costs at El-Hasa	37623.922	37927.158
Cost of Superphosphate production	8075.300	14609.653
Cost of Jorphus Production	19136.667	13709.278
Cost of Low-grade Phosphate Production	17264.000	-
Cost of Crushing and Screening	12227.216	16093.484
Drying by Kilns	36730.065	57657.476
Cost of Sun-drying Yards	60.170	2200.060
Beneficiation Plant Costs	3591.613	4950.089
Internal Transport by Car s	36610.532	31788.109
Internal Transport by Conveyor Belts	19682.680	27165.872
Total Directo Costs	629480.493	568453.300
Indirect Cost:		
Cost of Surveying	5058.961	5426.445
Laboratory Cost	3304.087	3228.840
Geological Costs	3196.615	56.995
General Administrative Expenses of Mines	24293.454	28826.114
Health Services and Laborer's Insurance Fees	7261.735	6785.623
Total Indirect Costs	43114.872	44324.017
Depreciation Expenses:		
Trucks and Cars	26212.813	23622.076
Machinery and Equipment	51636.759	52649.731
Rails, Wagons and Decouvilles	3158.489	4602.899
Water Pressure and Pipe Lines	459.133	534.719
Electric Lines	195.312	231.324
Buildings and Roads	29109.079	32348.161
Capital Investment	18876.901	23139.868
Mining Tools	11034.838	7887.857
Total Depreciation Costs	42633.310	145916.634
GRAND TOTAL	815248.675	758694.381

Source: Final Reports of the Accounting Department of the JPMC for the Two Years involved (in files of the Department).

Cost Item	JD per ton
Direct cost	0.402
Works overhead[1]	0.733
Office overhead[2]	0.271
Total	1.406

Cost calculations for 1963 and 1964 show that there has been a saving in the cost of production and mining, in favour of 1964, amounting to seventy-one fils per ton. If multiplied by tons produced in 1964, the total saving would be JD 42,874.202. In comparison with 1955 figures the improvement has apparently resulted in greater cost savings.

Distribution overhead and operating costs: The JPMC sells phosphate f.o.b. ports of export. Since these ports are away from mines, transportation costs pose a big problem. Calculations based on Appendix 1 revealed that the distribution overhead (including transportation to, and handling product at ports) were JD 1.424 per ton in 1963 and JD 1.527 per ton in 1964.

Operating cost per ton for the two years under consideration was JD 257 in 1963 and JD 0.240 in 1964.[3] The three major categories of cost would then be summarized as follows:

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[1]Includes direct labor, materials, explosives, lighting, etc.

[2]Includes mine management, salaries and depreciation.

[3]JPMC, "Statement of operation costs for the years 1963 and 1964" (files of the Accounting Department).

		1963		1964
Production and mining	JD	1.281	JD	1.210
Distribution overhead		1.424		1.527
Operating cost		0.257		0.240
Total cost per ton		2.962		2.977

Concluding remarks: In the light of the preceding analysis the cost of producing Jordanian phosphate can be evaluated. This evaluation could have been more precise if cost data in other phosphate producing countries had been available.[1] However, the general impression, among those concerned about the phosphate industry in Jordan, is that cost figures are relatively high. This results in higher prices; in fact it will be shown later that prices of Jordanian phosphate are among the highest in the world.

The reason for high cost figures is the distribution overhead, mainly transportation cost. However, future expectations are brighter. The implementation of the new Jordanian-Lebanese trade agreement, concluded in April 1965, lowers distribution overhead costs[2] incurred on phosphate handled in the Lebanese territory. The same thing is expected to take place in Syria. Moreover, if the JPMC chooses the alternative of producing from El-Hasa amounts shipped through Aqaba, and cutting production from Russeifa to amounts shipped through Beirut, transportation costs become much lower. Consequently overall unit cost will be reduced remarkably.

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[1] This is a limitation which the writer is painfully aware of.

[2] In addition to lower freight rates, the agreement provides for lower handling costs at the port of Beirut.

CHAPTER III

MARKETING PROBLEMS OF PHOSPHATE

Present Marketing Organization

Introduction

Marketing of phosphate rock on the world market is a very complex operation. "... it requires people skilled and experienced not only in salesmanship but also in barter deals, foreign exchange, trade discounts, product quality, import regulations, trade balances, shipping costs and practices... and many other facets of the operation."[1] Jordanian phosphate marketing suffers from problems that relate to most of these facets. This chapter is devoted to the survey, analysis, and solution of the major problems. Prior to the treatment of these problems it is convenient to give a brief description of the present marketing organization of Jordanian phosphate.

JPMC Marketing Activities

Marketing activities of Jordanian phosphate are in charge of the commercial director of the Jordan Phosphate Mines Company. These activities include selling of phosphate, purchasing and assuring the availability of supplies, storing and issuing these supplies, planning the transport of

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[1] "Markets for Jordan Phosphate Rock, Prepared by Stanford Research Institute" (Menlo Park, California, 1963), p. 68. (Mimeographed).

phosphate to ports of exportation, handling phosphate at the ports, and loading it on board ships.

There were eight staff members in the JPMC commercial department in 1964. The sales division of the JPMC is headed by a sales manager who is the commercial director. He is helped by a few sales and shipping clerks.

Almost all phosphate produced is prepared for shipment outside Jordan because local sales are negligible. If a sale is to be made locally it is effected through direct contact with buyers or, occasionally, through retail outlets which handle agricultural equipment.

Foreign sales policy: Sales to foreign countries are effected through one or more of the following channels:

1. Agreements concluded through private contact with industrial firms. Mutual visits between the officials of these firms and the officials of the JPMC culminated in concluding these agreements.

2. Government agreements: A number of bilateral and multilateral trade agreements have been concluded between the Government of Jordan and other governments. These agreements facilitated the exchange of imports and exports of different commodities with phosphate among the most important of Jordan's exports. Trade agreements between Jordan and India, and Jordan and Yugoslavia are outstanding examples. Transactions may be carried out according to barter deals or by confirmed and irrevocable letters of credit.

3. Agents: This is an important channel through which sales to foreign importers are brought about. The JPMC has a number of agents

scattered over Jordan's phosphate market. In London, for example, the agent is "Crockston and Company"[1] a fertilizer manufacturer. This agent covers areas in Western Europe where Jordan has serious transportation disadvantages. Last year Crockston helped the JPMC to resume selling phosphate to Italy after that country had stopped buying this material from Jordan. In India the representative of the JPMC is E.I.D. Parry who owns most of the Indian fertilizer plants. In Ceylon, "Roberts and Company" buys Jordanian crushed phosphate (Jorphos) and acts as an agent to cover certain parts of Southeast Asia. However, it has not been remarkably successful.[2] An Arab who owns a business in Tokyo represents the JPMC in Japan. But he is not authorized to conclude sales transactions.

Agents representing JPMC are granted a commission of two per cent in all cases. This remuneration is not considered satisfactory if compared with what other phosphate agents are paid.[3] Moreover

> "Overseas representation of the JPMC is not considered of high caliber. It is not wide enough and agents are not given backing or subjected to control. Customers are not clear as to whom they are dealing with and agents do not seem to be given as much latitude and flexibility as they should have in negotiations. No regular reports are received from agents and the head office is not provided with market intelligence necessary for wider operations."[4]

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[1] Names of agents given by Sales Manager. Interviewed, March 16, 1965.

[2] Ibid.

[3] Ibid.

[4] "The Expansion of the Phosphate Industry in Jordan--Report on Marketing Prepared by the Economist Intelligence Unit" (Jordan Development Board, Amman, 1964), p. 12. (Mimeographed).

Pricing policy: Jordan prefers to sell phosphate f.o.b., ports of exportation, under all circumstances.[1] In other words the c.i.f. terms have never been applied.[2] This suggests some rigidity on the part of the JPMC sales policy. Another marketing phenomenon is manifested in the pricing policy of the JPMC. The average price per ton of the Jordanian phosphate for an average TCP content of seventy-three per cent over the last five years is shown in Table.10.

TABLE 10

AVERAGE PRICES OF JORDANIAN PHOSPHATE
1961-1964

Year	JD/ton	$/ton
1960	3.851	10.78
1961	3.742	10.48
1962	3.751	10.50
1963	3.871	10.84
1964	3.807	10.66

Source: Calculated by the writer depending on table 3 and sales of phosphate as per respective annual reports.

These prices are f.o.b. ports of Beirut or Aqaba. However, they are high compared with recent list prices (from which trade discounts may be subtracted) of the Floridan phosphate:

[1]The JPMC has to ship phosphate to port of export.

[2]The JPMC does not worry about cost, insurance and freight after the product is shipped from port of export.

TABLE 11

LIST PRICES OF FLORIDAN PHOSPHATE
(Amounts in $/ton)

TCP%	1962	1963	1964
66/68	7.00	7.00	6.70
68/70	7.65	7.65	7.65
70/71	8.20	8.20	8.20
71/73	8.45	8.45	8.45
74/75	9.25	9.25	9.25
76/77	10.25	10.25	10.25
80/82	-	-	12.90

Source: Economist Intelligence Unit, op.cit., p. 15.

To the above figures in the table the fact may be added that for an average of seventy-six per cent TCP,[1] the average price of Moroccan phosphate in the period 1961-1963 was $10.76.[2] Thus the price of Jordanian phosphate is relatively higherthan the price quoted by competitors although its quality is sometimes inferior. The seventy-three percent TCP Floridan phosphate is quoted at $8.45 per ton, whereas the corresponding Jordanian product is sold for about $10.50/ton. Also while the seventy-six percent TCP Moroccan phosphate is sold for $10.76 per ton, the same price may be

[1] Tri-Calcium of Phosphate.

[2] Mamduh Abu Hassan, "A Report to JPMC Board of Directors", Amman, 1963, p. 15. (Mimeographed).

charged by Jordan for phosphate with a seventy-two percent TCP content.

Suggested improvements: The existing staff of the marketing department are not adequate in number. They cannot be expected to deal with orders and enquiries turned in by customers and agents. The JPMC officials interviewed feel that marketing staff should be strengthened to include a marketing director, a sales manager, a technical sales advisor, a sales and shipping assistant and a larger number of clerks.[1] The marketing director and sales manager should preferably, but not necessarily, have experience in the fertilizer industry. Both of them should spend at least one-third of their time in travel because spreading knowledge of the product and eliminating fears of risk and uncertainty are key factors in selling phosphate rock.

Pitfalls in agent representations should also be filled out. Admittedly a number of wholly owned branch offices would not be justified by the turnover of the business. It might be more economical therefore to employ agents who are adequately remunerated and supervised by frequent visits. The previously mentioned agents in London, India, Ceylon and Italy may be satisfactory but in Japan a new organization is needed. Industry officials have expressed the opinion that contracts should be made with powerful organizations in Japan like Zen Kozen (32.9% of Japan's purchase of phosphate) and Mistsu Bussa (32.4%).[2] Moreover in Pakistan and Australia new agency arrangements appear to be necessary since, as

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[1] Interview with the commercial director of JPMC, March 15, 1965.

[2] Ibid.

will be shown later, these two countries are expected to be better importers of Jordanian phosphate.

The pricing policy of the JPMC should be revised. "In deciding upon its prices of phosphate Jordan must take the competitor's list price and add to it or subtract from it any quality differential and the freight differential to major markets. The price still has to be modified in individual markets depending on the particular freight differentials of the market in question."[1] Thus Morocco, for example, quotes lower prices to Japan than to Western Europe since it has little freight advantage over Florida in the Far Eastern market.

Apart from adjustment of list prices an exporter must be ready to follow the discount practices of individual markets. Italy, for example, is one of the most competitive markets and hence is a country where discounts are psychologically necessary.[2]

Jordan should consider its prices relative to those of Morocco when selling in Eastern Europe, Mediterranean and India, and relative to Florida's when selling in Japan and Australia.[3] In none of these cases is the freight advantage substantial enough to justify setting f.o.b. prices of Jordan above the equivalent f.o.b. prices of her competitors.

A phosphate rock supplier cannot afford to be rigid in selling terms. He must be ready to sell f.o.b. or c.i.f. according to the buyer's

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[1] Economist Intelligence Unit, op.cit., p. 21.

[2] Ibid.

[3] Ibid.

requirements. Large customers often have their own shipping offices or agents and prefer to buy f.o.b. shipping point. Some buyers on the other hand may consider the arrangement of freight as a desirable service by the seller. Japanese shippers show a marked disinterest in Aqaba which, according to one view, can be overcome only by selling phosphate on a c.i.f. basis as other Red Sea suppliers, Israel and Egypt, already do.[1]

Phosphate Marketing Problems

In this section three of the most important marketing problems are studied. First, the problem of transportation will be reviewed.

1. Transportation

Ever since the beginning of the phosphate industry in Jordan, transportation has been its most serious problem. The cost of transportation is twice as much as the cost of production and mining. "In 1952, of the $12.26 price per ton f.o.b. Beirut, $2.80 represented production cost, $9.46 transportation."[2]

Briefly, the trouble lies in the fact that ports of export are very distant from the mines in both Russeifa and El-Hasa. Moreover the growth in capacity of transportation facilities (especially railway vehicles) cannot lag behind the increase in production and the expansion of the market.

Phosphate is hauled to Aqaba and Beirut by highway and railroad.

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[1] Interview with the commercial director, March 15, 1965.

[2] K. Grunwald and J. Ronall, Industrialization in the Middle East (New York: Council for Middle Eastern Affairs Press, 1960), p. 292.

Phosphate exported from Aqaba is transported 189 kilometres on the railway line from Russeifa to a point called Ras el-Naqab which forms the end of the line (see figure four). It is then trans-shipped to highway vehicles and hauled 88 kilometres to Aqaba.[1] A government road expert stated that "... whether it will be worthwhile to extend the railway from Ras el-Naqab to Aqaba will depend on the volume of phosphate which Jordan will be able to produce and sell abroad."[2] In fact any plans regarding the rehabilitation or construction of roads between Amman and Aqaba have included a recognition of the needs of this industry.

All of El-Hasa phosphate is shipped to Aqaba over a distance of 210 kilometres of which only 120 kilometres are covered by the existing railway,[3] and there is virtually little return traffic. Thus rail transportation is not now used by El-Hasa minesbecause the cost of transportation from rail cars to highway vehicles would apparently more than offset any advantages cultivated from the use of trains. Moreover, rail transport of Russeifa and El-Hasa phosphate exhausts the present railway. It will call for "a complete renewal of track from El-Hasa to Ras el-Naqab, as well as additional equipment for trans-shipment at Ras el-Naqab, and both of these investments would prove redundant if it should become desirable later to extend* the railway to Aqaba.[4] For these reasons the

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[1] "An Analysis of Alternative Phosphate Transportation Methods for the Hashemite Kingdom of Jordan, Prepared by Stanford Research Institute" (Jordan Development Board, Amman, 1963), p. 58.

[2] International Bank for Reconstruction and Development, op.cit., pp. 255-256.

[3] Ibid.

[4] Ibid.

*This is called for in the five-year development plan for Jordan.

JPMC RUSSEIFA OPERATION FLOWSHEET
1963

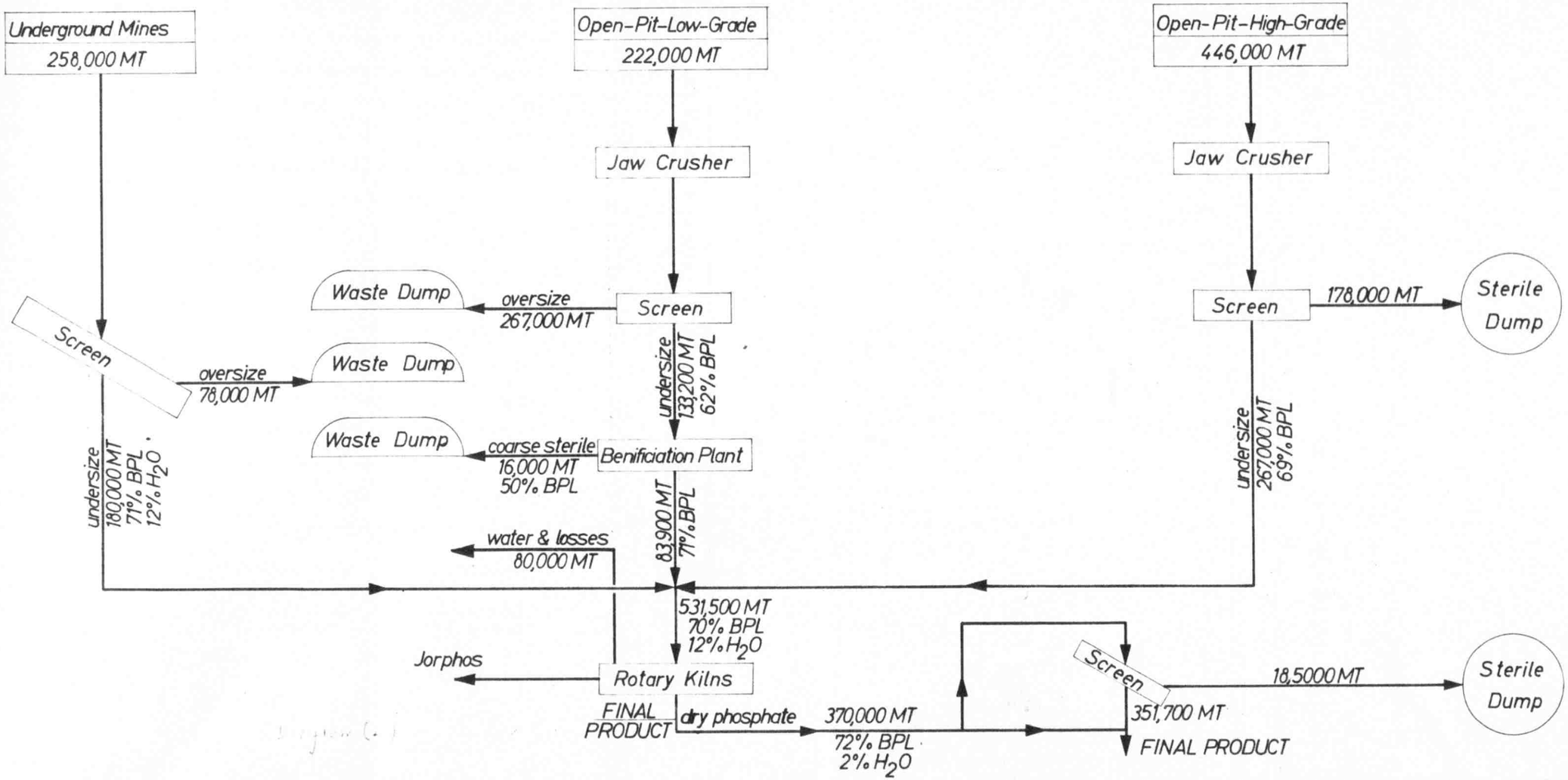

Figure 2

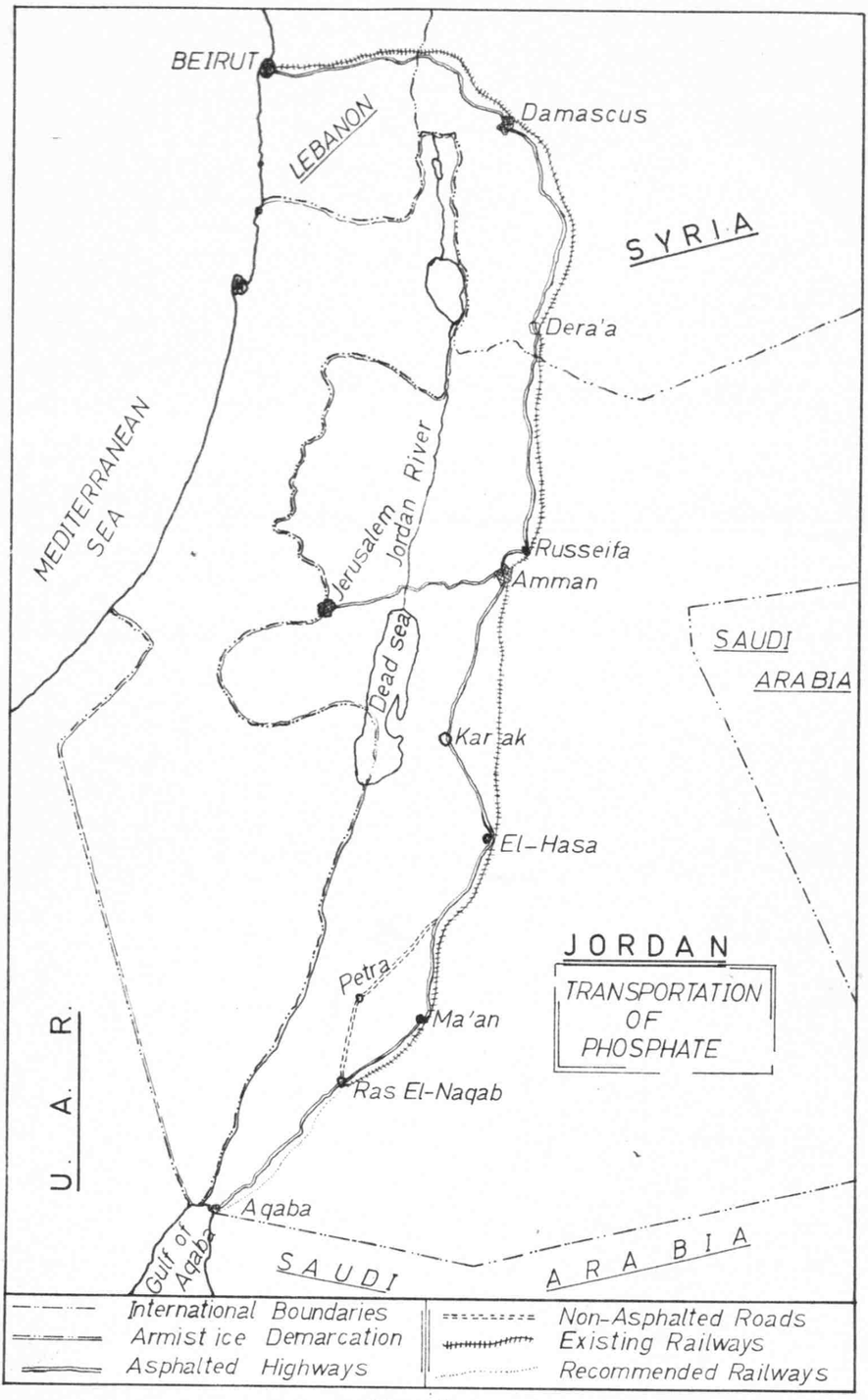
BEIRUT
LEBANON
Damascus
SYRIA
Dera'a
MEDITERRANEAN SEA
Jordan River
Jerusalem
Russeifa
Amman
Dead sea
SAUDI ARABIA
Kar'ak
El-Hasa
JORDAN
TRANSPORTATION OF PHOSPHATE
Petra
Ma'an
Ras El-Naqab
U. A. R.
Aqaba
Gulf of Aqaba
SAUDI ARABIA
International Boundaries
Armistice Demarcation
Asphalted Highways
Non-Asphalted Roads
Existing Railways
Recommended Railways

Figure 4

the responsible authorities in the phosphate industry in Jordan have chosen to transport El-Hasa phosphate by trucks, "particularly since the number of trucks necessary could be more readily and speedily adjusted to the development in traffic."[1]

Towards Beirut, phosphate is transported from Russeifa by highway vehicles and railway trains over a distance of 360 kilometres. This necessitates a long rail or highway journey and passage through two foreign countries, Syria and Lebanon. The transportation policies of these countries and their currency and customs regulations add to the difficulties of this route.

In comparison, most of Florida's deposits lie within a radius of about 70 kilometres from Tampa, the port of export.[2] The port of Safi in Morocco is also 70 kilometres away from the Moroccan phosphate deposits while the other major port of export, Casablanca, is located only 125 kilometres from the mines.[3]

Nevertheless, compared to 1952 conditions, the transportation of Jordan's phosphate has experienced favourable developments. Many transport cost reductions have been achieved. In 1956, for instance, a Belgian loan was used to procure new rail cars thus increasing the capacity of train transportation to Aqaba.[4] In 1958 the JPMC acquired twenty-five big trucks

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[1] Ibid.

[2] Highway Research Board, Bulletin 301 (Washington: Press of National Academy of Sciences, 1961), p. 109.

[3] Ibid.

[4] JPMC Annual Report, 1961, p. 7.

(MAN) and this helped to lower the cost of transportation per ton.[1] In 1960 His Majesty King Hussein opened the Desert Highway between Amman and Aqaba.[2] This was an event of major importance to the industry. The new facilities are expected to increase capacity and reduce costs. In addition to these improvements the Government of Jordan helped, over the past decade, to reduce cost of transportation to Beirut and Aqaba. The effect was to increase quantities transported to both ports. These quantities are represented in the following table.

TABLE 12

JORDAN PHOSPHATE HAULED TO AQABA AND BEIRUT
DURING THE YEARS 1953-1964
(Amounts in metric tons)

	To Aqaba		To Beirut		
Year	By Trucks	By Train	By Trucks	By Train	Total
1953	-	-	38932	-	38932
1954	11012	-	28100	18261	57513
1955	33449	38191	56640	21926	160206
1956	33972	46619	56452	39515	176558
1957	21432	82970	104573	45985	254960
1958	118835	55519	53190	42169	269713
1959	102818	55920	56258	54434	278430
1960	147511	66866	41539	44914	300830
1961	207449	73558	14814	45841	341662
1962	234966	62066	53014	50031	400077
1963	203899	39568	55645	34331	333443
1964	456900	37605	68435	70409	633349

Source: JPMC Annual Reports, 1954-1964.

[1] Ibid.

[2] Ibid.

The table reveals that exportation in 1953 was possible only through Beirut. Moreover, the only means of transportation before 1953 was highway vehicles. The table also reveals that after 1958 trucks hauled most of the phosphate exported through Aqaba. However, before 1958 most of the amounts transported to Aqaba were shipped by rail cars. The opening of the Desert Highway in 1960 and the purchase of MAN trucks in 1958 were sufficient reasons for heavier dependence on highway vehicles in the last six years.

Both trucks and rails were employed for shipment to Beirut, but there was no regular pattern of use. In some years the volume carried by trucks exceeded that transferred by trains and vice versa. This is explained by variations in shipping rates between the two means of transport as well as other cost fluctuations.

Rates: Transport rates for Jordanian phosphate have varied slightly from year to year. Yet their general trend may be indicated by the agreement signed in 1963 by JPMC and the Garage Owners Union according to which the latter agreed to transport phosphate by trucks to Aqaba at the following rates:[1]

1. JD 0.900 per ton on phosphate hauled from Russeifa to Aqaba by trucks that come to Amman loaded with merchandise from Aqaba port.

2. JD 1.400 per ton of phosphate shipped from Russeifa to Aqaba by trucks called especially from Aqaba to Russeifa mines on condition that these trucks come from the port empty.

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[1]Abu Hassan, op.cit., p. 2.

3. JD 0.750 per ton of phosphate shipped from El-Hasa to Aqaba.

The Agency for Phosphate Transportation agreed to truck phosphate from Russeifa to Beirut at the rate of JD 1.275 per ton.[1] As for rates applied to trains whose destination is Beirut the contract stipulates that one Jordanian Dinar per ton is to be paid for the first 6000 tons, JD 0.900 per ton for the next 4000 tons and JD 0.850 per ton for any quantity exceeding 10,000 tons.[2]

Since traffic between Amman and Aqaba is not big, and tons shipped by the Garage Owners Union trucks at JD 0.900 per ton depend on return loads from Aqaba, small amounts of phosphate are trucked at this rate. Therefore trucks have to be especially asked for from Aqaba with the result of having to pay JD 1.400 per ton (point 2 above). On the other hand, the present capacity of railway trains does not exceed 60,000 tons annually while that of the two trucking services is 240,000[3] tons under best conditions. A difficulty arises therefore, as to providing facilities for trucking to Aqaba port an estimate of 550,000 tons during 1965.[4]

In other words the discrepancy in trucking phosphate to Aqaba in 1965 will be around 250,000 tons.[5] If this amount is to be produced from Russeifa, trucks have to be called for to ship each ton for JD 1.400. If it is shipped from El-Hasa, however, only JD 0.750 is paid per ton. Thus

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[1] Ibid.

[2] Ibid.

[3] Ibid., p. 3.

[4] In 1964 it can be seen in table 12 that 494505 tonswere trucked to Aqaba. Assuming a conservative increase of only ten per cent in 1965 would approximate the 550,000 tons.

[5] 550,000 - (240,000 + 60,000) = 250,000 tons.

a saving of JD 0.650 is realized on each ton, or a total of JD 162,500. This is the quantitative justification for the diversion of major mining operations from Russeifa to El-Hasa.

Hauling phosphate to Lebanon suffers from certain complications. The rate for shipment by rail is JD 1.795 per ton.[1] Although this is expensive, amounts shipped by train can not go below 50,000 tons a year.[2] The use of trucks depends upon availability of return loads from Beirut. If a "dead head" return can be avoided, the charges for shipping phosphate to Beirut are substantially reduced, otherwise the present rate of JD 1.345 per ton continues to prevail.[3]

Phosphate shipped to Beirut is unloaded in special areas of the port and kept uncovered until it is loaded on board ships. The cost of loading is JD 0.462 per ton while in Aqaba it does not exceed JD 0.100.[4]

To improve the situation, amounts shipped by train should be reduced. An agreement with the countries who are parties to the Arab Transit Agreement would be necessary to bring about the reduction. Moreover, it is necessary to inform the Lebanese authorities that phosphate exportation through Beirut will rise substantially if the cost of loading is reduced.

Highway vehicles or railway trains: Should Jordan depend on trucks or trainsor both in shipping her phosphate to ports of export? While there

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[1] Abu Hassan, op.cit., p. 6.

[2] Ibid. This is according to an Arab Transit Agreement concluded in 1961.

[3] Ibid.

[4] Ibid.

is a sizable trucking industry in the country, a project is at hand regarding the extension of the Hedjaz Railway Line to Aqaba. In addition, average truck-transport costs to Aqaba exceeds that of the train. In 1963 and 1964 average transportation rates per ton to Aqaba and Beirut are presented below:[1]

	To Aqaba		To Beirut	
	By Trucks	By Trains	By Trucks	By Trains
1963	JD 1.188	JD 1.000	JD 1.330	JD 1.078
1964	1.062	.348	1.284	1.733

Towards Aqaba rail rates have been reduced substantially, but capacity of trains is severely limited. While trucking services to Aqaba have been reduced, rail service has been curtailed to a greater extent. On the other hand rail rates to Beirut have been considerably raised, while trucking costs have been reduced.

The problem at Russeifa and El-Hasa can be considered separately. The railway cars cannot provide facilities adequate for future shipments from expanding operations at Russeifa. Therefore it is necessary to use trucks simultaneously with trains. Amounts carried by trains, however, have to be trans-shipped by trucks from Ras el-Naqab, the end of the railway line, to Aqaba which entails an additional cost of JD 0.310 per ton.[2]

If expansion in El-Hasa operation takes place, shipment of El-Hasa

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[1] Calculated from tables 8 and 11.

[2] An average for 1963 and 1964 calculated from tables 8 and 11.

phosphate poses a bigger problem. Little traffic other than the transport of phosphate now exists on the route between El-Hasa and Aqaba, nor the situation is likely to change. Besides

> North bound traffic from Aqaba through El-Hasa will continue to be small; ... in 1961 the largest town on the route, Ma'an, had a population of only 6937; the whole of Souther Jordan had a population of 3534. With these figures in mind imports in the future regardless of their magnitude will not constitute a northbound return load possibility for transport vehicles that carry El-Hasa phosphate to Aqaba.[1]

The choice between trucks and trains for shipment of El-Hasa phosphate is more subtle. To give a better judgement each will be considered separately.

Trucking costs to El-Hasa: A recent study[2] indicated that trucking industry in Jordan employs some 1150 trucks having pay loads of nine tons or greater; the average age of trucks is between seven and eight years and the average age at retirement is about twenty-one years with an average annual utilization of 22,000 kilometres. Hence the history of a considerable volume of trucking activity in Jordan suggests that it will not be difficult to obtain support for the trucking operation needed to serve El-Hasa Phosphate Project. Furthermore, trucks already in use are employed well below capacity. A three-months survey[3] indicated that there are on

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[1] Stanford Research Institute, loc.cit., pp. 74-75 (underlined words are the writer's).

[2] Battelle Institute, Feasibility Study of a Truck and Bus Assembly Plant for Jordan (Frankfurt at Main; 1962), p. 22.

[3] Donald B. Cadler, Counselor of U.S. Embassy in Jordan for Economic Affairs, Truck Transportation in Jordan (Amman: 1962), p. 30.

the average 380 trucks in Aqaba waiting for loads; about half of these are thirteen-ton payload vehicles.

It is estimated that trucks will complete the normal transportation cycle (i.e. make a round trip of 422 kilometres between El-Hasa and Aqaba and deliver a 30 tons payload) in about 14.23 hours.[1] The estimate comprehends predictable delays such as waiting for service, rest stops, time out for meals and change of drivers. The number of trucks required if the annual estimated output of El-Hasa Project stops at 500,000 tons is 44 while it is 88 if the postulated output jumps to one million tons.[2] The total of trucking costs for these postulated outputs is summarized in Table 13.

Table 13 shows only a slight variation in delivery costs per ton between the two production levels. However the average cost of transporting one metric ton a distance of one kilometre is at 3.6 fils or 1.5 cents for every short ton-mile. This compares favorably with costs of long-haul bulk cargo trucking operations in the United States which have been reported at 2 cents.[3]

Railway costs to El-Hasa: The Jordan Royal Hashemite Railway is a 366 kilometre section of the Hedjaz Railway. It was mentioned earlier that El-Hasa is located on the railway about 120 kilometres north of Ras el-Naqab but rail transportation is not presently used by El-Hasa mines.

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[1] Stanford Research Institute, "Markets for Jordan Phosphate Rock," p. 74.

[2] Ibid., p. 62.

[3] American Society of State Highway Officials, Line Haul Trucking Costs in Relation to Vehicle Gross Weights (Washington, D.C.: 1961), p. 94.

TABLE 13

SUMMARY OF ANNUAL TRUCKING COSTS FOR EL-HAS PROJECT

Item	Annual Production Levels	
	500,000 tons	1,000,000 tons
Capital Recovery[1]	JD 83336	JD 166672
Direct Current Operating Exps.	2541964	509776
Insurance and Licences	11704	23408
Current Administrative Expenses	26667	53318
Interest on Working Capital	3667	7332
Total Annual Costs	380338	760506
Cost per ton	0.7615	0.7600

Source: Stanford Research Institute, "An Analysis of Alternative Phosphate Transportation Methods for the Hashemite Kingdom of Jordan," Amman, 1963, p. 69.

However, the rail extension to Aqaba (98 kilometres) appears to be likely. In accordance with the five-year development plan for Jordan, an agreement for the construction of the rail extension now is now being discussed by the Jordanian Goverrment and various foreign agencies. Though under present circumstances economic justification of the rail extension has not been demonstrated, a decision to operate the El-Hasa Phosphate Project at any one of the estimated levels of output might provide the margin for additional traffic needed to justify the construction of the railway. Table 14 il-

[1] Computed at JD 1894 per year (Interest rate 15% = rate of return).

lustrates the anticipated structure of railway costs if this construction takes place.

TABLE 14

SUMMARY OF ANNUAL RAILWAY COSTS FOR EL-HASA PROJECT

Item	Annual Production Level	
	500,000 tons	1,000,000 tons
Capital Recovery	JD 78850	JD 145278
Direct Operating Expenses	31860	63720
Maintenance and Repairs	17820	34460
Switching Charges	3977	7954
Interest on Working Capital	739	1459
Total Cost Annually	136686	263484
Cost per ton	0.277	0.264

Source: See Table 13.

In comparison with Table 13, the above table shows that shipping a ton of phosphate by truck would be three times as costly as shipping by rail. However, the initial capital requirements needed by the highway alternative would be JD 334,000 and JD 668,800 for the first and second estimated outputs respectively, while the rail alternative would require JD 494,940 and JD 796,210.[1] The capital required for highway transport of phosphate would be limited to the purchase of a fleet of vehicles. If the

[1]Stanford Research Institute, "An Analysis of Alternative Phosphate Transportation Methods for the Hashemite Kingdom of Jordan," p. 79.

rail alternative is used, however, investment in single-use capital equipment would be required--locomotives designed especially for El-Hasa, road bed and track, and switching facilities. In contrast with these facts about the railway alternative, most of the highway to Aqaba is in good condition and its continued availability and improvements are reasonably well assured by public revenues from the El-Hasa Project. On the other hand the availability of rail services is dependent on a program of rehabilitation and construction by agencies other than the El-Hasa Project.[1]

These arguments suggest first consideration be given to highway transportation for the El-Hasa Project. However, the low cost of annual railway services shown in Table 14 might be the dominant factor in establishing economic feasibility of the railway line to Aqaba. But it is still doubtful whether this single immediate pecuniary advantage can offset all the disadvantages involved in choosing the railway alternative.

Lease or buy trucks: If highway vehicles are chosen for hauling El-Hasa phosphate, it remains to decide whether the JPMC should buy or lease the vehicles. Leased trucks carrying El-Hasa phosphate to Aqaba have been found more suitable for the following reasons:

1. Information obtained and referred to previously indicates that the JPMC is transporting the El-Hasa phosphate at the rate of JD 0.750 per ton on a rental basis. Table 13, on the other hand, shows the rate at JD 0.760 per ton carried by purchased vehicles.

2. The previous discussion has revealed a well-developed trucking

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[1] International Bank for Reconstruction and Development, op.cit., pp. 261-263.

industry in Jordan with vehicles available in quantities sufficient for the El-Hasa Project. The utilization of these trucks would decrease the idle capacity of trucking industry.

It would not seem prudent for JPMC to buy any trucks until future governmental policy on rail and highway transportation is clarified.[1]

Shipping phosphate from ports of export: From the viewpoint of shipment to purchasing countries Jordan has a favourable location and is actively competitive with large phosphate producers. The following table enables a better comparison between Jordan and other phosphate shippers to Southeast Asia and the Far East.

In respect to distances between ports, Jordan has an advantage over other suppliers in moving phosphate rock to Japan and India. However, movement to Southern and Western Europe favours North African suppliers. Jordan is also inferior to Florida, in respect to the New Zealand and Australia markets.[2]

But mileage alone is not an adequate measure of freight costs on different trade routes. Such costs are also determined by the accessibility of the port of origin, the volume of general shipping at the point of origin and the opportunities for return cargoes.[3] Unit costs are obviously raised when ships sail with unsold cargo space. "Freight rates over the past few

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[1]This is a point expressed as an opinion of the Beirut Shipping Office Manager. Interview on April 2, 1962.

[2]Stanford Research Institute,"An Analysis of Alternative Phosphate Transportation Methods for Jordan," p. 83.

[3]Economic Intelligence Unit, op.cit., p. 19.

TABLE 15

REPORTED SHIP CHARTER RATES FOR SHIPMENT OF PHOSPHATE ROCK
1956-1962
(Dollars per metric ton fio)[1]

Run	1956	1957	1958	1959	1960	1961	1962
Tampa - Japan	-	9.25-24	7-8	6.5-8.5	7.5-10	8-11	6-9
Casablanca - Japan	19	-	-	-	-	10.05	7.55
Aqaba - Japan	11-14	-	-	-	-	12.5	13
Kosseir - Japan	-	6.65	-	5.60	7.55	9.75	-
Tampa - Bombay	-	-	-	-	-	-	7.20
Aqaba - Bombay	9.45	-	6.30-6.65	-	-	-	-
Aqaba - Madras	6.65	9.16	6.30	-	7.33	7.8	6
Aqaba - Rejeka (Yugoslavia)	-	-	-	-	-	-	3.8

Source: "Ship Charter Rates for Shipment of Phosphate Rock," European Chemical News, London, December 1963, p. 33.

years have been consistently lower between Casablanca and Japan than between Tampa and Japan though Tampa enjoys an advantage of 1000 nautical miles."[2] The likely explanation is that the return journey to Florida (Tampa) might have been less profitable. Assuming full loads and on the basis of operating costs, freight rates to Japan and Taiwan from Tampa, Casablanca and Aqaba would be as follows:[3]

[1] Free in and out, i.e. charges for loading and unloading excluded.

[2] Ibid.

[3] Ibid.

	To Japan $/ton	To Taiwan (Formosa) $/ton
Tampa	$ 3.64	$ 3.96
Casablanca	4.04	3.60
Aqaba	3.10	2.68

The figures indicate that Jordan would have an advantage of $0.54 and $0.94 per ton over her biggest competitors (Florida and Morocco respectively) in shipment to the world's largest phosphate importer, Japan. But in order to gain full benefit from her location Jordan should sell on c.i.f. terms in addition to f.o.b. The former is a convenience required by many phosphate buyers. The c.i.f. terms encourage customers to buy from the nearest sources. Thus as India's fertilizer production develops, one would expect her to depend mainly on phosphate supplies from the Near East. Similarly, West Europe looks to North Africa as its much favoured source of supply.

2. Competition

This is the second serious problem from which marketing of Jordanian phosphate suffers. Generally it arises because of the following factors:

1. High prices of Jordanian phosphate

2. Occasional inability to meet quality standards required, at times, by Jordan's customers.

3. High transportation costs because of distance between Jordan's mines and her ports of export.

Within Jordan there is no competition between El-Hasa and Russeifa deposits. The market for each is largely non-competitive. El-Hasa produces

a high grade product while Russeifa produces a low quality phosphate. The two grades are used for different purposes.

However it is argued that the strongest competition comes from Morocco, Algeria, Tunisia, Egypt and Jordan. These states are the principal exporters of the world phosphate. In 1962 they exported 10,754,351 tons out of 19,203,670 tons of total world exports.[1] A brief survey of phosphate operations in each of these countries may clarify Jordan's competitive position.

Morocco: Morocco is supplying some forty per cent[2] of the world's consumption, thus ranking as the largest exporter of rock phosphate. For although the United States produces more than Morocco, most of her production is consumed locally. "Reserves of rock phosphate in Morocco are estimated at a minimum of thirty billion tons with grades of 70-75% TCP. Both production and exports have been growing at the same standard of seven per cent a year. During 1965 projected production is 13.5 million tons."[3]

Moroccan rock phosphate is mined by both open pit and underground mining methods utilizing the most modern equipment. Stating the differences between Jordan and Moroccan phosphate operations the technical director of the JPMC pointed out that the Moroccan product is screened and dried in kilns

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[1] Abu Hassan, op.cit., p. 14.

[2] "El-Hasa Phosphate Project--Market and Transportation Survey, Vol. IV", A Report Prepared by Parsons Corp. (Amman, 1963), p. 55 (Mimeographed).

[3] Ibid.

until moisture is reduced to two per cent of total volume. Rock products are transported to Casablanca (Morocco's primary port) from two mines. One mine is located some ninety miles from Casablanca and produces six million tons annually, the other is fifty miles away and produces four million tons.[1]

Tunisia:[2] Tunisia's production during 1962 reached 2,100,000 tons (See Appendix II, table 1). Of this 200,000 tons are converted every year to superphosphate for domestic use and another 100,000 tons is directly applied to the soil. This leaves a balance of 2,000,000 tons for export. The Gafsa mine, which is the main source of Tunisia's phosphate rock, lies about 150 miles west of Sfax, the port of export.

As the production of Gafsa contains sixty per cent TCP, it is up-graded by washing, drying and air separation to sixty-five per cent. Annual production of this quality is 1,500,000 tons. Plant and equipment to up-grade production to seventy-five per cent TCP now are being erected. The balance of production is extracted from two other sources. One is fifteen miles from Tunis (another port of export) and the other is 10 miles from Gafsa. Tunisian phosphate operations are controlled entirely by the government.

Algeria:[3] The 420,000 tons of phosphate rock produced annually by Algeria are extracted from Djebel Kouif which is sixty miles south of the

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[1] Interview with JPMC Technical Director, April 12, 1965.

[2] Parsons Corporations, op.cit., p. 57.

[3] Chemical Trade Journal and Chemical Engineer (London), "African Phosphate Rock," V. 153, No. 3912, Dec. 22, 1963, p. 1417.

export port of "Bone." The entire production is for export. Algerian products do not exceed sixty-five to sixty-six per cent TCP. Reserves are estimated at 700 million tons. Phosphate operations in Algeria are owned by private shareholders.

Egypt: At present Egypt is not a prominent phosphate producer. However plans have been devised to produce 260,000 tons of phosphate per year.[1] Egyptian phosphate is exported from the port of Kosseir which is only twenty miles from the mines. Egypt competes with Jordan in the South-east Asian markets and in India which imports most of her phosphate from the port of Kosseir.

Among Arab countries the problem of competition should not be difficult to resolve. To avoid cut-throat competition in phosphate marketing authorities on the subject recommended the establishment of an organization for coordinating marketing policies among the Arab states that produce phosphate.[2] Within the realm of an Arab Common Market (which incorporates at present a number of Arab countries in the form of an economic unity) the establishment of such an organization seems to be possible. Arab phosphate producers could then exercise more influence on the world prices of phosphate. An agreement on the division of the phosphate markets among them might also be possible.

With non-Arab phosphate producers the problem of competition is more difficult to deal with. The following countries are the most prominent

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[1] Ibid.

[2] Abu Hassan, op.cit., p. 9.

non-Arab competitors to Jordan.

Florida:[1] This is one of the world's largest phosphate producing areas. Thirty per cent of the world's production is exported from Florida. The grades of the Floridan phosphate vary between sixty-eight and eighty-two per cent TCP. Florida's ore proven reserves amount to one billion tons, with about two billion tons more which can be mined under different mining conditions. All mining operations in Florida are by open-pit methods. The product is hydraulically crushed and screened, and after beneficiation it is dried in kilns with moisture content reduced almost to one per cent. Due to lack of storage facilities in the port, daily production is transported directly from the mining area and loaded immediately aboard ships. Appendix II, table 1 shows quantities of phosphate produced by Florida during the previous five years.

Senegal:[2] During 1961 Senegal entered the market as supplier of phosphate, exporting 340,000 tons during that year. The Senegal phosphate is of a high grade, not less than eighty-two per cent TCP. Proven reserves are estimated at forty million tons; thus Senegal is expected to be an important producer of rock phosphate.

Togo:[3] Reserves of eighty per cent TCP in Togo proved to be about

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[1] United States Government, Minerals Yearbook, op.cit., pp. 973-976.

[2] Chemical Trade Journal and Chemical Engineer, op.cit., pp. 1417-1418.

[3] It has to be noted that phosphate produced by all African countries except Egypt and Morocco, is marketed by one organization named "Union Phosphatiere Africaine." A similar organization is needed by the Arab

eighty million tons. In 1962, 360,000 tons of rock phosphate were produced and exported. Production is expected to double.

Nauru and Christmas Isles: These islands are the main phosphate exporters to Australia. In 1962 Nauru Island exported 1,810,000 tons of which 1,134,000 tonswere imported by Australia. Christmas Isles exported 612,000 tons of which 527,000 tons were imported by that country.[1]

Phosphate produced by these isles is of a high grade (eighty per cent TCP in Naura and seventy-six per cent TCP in Christmas).[2] Since they are near to the Australian market transportation costs incurred by the isles are far less than those which Jordan would sustain in exporting to that country. However, it is expected that reserves in the isles will be soon depleted giving Jordan a hope of capturing part of the Australian market.[3]

Israel: Israel also has begun phosphate production in recent years. Furthermore has pushed Jordan out of the market in Turkey. In 1961 Israel produced over 200,000 tons of phosphate and this has been increasing.[4] Israeli authorities have recommended the construction of a loading apparatus at the port of Eilat, not very far from the Port of Aqaba. However, the

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phosphate producers. Morocco, the principal Arab phosphate producer, is not included in this organization. This gives a good opportunity for other Arab phosphate producers to convince Tunisia and Algeria (members of the organization) to come to an optimum solution.

[1] Abu Hassan, op.cit., p. 12.

[2] Ibid.

[3] Parsons Corporation, op.cit., p. 59.

[4] Abu Hassan, op.cit., p. 13.

Israeli phosphate is not of high quality.[1]

Jordan can compete actively with most phosphate producers on the basis of her favourable location (see Appendix III). This is especially true when supplying areas east of the Suez Canal. Table 15 lists freight costs in comparison with Tampa, Casablanca and Sfax (Tunisia) to selected destinations east of Suez.

TABLE 16

FREIGHT ADVANTAGES TO AQABA
OVER SOME PHOSPHATE SUPPLIERS TO EAST OF SUEZ

Destination	Differential Relative to Aqaba ($ per ton)		
	From Casablanca	From Sfax	From Tampa
Karachi	1.40	1.00	3.00
Calcutta	1.40	1.00	3.00
Taiwan (Formosa)	1.40	1.00	1.80
Yokohama	1.40	1.00	1.80
Sydney	1.40	1.00	Negligible
Capetown	Negligible	0.40	0.70

Source: "Phosphate Transportation," Phosphorus and Potassium, London, September 1961, p. 32.

3. Complexities of Foreign Trade

This problem arises mainly because of barter trade agreements between Jordan and her customers. Some countries accept Jordan's phosphate in direct

[1] Ibid.

exchange for commodities demanded in the Jordanian market. But when phosphate exports are made to a certain country for, say, JD 100,000, the value of imports in return may not exceed JD 60,000. If that country refuses to pay the balance in hard currency, Jordan acquires a frozen balance.

An example is found in trade with Yugoslavia. According to a 1957 agreement, Jordan was to export to that country 150,000 tons of phosphate annually valued at about JD 500,000. However, annual imports from Yugoslavia were approximately JD 250,000;[1] the difference was Jordan's frozen balance. By December 31, 1964 this figure increased to JD 600,000.[2]

Barter arrangements with India have been advantageous to Jordan in the past but soon these will no longer serve their purpose. "In recent years Indian requirements of phosphate rock have been obtained from Middle Eastern countries with Jordan contributing twenty-eight per cent of those imports."[3] However this pattern is changing because India's requirements of phosphate are increasing and "... we (India) cannot reasonably hope to increase our barter imports from ... Jordan but must, on the other hand, be prepared to face a reduction as she is anxious as we are to increase her foreign exchange earnings."[4] Besides, Jordan's population is small and her consumption potential for commodities which India offers (jute, fabrics, tea and light engineering tools) is also small. In fact Jordan's market

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[1] Al-Hayat Newspaper, Beirut, October 21, 1964.

[2] Ibid.

[3] "Draft Memorandum on India's Rock Phosphate Imports, Prepared by Indian Association of Superphosphate Producers," Bombay, 1964, p. 3.

[4] Ibid.

can no longer absorb economically many of the imports derived from the barter agreements. Therefore "there is no escape" from the obligation to sell rock phosphate for free foreign exchange.[1]

Similar problems and even disputes with other countries have been encountered by Jordan. Yet mutual benefits were the basis for dispute settlement. For example, negotiations culminated in a trilateral agreement between Jordan, Yugoslavia and the United Arab Republic in 1964. The agreement stipulates that Yugoslavia will transfer to the United Arab Republic commodities worth JD 350,000. Jordan will then import Egyptian commodities worth this amount. The balance of the frozen money will be settled by a similar arrangement.[2]

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[1] Ibid., p. 5.

[2] Ad-Difa' Newspaper, Jerusalem, November 10, 1964.

CHAPTER IV

PROSPECTS FOR MARKETING JORDANIAN PHOSPHATE

Potential Marketing Achievements

Introduction

In 1962 Jordan secured a loan of seven million dinars from Kuwait. Three million dinars from this loan was appropriated for expansion and modernization of the phosphate industry in Jordan.[1] By 1970 production of phosphate is expected to rise substantially. Without a careful study of marketing potential, this expansion is hazardous. It is the purpose of this chapter to examine Jordan's potential phosphate sales and present an analysis of possible markets that would absorb the forecasted amount of production.

Factors for Market Expansion

Stimulated by the demand of world fertilizer industry and the rapid expansion of industrial phosphorus derivatives, world demand for phosphate rock is constantly rising. World consumption of this material increased by twenty-two per cent between 1954 and 1960, with Asia showing the most

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[1] Yusuf An-Nimri, "The Jordan Phosphate Mines Company," A Lecture delivered in Amman, June 1964.

striking increase of seventy-six per cent over the same period.[1]

In view of these figures, plans for expanding Jordanian rock production for sale to Asia and other areas appear to be in order. Jordan's relative proximity to Asian countries, and the existence of the El-Hasa deposit in the vicinity of Aqaba (the preferred port for shipments to Asia) are two factors that make her chances of capturing Asian markets brighter.

In forecasting Jordan's sales of phosphate certain points should be considered. The first is identifying world markets to which Jordan's phosphate can be shipped competitively. In addition, the phosphate requirements of these markets and the portions of them that Jordan may reasonably expect to capture need to be approximately ascertained. Moreover, the characteristics of phosphate rock ordinarily traded and the methods employed in moving this material to markets, including transport methods and marketing channels, should not be ignored. It is by analyzing each of these points that the potential sales of Jordan phosphate can be estimated with a low margin of error.

As noted in the previous chapter Jordan has been selling phosphate through special arrangements. Through the agreement with Yugoslavian Yugometal Enterprises, for instance, Jordan's output of phosphate rock has been moving in recent years to Balkan countries in spite of the transport cost advantage held by North African suppliers.[2] Such arrangements, however,

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[1]Food and Agricultural Organization of the United Nations, Fertilizers (Rome: 1960), pp. 19-20.

[2]The agreement stipulates that Yugometal should import 300,000 tons of Jordan phosphate for the purpose of either consumption or resale to other Balkan countries.

although representing an outlet for Jordan's product, may entail certain hazards. Jordan, after becoming partially dependent on the Balkan market faces the possibility of having the market disappear completely and abruptly when the agreements expire. Such a hazard is aggravated by the fact that North Africa and Russia are in a better position to supply this area

Phosphate requirements in world markets: In determining the areas to which Jordan is expected to be a major supplier, table 17 is reproduced to show world consumption of phosphate fertilizers.

This table provides data up to 1959 only. Since then, however, radical changes have taken place in the phosphate fertilizer consumption of some countries. In India, for example, the table shows a consumption of 41,700 tons of phosphatic fertilizers in 1959. In 1963 consumption increased to 96,500 tons,[1] or more than double that of 1959. Most of these countries import phosphate for the manufacture of fertilizers. If it is assumed that 1.75[2] tons of rock phosphate is required, on the average, to produce one ton of superphosphate, it is easy to calculate the tons of phosphate required to produce the reported amounts of fertilizer consumption.

Potential sales to markets east of Suez: Table 17 shows that in countries east of Suez phosphate consumption has increased during the years indicated. These countries include (in addition to countries in South and

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[1] National Council of Applied Economic Research, Factors Affecting Fertilizer Consumption (New Delhi: 1964), p. 52.

[2] Indian Association of Superphosphate Producers, op.cit., p. 3.

TABLE 17

CONSUMPTION OF PHOSPHATE FERTILIZERS IN SELECTED COUNTRIES
(1000 of metric tons)

Country	1955	1956	1957	1958	1959
Japan	318.0	337.0	290.0	389.0	436.0
India	12.1	17.7	25.9	34.6	41.7
China, Taiwan	30.9	26.2	27.9	35.0	37.2
Malaya	2.0	4.1	3.1	-	-
South Korea	28.2	50.8	68.5	66.7	119.4
Pakistan	-	-	2.7	2.4	7.9
Turkey	10.4	5.1	6.3	4.4	12.4
Phillipines	9.4	7.9	4.1	7.0	7.9
Tanganykia	6.1	6.2	6.2	5.7	9.1
Australia	474.8	441.1	495.8	476.0	537.4
New Zealand	210.5	215.4	190.7	181.0	198.1
France	629.3	674.2	760.2	764.4	783.0
West Germany	473.5	566.5	584.0	607.9	706.9
Italy	419.7	391.4	384.2	380.8	389.0
Poland	150.6	156.4	148.8	256.0	295.0
Spain	268.1	271.8	281.9	316.0	278.0
United Kingdom	369.2	356.0	354.8	372.0	428.0
United States	2129.0	2179.0	2163.0	2406.0	2134.0
Yugoslavia	19.7	27.5	57.2	76.3	95.9
Lebanon	4.0	4.7	6.8	8.4	9.1
Union of South Africa	119.0	142.8	132.4	134.8	132.1

Source: Food and Agriculture Organization of the United Nations, Fertilizers, (Rome: 1960), pp. 79-80.

Southeastern Asia) New Zealand, Australia, and Union of South Africa. It was shown previously that in shipment to most areas east of Suez Jordan's transport advantage over other suppliers (United States and North Africa) is between $1.40 and $3.00 per ton.[1] This suggests that Jordan's logical marketing area lies in countries east of Suez. It was estimated that east of Suez area will need the following amounts of rock, phosphate in excess of supplies available from captive sources:[2]

Year	Amount needed in tons
1965	4,000,000
1970	6,000,000
1975	8,900,000

These figures do not comprehend China's needs which cannot be projected because of insufficient data. Table 18 shows the projected needs of phosphate-importing countries in the east of Suez area.

Competition for these markets will come from eight phosphate rock suppliers. As expected, the United States and Morocco took the lead in the recent past. In 1960 and 1961 the percentage distribution of phosphate deliveries, by origin, to countries in table 17 was estimated to be as shown in table 19.

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[1] Supra, Chap. III, Table 16.

[2] Stanford Research Institute, Markets for Jordan Phosphate Rock, p. 45. Captive sources are the nearest suppliers; within this area captive sources are Maketea, Nauru and Christmas Island.

TABLE 18

PROJECTED IMPORTS OF PHOSPHATE ROCK WITHIN JORDAN'S LOGICAL MARKETING AREAS
('000 of metric tons)

Country	Imports		
	1965	1970	1975
Japan	2,500	3,000	3,500
India	600	1,650	3,000
Australia and New Zealand	-	600	1,100
Union of South Africa	400	400	400
Taiwan-China	140	165	195
Malaya	100	125	160
Ceylon	80	110	140
Philippines	50	75	100
Pakistan	15	90	150
Others	100	150	200
Total	4,000	6,400	8,900

Source: Stanford Research Institute, Markets for Jordan Phosphate Rock, p. 45.

Prior to estimating Jordan's share of phosphate sales to countries east of Suez, Jordan's performance during the past three years is reviewed in table 20.

The table shows that Jordan's share of these markets has declined from four per cent in 1960-1961 to three per cent in 1962-1964. However it is assumed that the whole marketing organization of the JPMC is going

TABLE 19

APPROXIMATE SHARE OF WORLD PHOSPHATE SALES TO MAJOR CONSUMERS

Phosphate rock supplier	Percentage Distribution	
	1960	1961
United States	39	40
Morocco	25	23
Christmas - Maketea	10	13
Egypt	9	10
Algeria - Tunisia	8	5
Jordan	3	4
Togo - Senegal	3	2
Israel	1	1

Source: "Phosphate Rock--International Trade," Journal of World Phosphorus and Potassium, London, April 1962, pp. 11-13.

to be strengthened. This includes, better agents, flexible selling terms, more appealing prices, aggressive marketing techniques, and dependence on El-Hasa phosphate shipped from Aqaba. All these factors should enable Jordan to improve her position during the coming decade. Thus, subject to a certain margin of error, Jordan's estimated share of these markets, taken alone, is presented in Table 21.

Table 21 reflects the difficulty that Jordan faces in obtaining a large share of a distant market like Japan, as opposed to the relative ease of developing a larger share of a closer more rapidly expanding market like India.

TABLE 20

JORDAN'S SHARE OF PHOSPHATE SALES TO COUNTRIES EAST OF SUEZ
1962-1964
(Amounts in metric tons)

Country	Total imports in the period.	Jordan's share	%
Japan	5,672,169	43,443	0.8
India	842,827	343,616	40.00
Australia and New Zealand	6,816,349	nil	nil
Taiwan, China	212,113	nil	nil
Malaya	152,028	nil	nil
Union of South Africa	1,290,000	nil	nil
Ceylon	151,794	18,596	12.0
Philippines	57,514	nil	nil
Pakistan	26,670	8,890	34.0
Total	15,211,464[1]	411,545[2]	3.0[3]

Source: (1) Journal of World Phosphorus and Potassium, April 1965, p. 19.
(2) JPMC Annual Report, 1964, p. 14.
(3) Average calculated by the writer.

It has been possible to figure out Jordan's share as presented in Table 21 by depending on historical data analyzed previously. Also it has been assumed that the portion of any market judged available to Middle Eastern suppliers would be shared equally by those who are similarly located, namely, Egypt, Israel, and Jordan.

Jordan's four per cent share of Japan's imports was arrived at on the following basis:

TABLE 21

JORDAN'S ESTIMATED SHARE OF PROJECTED IMPORTS OF PHOSPHATE ROCK WITHIN HER LOGICAL MARKETING AREA
('000 of metric tons)

Country	Jordan's estimated share	1965	1970	1975
Japan	4%	100	120	140
India	40%	240	660	1200
Australia and New Zealand	10%	-	60	110
Union of South Africa	15%	60	60	60
Taiwan	15%	21	25	29
Malaya	25%	25	30	40
Ceylon	30%	24	33	42
Philippines	25%	15	20	25
Pakistan	35%	4	32	53
Others	25%	25	57	50
Total		514+	1077	1749

Source: Stanford Research Institute, "Markets for Jordan Phosphate Rock," p. 51.

(a) In the past five years these three Middle Eastern suppliers have shared six per cent of Japan's imports.[1] They should be able to encroach upon a large part of the eleven per cent of Japan's imports from Maketea and Christmas especially because of the approaching depletion of

[1] "Japan's fertilizer Industry Expanding," Journal of World Phosphorus and Potassium, London, June 1962, p. 6.

reserves in those islands.[1]

(b) Allowing a total of twelve per cent for division among the three Middle Eastern suppliers gives Jordan four per cent of the total.

In case of India, table 20 shows that Jordan's share of her imports was forty per cent. It has been assumed that this will continue in the future. The same is true with Pakistan. The twenty-five per cent allocated to Malaya, Philippines, Ceylon (thirty per cent), and "others" has been estimated on this basis.[2] Proximity of Middle East to these areas should allow the Middle East to relatively dominate their markets, with African suppliers having significant but lesser share. Allowing the Middle East seventy-five per cent of the needs of these areas and giving Jordan one-third of this portion results in an estimated twenty-five per cent of the total. Jordan is expected to capture thirty per cent of Ceylonian imports because that country demands Jordan's crushed phosphate (Jorphos) to be used in the tea farms.[3]

Australia and New Zealand are presently importing their phosphate needs from captive[4] sources like Maketea, Christmas and Nauru Islands. But these two countries will have to draw upon distant sources for future purchases to supplement these captive sources. Yet the Middle East will have no significant advantage over other suppliers. Since some ten suppliers

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[1] Ibid.

[2] Interview with Sales Manager of JPMC, March 16, 1965.

[3] Ibid.

[4] Nearest sources.

will be competing for the Australian and New Zealand markets, Jordan is assumed ten per cent of the supplement.[1]

On the basis of the above studies Jordan would have a market for some 514,000 tons of phosphate in 1965, 1,077,000 tons in 1970 and 1,740,000 tons in 1975 (see table 21). This is only in markets that lie east of Suez Canal, which markets have been described as Jordan's logical marketing area.

Potential sales to other markets: Jordan's phosphate marketing prospects are not limited to areas east of Suez. But since those areas are expected to accommodate a major portion of Jordan's deliveries they were given separate consideration in the previous section.

Jordan is justifiably expected to continue selling phosphate to some, if not all, of her present markets outside east of Suez area. In order to identify and evaluate these markets Table 22 which surveys Jordan's exports during the last five years is now considered.

Apparently, Jordan could market a large portion of her phosphate to European consumers such as Czechoslovakia and Yugoslavia, Italy, Bulgaria, and Asian consumers such as Turkey and Syria. Most of the countries listed in Table 22 are developing, and, as might be expected, agriculture forms the dominant basis of their economies. Therefore in order to develop their agricultural products their phosphate consumption will rise whether for direct application to soil or for the manufacture of fertilizers. Other countries expected to be importers of phosphate are Syria and Iraq.

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[1]Stanford Research Institute, "Markets for Jordan Phosphate Rock," p. 56.

TABLE 22

SALES OF JORDANIAN PHOSPHATE BY COUNTRIES
1960-1964
(Amounts in metric tons)

Country	1960	1961	1962	1963	1964
Spain	6750	-	-	-	-
Italy	-	-	-	2000	44962
Pakistan	-	-	-	-	8890
Japan	-	17040	4467	-	38776
India	72012	106950	128682	95796	119138
Poland	39115	10100	9400	20350	-
Bulgaria	-	-	-	-	24124
Cezchoslovakia	48465	64200	81073	60750	78440
Turkey	-	-	-	-	96290
Lebanon	9764	8706	13244	12962	20540
Yugoslavia	149400	184719	134472	164636	184635
Greece	3400	-	-	-	-
France	-	-	-	-	3220
Syria	-	-	-	-	213
Ceylon (Jorphos)	-	2500	-	10760	7836
England	-	-	-	-	10
Local Sales	-	121	102	250	-
Total	328906	394336	371640	368504	627074

Source: JPMC Annual Report, 1964, p. 14.

Table 23 shows estimated phosphate imports by countries which are present or anticipated markets lying outside the east of Suez area.

TABLE 23

PROJECTED IMPORTS OF PHOSPHATE ROCK BY COUNTRIES OUTSIDE EAST OF SUEZ AREA
(Amounts in '000 tons)

	Imports		
Country	1965	1970	1975
Iraq	35	45	50
Syria	15	20	30
Lebanon	25	35	50
Turkey	100	160	260
Cyprus	20	20	20
Greece	220	280	360
Italy	1100	1600	2000
Czechoslovakia	600	900	1500
Yugoslavia	450	750	1200
Total	3165	4260	5970

Source: Stanford Research Institute, "Markets for Jordan Phosphate Rock," p. 45.

Jordan is expected to supply all of the phosphate needs of her neighbours; Lebanon, Syria and Iraq (a total of 290,000 tons). In case of Yugoslavia, Jordan is now supplying forty per cent of her needs. Assuming that this will continue, Jordan is expected to sell 960,000 tons to that country over the next decade. Moreover, giving a conservative estimate of

five per cent of the purchases of Italy (which is near Aqaba) and Czechoslovakia (which now purchases five per cent of her phosphate from Jordan) would give Jordan a total of 390,000 tons of the imports of these two countries over the same period. A reasoning similar to that presented in case of Malaya, Philippines and Ceylon applied to Turkey, Greece and Cyprus. Accordingly Jordan could be allowed ten per cent of the imports of these countries or a total of 144,000 tons in a period of ten coming years. Hence Jordan is expected to deliver another 1,770,000 tons of phosphate by 1975. Of this amount it can be found that around 467,000 tons is expected to be sold in 1965, 625,000 in 1970 and 806,000 in 1975.

Analysis of Possible Markets for Jordan's Phosphate

New Possible Markets

The term "possible markets" in this section denotes any potential expansion in Jordan's phosphate sales whether in new or existing markets. Countries in both markets will be briefly surveyed from the viewpoint of their need for phosphate rock.

Australia:[1] In Australia there are twenty superphosphate plants that produced two and a half million tons of superphosphate in 1962. In 1961 Australia imported around 1.7 million tons from Oceania, Nauru and Christmas Islands. Production of phosphate rock in Australia is negligible and she has been importing all her needs of this material.

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[1] Lamer, op.cit., pp. 280-283.

New Zealand: With the exception of small quantities of organic fertilizers, all fertilizers manufactured domestically in New Zealand are based on phosphate. Production of fertilizers in this country has increased at an average annual rate of 6.6% over the past 22 years and in 1962/1963 totalled 1,418,781 tons.[1] There are eight companies in New Zealand which produce phosphate fertilizers in twelve plants with a total of 1.3 million tons of superphosphate per year.[2]

Gross land farming has been the basis of the economy of New Zealand. It is therefore not surprising that superphosphate production should exhibit an upward trend. The contribution of the fertilizer industry to the new Zealand economy may be judged from the fourfold increase in exports of agricultural products over the past twenty years.[3]

After depletion of reserves in the captive markets of Nauru and Christmas, location of Australia and New Zealand from sources of phosphate rock becomes remote. Therefore, it is to the advantage of these two countries to consider importation from a relatively near source of supply such as Jordan.

Union of South Africa: Corn is South Africa's most important crop. In 1962 South African corn output reached a peak of fifty-four million quintals.[4] Superphosphate has been found to be most important for corn;

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[1]"New Zealand, A Big Fertilizer Consumer," Journal of World Phosphorus and Potassium, London, July 1962, p. 12.

[2]Ibid.

[3]Ibid.

[4]W.J. Pretorius, An Economic Study of the Wheat Industry in the Union of South Africa (Union of South Africa, Department of Agriculture and Forestry, 1963), p. 141.

nitrogen and potassic fertilizers produce no significant increase in corn yields. The great efforts to maintain agricultural production on a high level required substantial quantities of fertilizers. Superphosphate production has therefore increased and two superphosphate plants have been established. However superphosphate production is not large enough to satisfy the needs of the enlarged crop area or to compensate for the adverse effectsof frequent droughts. Consequently the need has arisen for a third superphosphate plant scheduled to start production in 1965.[1] Thus the Union of South Africa will be an important importer of phosphate. Jordan is geographically in an excellent position to capture part of these imports.

Taiwan: In Taiwan the Japanese established two superphosphate plants owned by the "Taiwan Fertilizer Company." During the war both of these plants were damaged but were reconstructed afterwards. The Taiwan Fertilizer Company produced 30,000 tons of superphosphate in 1948 which increased to 66,000 tons in 1952.[2] Since then the requirements of the Formosan farms have been increasing and fertilizer production has not been sufficient to supply the needs of the Island. Thus Formosa is considered a potential purchaser of phosphate. Being in Jordan's logical marketing area she is expected to partially depend on Jordanian supplies.

Pakistan: Her fertilizer consumption has been very low. But the

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[1] Ibid.

[2] M.M. Alicante, "The Fertilizer Problem in the ECAFE Region," Journal of the Soil Science Society of the Philippines, (Manila, first quarter, 1953), p. 22.

successive five-year development plans of Pakistan have considered the establishment of superphosphate factories. The sulphuric acid industry serves as a basis for these factories. In fact, the districts of Karachi, Punjab and East Bengal supply part of the superphosphate needs of the country.[1] As shown earlier, Pakistan is considering the consumption of 90,000 tons of phosphate by 1970.

Malaya: In the Malayan Federation fertilizers are used on rubber, the main commercial crop. Young rubber plants in their first years of growth respond principally to phosphatic fertilizers. Ground phosphate rock is also used and Malaya is importing 10,000 tons of this material from Christmas Island each year.[2] After the Japanese evacuated Malaya, the use of phosphate increased so remarkably that a superphosphate plant with a capacity of 100,000 tons per year is under consideration.[3]

Philippines and Ceylon: While fertilizers are very much needed in the Philippines there has been no domestic fertilizer industry in those islands for growing sugar cane, rice and corn. In the post war period projects were developed for the establishment of a superphosphate plant with 75,000 short tons annual capacity. The plant would obtain sulphuric acid from domestic pyrites and phosphate rock would be imported. The superphosphate factory would cover about 15 per cent of domestic requirements, which are estimated at 500,000 metric tons.[4]

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[1] Government of Pakistan, Second Five-Year Plan, (Rawalpindi, 1964) p. 171.

[2] Parsons Corporation, op.cit., p. 40.

[3] Federation of Malaya, Department of Agriculture, Malayan Agricultural Statistics (Kuala Lumpur, 1961), p. 81.

[4] Lamer, op.cit., p. 445.

Ceylon is importing comparatively large quantities of fertilizers for use on rubber, tea and rice. The World Bank representatives, who investigated the problem of the fertilizer plant in Ceylon, came to the conclusion that it is economically more desirable for the island to import fertilizers than to establish an expensive fertilizer plant without raw materials.[1] However, Ceylon imports Jordanian crushed phosphate for use in tea farms and rock phosphate from Makatea Island whose deposits were described previously as approaching depletion.

Existing Markets

Jordan's phosphate market extends to many countries. Only the most important consumers will be reviewed here.

Czechoslovakia:[2] Available information indicates that imports of rock by this country have been growing at a rate of over thirty per cent per year during the past four years. Recently, North Africa has supplied fifty per cent of Czech requirements, while Egypt and Jordan twenty-five per cent. The 1962 phosphate fertilizer production of Czechoslovakia reached 176,000 tons.

India: India's cultivated lands are quite wide with a low yield per acre. Therefore, a large consumption of fertilizers is needed. Although there are problems facing the wide use of fertilizers (such as farmer education and foreign exchange) the use of phosphate has been

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[1] International Bank for Reconstruction and Development, The Economic Development of Ceylong (Baltimore: Johns Hopkins Press, 1953), p. 553.

[2] Parsons Corporation, op.cit., p. 32.

centered upon. Rock imports have increased in the last three years with Jordan supplying about forty per cent of these imports (see table 19).

While India supplies a few thousand tons per year of her rock, no deposits which offer any hope of significant production have yet been discovered. However, production of phosphate fertilizers is considerable; there are 15 plants in operation and 21 additional plants licensed for construction.[1] Based on unofficial estimates, India's requirements of phosphate rock will be 600,000 tons in 1965, 1,650,000 tons in 1970 and 3,000,000 tons in 1975 (see also table 17).

The degree of success which the Indians realize in expanding their consumption of phosphate during the next five years will be one of the greatest single factors affecting the market potential for Jordan's phosphate rock. Likewise, Jordan's ability to arrange to take goods in return for rock will directly affect her program of sales to India.

Japan: This country is the world's largest importer of phosphate rock and the fifth largest consumer of phosphate fertilizers.[2] In Japan "the fertilizer industry accounts for more than 20% of the total shipments of the chemical industry. The basis for the industry's growth has been the large expanding domestic market and the government control on all fertilizer imports. In the fertilizer year 1960-1961 production of phosphatic fertilizers reached 504,075 tons (an increase of 17.2% in the five-year period

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[1] Fertilizer Association of India, Fertilizer Statistics (Bombay: 1962/163), p. 24.

[2] "Japan's Fertilizer Industry Expanding," The Journal of Phosphorus and Potassium, London, June 1962, p. 7.

1955-1960). Imports of phosphate rock now total more than two million tons a year--double their 1950 level."[1]

In the last eight years Japan's imports have been divided among: Florida sixty-eight per cent, Makatea eleven per cent, Morocco eight per cent, Tunisia two and a half per cent, Egypt four and a half per cent, Jordan less than one per cent, and the rest divided among Israel, Senegal, Togo and North Vietnam.[2]

The Japanese Government has plans for increasing the level of agricultural productivity during the next ten years in order to release farm laborto Japanese industry.[3] To enable this reduction of farm manpower, higher concentration of fertilizers resulting in emphasis on production of concentrated materials is expected. This will require a higher grade of phosphate rock some of which is available in El-Hasa deposit. The Japanese Government exercises no central over imports of phosphate rock and foreign exchange is freely available for its purchase.

The increase in Japan's imports is not expected to match the level of 1950's. An average of four per cent per year is estimated bringing the imports to 2.5 million in 1965, 3 million in 1970 and 3.5 million in 1975 (see table 18).

Yugoslavia: Imports of phosphate rock into Yugoslavia have been

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[1] Ibid.

[2] Parsons Corporation, op.cit., p. 38.

[3] The Journal of Phosphorus and Potassium, loc.cit., p. 8.

increasing at the rate of about 15% per year over the past five years.[1] The great proportion of these imports are supplied by Jordan. If rock needs by Yugoslavia continue to grow at the rate of fifteen per cent per year, the total imports would amount to 450,000 tons by the end of 1965. If Jordan can renew the present agreement with the Yugometal Enterprise her sales to Balkan countries would absorb a good portion of projected production.

Italy: In Europe, Italy is the second after France in phosphate importation. In 1962 Italy's imports amounted to 1,541,000 tons supplied by Florida, Morocco, Togo, Tunisia and Algeria.[2] It is sure that Jordan's competitors do not have a big advantage over her because the distance between Italy and Aqaba is shorter if compared to the distance between Italy and Florida. After being convinced of Jordan's phosphate quality Italy imported 45,000 tons of thismaterial in 1964. In Italy there are about 65 superphosphate plants seventy-five per cent of which is controlled by Monticatini Corporation.[3] Thus Italy is a major producer of superphosphate. Since her deposits of phosphate rock are little, she is a major importer of phosphate rock. (See table 23 for Italy's projected imports by 1975).

Turkey: Turkey had no superphosphate factories before the Second War. However, consumption of phosphate by Turkey doubled over a period of

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[1] Food and Agriculture Organization of the United Nations, Fertilizers (Rome: 1964), p. 85.

[2] Ibid.

[3] Lamer, op.cit., p. 320.

only two years. In 1962 her imports of phosphate amounted to 46,000 tons raised to 100,000 tons in 1964.[1] Almost all of Turkey's 1964 imports were supplied by Jordan. Superphosphate production in Turkey is expected to increase with the subsequent increase in phosphate imports if no foreign exchange difficulties arise.

Poland: In 1962 Poland purchased 582,000 tons of phosphate of which Jordan's share constituted 9000 tons while the rest was imported from North Africa.[2] Jordan is apparently at a disadvantage relative to North African suppliers, but Poland buys Jordanian phosphate in order to maintain her good economic relations with the country.

Bulgaria: Like Turkey, Bulgaria had no superphosphate plants before the Second War. Although it is not possible to obtain correct figures about the imports of Bulgaria, they were estimated at 62,000 tons of phosphate in 1962.[3] Jordan's prices seem to suit Bulgarian importers and in 1964 Jordan deliveries to Bulgaria amounted to 24,000 tons.

Lebanon: No commercially exploitable phosphate deposits have been found in Lebanon. All Lebanese needs of phosphate have been imported from Jordan. Future needs are also expected to be imported from Jordan. The same is true for Syria and Iraq.

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[1] Abu Hassan, op.cit., p. 8.

[2] Ibid., p. 9.

[3] Ibid.

Concluding Remarks

It may be concluded from the previous arguments that Jordan's future market for phosphate is promising. Although the future is uncertain, projection can be made on the basis of available historical data, allowing for unpredictable variables. In summary, the prospected exports of Jordan's phosphate can be shown as follows:

Year	Exports to countries East of Suez	Other Exports
1965	514,000 metric tons	467,000 m.t.
1970	1,077,000 " "	625,000 "
1975	1,749,000 " "	806,000 "

Hence, measures should be taken to assure the availability of 981,000 tons of phosphate for the fertilizer year 1965-1966, about 1,702,000 tons for 1970-1971 and 2,647,000 tons for 1975-1976. In order to benefit from Aqaba as the preferred port for shipment to Asia, and relieve pressure on Russeifa deposits, it appears imperative to proceed in the execution of the El-Hasa Phosphate Project. El-Hasa deposits assure the availability of higher grade phosphate expected to be required by countries like India and Japan.

The construction of a drying kiln in El-Hasa and the establishment of a warehouse with enough capacity to accommodate all dried material, are two facilities urgently needed. Moreover, facilities for storing and loading on board ships at Aqaba port should be improved. Even the present

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[1]Higher-grade phosphate contains seventy-four per cent TCP or more.

level of operations can hardly be accommodated at Aqaba.

Expanding Jordan's market for phosphate not only necessitates aggressive marketing techniques and an improved overseas representation. More important is revising the pricing system of the JPMC. The actual price that a rock purchaser would be willing to pay for rock from a new source can be determined only by a trial of the new rock in his plant and comparison of all costs involved in coverting the rock to product. Intangibles that would have some monetary value include assurance of supply, consistant quality, guaranteed transport rate, on time delivery and reciprocity.[1] Absence of any one of these attributes decreases the price that a purchaser can afford to pay and affects his position as a loyal customer.

Jordan Government can play a positive part in capturing new markets for phosphate. The time has come to coordinate Jordan's foreign trade policy in a way that takes into account the marketing of phosphate, Jordan's most important export. Most of Jordan's balances of payments show that her imports are mainly from countries that do not buy Jordan's phosphate. These countries, however, obtain their phosphate from other sources. It sounds practical therefore to establish a "phosphate marketing bureau" in which the Ministry of Economy, Currency Department and the JPMC are represented. This bureau could be provided by commercial attaches for the purpose of revising the Jordanian balance of payments, and setting a plan

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[1] Stanford Research Institute, Markets for Jordan Phosphate Rock, op.cit., p. 109.

for importation aiming at cooperating with countries that import Jordan's phosphate. Representatives of the Currency Department can work out plans with countries that lack foreign exchange but who are willing to buy phosphate on a barter basis.

CHAPTER V

THE INDUSTRY IN PERSPECTIVE

Expansion of Mining Operations

The El-Hasa phosphate project: Reference has been made to the prospected expansion of phosphate mining industry in Jordan. Although this mineral is located in areas of the country other than Russeifa and El-Hasa, at present, mining operations are expected to extend at a large scale to El-Hasa area, 170 miles to the south of Amman.

The Jordan Phosphate Mines Company obtained a concession for mining El-Hasa phosphate in 1960. Since then El-Hasa production has never exceeded 60,000 tons of dried product per year. It will be recalled that Russeifa output is about 500,000 tons yearly. However in 1962 the Government of Jordan started to consider the expansion of the phosphate industry. Plans were set and international mining and business consultants were asked to conduct geological surveys and economic feasibility studies of the El-Hasa area. The results of these studies were encouraging. The economic feasibility report prepared by Parsons Corporation expressed the possibility of extracting from El-Hasa about one million tons of phosphate ore by 1970.

It is envisaged that the proposed expansion will be handled by an enlarged company with the JPMC as its nucleus. Moreover the JPMC will be granted a concession for mining Jordanian phosphate wherever it is located. Its capital will be increased from JD 1.2 million to JD 5.0 million, the

increase contributed mostly by the Government of Jordan.[1]

Impact of the El-Hasa Project: The expansion of the phosphate industry will enable Jordan to produce various grades of phosphate which make it easier to deal with different international phosphate consumers. Steps are taken to push this scheme forward. The cooperation of international firms has been obtained in order to assure the availability of necessary machinery and equipment for the execution of El-Hasa Phosphate Project.[2]

Once the El-Hasa Phosphate Project in full operation, phosphate production by Jordan will be approximately one and a half million tons. Assuming that prices remain constant the phosphate industry in Jordan will generate, by 1975, a gross income of about eight million dinars of hard currency. A secondary benefit will occur with respect to the balance of payments. Thus the future contribution of the industry to the hard currency pool is estimated at twelve million dinars annually.[3]

Expansionary programs for the Jordan phosphate industry should not be limited to the remarkable increase in phosphate rock production. The possibility of processing phosphate rock in Jordan is not remote. It has been studied in detail and the results of this study are presented in the following section.

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[1] Yusuf an-Nimri, The Jordan Phosphate Mines Company (mimeo.), Amman, 1965, p. 8.

[2] Interview with the chief mining engineer, in the Ministry of Economy, Amman, April 12, 1965.

[3] An-Nimri, loc.cit., p. 10.

Jordan Phosphate Processing

General Considerations

The greater part of the food supply of the human race comes directly from the soil in the form of vegetables and grains, or indirectly as meat from domestic animals fed on the products of the cultivated soil. The world's agriculture requires the following substances to assure growth and food production: water, nitrogen, phosphorus, potassium, calcium, and sulphur.[1] These substances are applied to the soil in the form of fertilizers.

Although world production of phosphate rock has been increased during the last ten years at an annual rate of five per cent, world fertilizer consumption has been increasing at an annual rate of seven per cent.[2] The prospects of such increase offer Jordan a chance for increasing her production and exportation of fertilizers.[3]

Generally speaking, when a decision is made to build a fertilizer manufacturing facility

> ... it is essential that the choice of process be such as to produce the kinds of fertilizer materials which are suited to the crops, soils, and climate conditions in theareas in which they will be used. Once the desired characteristics of the end products have been determined, attention then may be given to the economic and technical aspects of producing such products.[4]

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[1] Gilbert Collings, Commercial Fertilizers: Their Sources and Uses (Philadelphia: Blakiston, 1950), p. 123.

[2] "A Report on El-Hasa Phosphate Project Prepared by a Team of Jordanian Trainees" (Jordan Development Board, Amman, 1963), p. 41 (Mimeographed).

[3] A small superphosphate plant is now operated by JPMC in Russeifa. Another superphosphate factory was established in Palestine in 1942/43. This factory succeeded in supplying Palestine superphosphate needs. Small quantities were exported but the plant closed in 1946 because of competition from foreign supplies. See Lamer, op.cit., p. 303.

[4] Lamer, op.cit., p. 176.

Feasibility of Processing

In studying the feasibility of establishing a phosphate fertilizer manufacturing industry in Jordan the following factors should be considered.

1. Market potentials for the various kinds of phosphate fertilizers.

2. The availability of raw materials required such as phosphate rock, sulphur or any other substitute, water, and power needed.

3. The initial capital investment requirements and payout returns.

4. Jordan's technical know-how and ability to run and maintain the manufacturing plantsand supporting facilities.

Market potential: Comprehensive market surveys were conducted by international consultants to ascertain the salability of Jordanian phosphatic fertilizers. The resultsof these surveys are reproduced in Appendix IV, table 7. The table reveals that Jordan's potential sales of normal superphosphate[1] are estimated at 164,000 tons in 1967, 191,000 tons in 1970 and 215,000 tons in 1975. If materialized, these sales would establish an economic basis for a Jordanian superphosphate factor.

In view of the factors mentioned in the footnote below regarding the difficulty of producing triple superphosphate, it should be wiser to disregard, for a time, the manufacture of this fertilizer in Jordan.

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[1]There are two kinds of phosphat fertilizers: normal superphosphate and triple superphosphate. The former contains 18-20 per cent of phosphoric Pentoxide (P_2O_5) while the latter contains 44-50 per cent of P_2O_5. Both of them could be produced by Jordan. However, the manufacture of triple superphosphate is so complicated and entails greater capital investment and labor and processing costs than those required by a normal superphosphate plant. The above market studies on Jordan's phosphate fertilizers have indicated that triple superphosphate potential sales would be less than the economic level which Jordan can produce of this fertilizer.

However, when the market potential warrants the establishment of a triple superphosphate manufacturing facility, such a venture may be considered.

Raw materials: The normal raw material requirements for the production of one ton of normal superphosphate, as supplied by the chemical engineer of the small superphosphate plant in Russeifa, are as follows:

Material and Overhead	Average Quantity
Phosphate rock (77% TCP, 33% P_2O_5)	0.600 ton
Sulphuric acid (93% or 98%)	0.420 ton
Water	0.500 ton
Electricity	26.00 KWH
Fuel oil	7.1 Gallons

Sulphuric acid is seen to be basic to the manufacture of superphosphate; it accounts, on the average, for 40.1 per cent of the total cost of manufacturing this fertilizer, thus ranking second to phosphate rock which carries 52.6 per cent.[1]

Sulphuric acid is the workhouse of industry and the king of chemicals. It is so indispensible in modern industry that its consumption is a reliable index of a nation's industrial activity.[2] Moreover, a high demand not matched by an adequate supply assures high prices in the world market. Therefore the acid could not possibly be imported by Jordan. A sulphuric acid plant is needed if a superphosphate plant is to be established in Jordan.

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[1] Lamer, op.cit., p. 150.

[2] Ibid.

Traditionally, sulphuric acid is manufactured by using one of the following as a main raw material: elemental sulphur, Pyrite (FeS_2), or Anhydrite ($CaSo_4$).[1] The cost of making one ton of sulphuric acid using each of these methods is shown in Appendix IV table 2. The table shows that using sulphur (which is not available in Jordan) is the cheapest way of producing the acid. The second cheapest is the anhydrite process.

This process consists of charging into a kiln a carefully blended mixture of crushed and sized gypsum, coke and shale. The kiln is then fired with pulverized coal. Reactions on several stages take place which yield sulphuric acid and cement as a by-product.[2] It is possible that this process can be successfully employed in Jordan. It will have two advantages:[3]

a. The operation will eliminate the need for importing sulphur, thereby reducing the flow of foreign exchange out of the country.

b. The by-product, portland cement, is in demand in Jordan and can be sold at market value. This is very beneficial since for every ton of sulphuric acid produced a ton of portland cement is turned out as a by-product.

Capital required: From an economic feasibility viewpoint the minimum production level of sulphuric acid should be 550 tons per day,[4] or 165,000

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[1] Jordan Development Board (Trainees Report), op.cit., p. 49.

[2] Interview with the JPMC chief chemical engineer, April 16, 1965.

[3] Ibid.

[4] W.H. Waggaman, Phosphoric Acid, Phosphates and Phosphatic Fertilizers (New York: Prentice-Hall Inc., 1952), p. 278.

tons annually (assuming three hundred working days per year). The daily capacity of the Jordanian sulphuric acid plant should, therefore, be at least 550 tons. The total capital investment for such a plant is estimated at $1,650,000, while the estimated cost of manufacturing a ton of this acid is estimated at $12.12 (see Appendix IV, table 6), or a total of $6866.54 per day at the rate of 550 tons of daily production. Assuming three hundred working days per year, the total manufacturing cost of sulphuric acid will be $2,059,962.00.

Normal superphosphate production: Economic feasibility studies show that the minimum production level of a normal superphosphate plant should be 100,000 tons per year with three hundred working days. This level of production is by far below Jordan's potential market for this material. However, the following appraisal of the unit cost of normal superphosphate production will be based on the minimum economic capacity of the plant, namely 100,000 tons a year.[1] Extrapolations would show that the per unit cost for a plant having a capacity of more than 100,000 tonsis expectedly lower.

Reference to Appendix IV, table 5 indicates that the cost of producing one ton of normal superphosphate at a plant having a capacity of three hundred tons a day is estimated at $12.28. In other words the total manufacturing cost per day would amount to about $3685.00.

Capital expenditures: For such a plant of superphosphate capital

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[1] Ibid.

requirements are estimated as follows:[1]

Item	Cost
Rock grinding equipment	$ 44,000
Acid dilution equipment	24,000
Dens	16,000
Conveying and storage facilities	320,000
Grinding and bagging product facilities	40,000
Building	116,000
Contingencies	64,000
Total	$624,000

Since the potential market for Jordanian normal superphosphate exceeds 100,000 tons, Jordan would need a plant with a higher capacity. It was stated earlier that Jordan expects to sell about 215,000 tons of her fertilizer by 1975. This implies that a plant with a capacity of at least 250,000 tons of normal superphosphate should be planned. Extrapolations can then be made to figure out the total capital requirements for constructing such a plant.

For operating any plant at Aqaba, Jordan needs a power-generating plant. Therefore at the place where the superphosphate and sulphuric acid plants are to be built, an electrical power plant should be constructed. It has been found that such a plant, when constructed at Aqaba, would cost $970,000.[2] The cost of a water processing plant, which is also needed for

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[1] Approximated from cost estimates published by the Sulphur Institute, Technical Bulletin No. 8, London, February 1964.

[2] Jordan Development Board, Trainees Report, op.cit., p. 58.

the fertilizer plant, is estimated at $56,000.[1]

In summary, the estimated total capital investment for the whole operation is summarized as follows:

Item	Cost
Sulphuric acid plant (165,000 tons annually)	$ 1,650,000
Normal superphosphate plant (100,000 tons annually)	624,000
Electrical power plant	970,000
Water process plant	56,000
Total	$ 3,330,000

These costs compared favourably with costs of similar plants in the United States. It was estimated that a normal superphosphate plant alone with an annual capacity of 330,000 tons per year would cost one and a half million dollars in the United States.[2] The sulphuric acid, power, and water processing plants would involve extra outlays.

Plant location: The location of a phosphate fertilizer plant is functionally related to the accessibility of phosphate rock, water, fuel, power, and sulphuric acid. Choice of location has also to do with the port from which the fertilizers will be exported.

The market potential studies indicated that three quarters of Jordan's fertilizer will be shipped to the market east of Suez. Hence, most of fertilizer exports will be made through the Port of Aqaba. It is more reasonable and economical, therefore, to construct both the super-

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[1] Ibid.

[2] Waggaman, op.cit., pp. 287-288.

phosphate and sulphuric acid plants near Aqaba. In assessing the availability of water for use in the Jordan fertilizer industry, Aqaba has also been found to be one of three best places. The other two are Russeifa and River Yarmouk area.[1]

Revenue realization: It appears convenient to calculate at this stage realizable revenue from operating a superphosphate plant in Jordan. Price movements of superphosphate do not show any apparent relationship to prices of phosphate rock and sulphuric acid.[2] However, the price of Jordanian superphosphate has been conservatively estimated at $18.60 per ton, f.o.b. Aqaba (see Appendix IV, table 5). Assuming that in the first year of operations 100,000 tons of superphosphate will be sold, the total realizable sales revenue will be $1,860,000.00. Since the production cost per ton--direct and indirect--is estimated at $12.28 (Appendix IV, table 5), the total production cost will be $1,228,000.00. Hence a net earning of about $632,000 per year is generated. Considering the total capital expenditures needed the payout period has been calculated as five years. This is relatively high. It is explained by the fact that the superphosphate plant will have to carry the cost of sulphuric acid and electrical power plants.

Jordan's technical know-how: Jordan does not completely lack the technical know-how for operating and managing her proposed superphosphate

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[1] Jordan Development Board, Trainees Report, op.cit., p. 61. River Yarmouk is one of the tributaries of River Jordan.

[2] Lamer, op.cit., p. 148.

plant. It will not be the first time to establish such a plant in the country. However, since the new plant is larger, the need may arise for importing some foreign experience and technical knowledge.

Sources of funds: It was mentioned earlier that the proposed fertilizer plant should be of about 250,000 tons annual capacity. Such a factory will necessitate a bigger sulphuric acid plant. The total cost of constructing such plants will expectedly be higher than those mentioned in the previous analysis; actually it has been estimated at about ten million dollars.[1]

In order to obtain the best result from this factory it is believed that a separate company forhandling this project is to be formed. The Government of Jordan will insist on possession of a reasonable share in this company. To procurethe remaining necessary capital, the following sources may be recommended:

1. Issuing shares by the new company handling the superphosphate project to either Jordaniansor other Arabs.

2. Obtaining loans from oil-rich Arab states.

3. Obtaining loans from the International Bank for Reconstruction and Development or similar sources.

Future of the Industry and Public Policy

Jordan leads a structure of economy which maintains a free enterprise society. In Jordan it is believed that individual financiers should

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[1]Jordan Development Board, Trainees Report, op.cit., p. 65.

be given ample protection which encourages them to invest their capital in national industries. Moreover, foreign investors have been given every possible encouragement for employing their funds in Jordanian industries.

Jordan has been adopting this policy since her creation as an independent state. This is at the same time when the neighbouring Arab states have embarked on some sorts of quasi-controlled economic systems especially in the last five years. Although the Government of Jordan does provide guidance to some business enterprises it limits this guidance to positive stimulation and qualified support within a basically free economic system. Mention was previously made of some regulations which restrain this system. These regulations include the enforcement of the Labor Compensation Law, imposition of production tax on local manufacture immuned from foreign competition, and determination of prices of protected manufacture.

The policy of the Government of Jordan towards the phosphate industry is not expected to change. The government now owns 50.4 per cent of the capital of the phosphate mining company. The government is also expected, as shown before, to contribute a larger proportion of the capital required for financing the expansion of phosphate mining operations to El-Hasa, as well as for building the fertilizer company.

However, within the foreseeable future nationalization of the phosphate industry is not envisaged. The present pattern of Jordanian public policy towards phosphate and other industries is expected to prevail. The government's role is to initiate industrial expansion, and participate in that expansion up to varying degrees.

SUMMARY AND CONCLUSION

Jordan's production of phosphate is expected to rise substantially. Studies conducted by international consultants indicated that Jordan's annual capacity of El-Hasa phosphate should be around one million tons by 1970. Moreover, production of El-Hasa and Russeifa mines is scheduled to approach two million tons of mined ore by 1975.

Throughout this research, three major issues facing the phosphate industry in Jordan have been dealt with. The first is the marketing problems of the industry, with transportation as the most important. The second is the marketing potential for the proposed expansion in Jordan's phosphate production. The third is the feasibility of establishing a superphosphate fertilizer at Aqaba.

Transportation:

Regarding this issue, the following findings were ascertained:

a. Practically about two thirds of Jordan's phosphate (mostly from Russeifa) are shipped through Aqaba Port and the rest through Beirut Port. Railway and highway vehicles are used in both cases.

In view of long distance between phosphate mines and ports of export, transportation cost is almost twice as much as the cost of production and mining. Therefore, ways should be sought to reduce these costs.

b. Transport-cost savings: El-Hasa - Aqaba route is shorter than that of Russeifa - Aqaba or Russeifa - Beirut. Movement of rock from El-Hasa to Aqaba is therefore cheaper than movement on any of the two

other routes. Hence all amounts exported through Aqaba Port should be extracted from El-Hasa. Also, the principle of transport cost savings necessitates that all amounts exported through Beirut should be produced from Russeifa.

c. Means of transport: It was shown that railway cars cannot accommodate the shipment of Russeifa phosphate. Trucks should therefore be used along with trains.

For shipment of El-Hasa phosphate it was found that highway vehicles are more convenient than railway cars. This is due to the large capital investment required for constructing El-Hasa - Aqaba railway line and purchase of railway locomotives and related equipment. However, the study revealed that it would be cheaper and wiser to lease rather than purchase highway vehicles.

Market Potential

International market potential for phosphate rock showed that demand has increased by five per cent annually. In Asia this increase is expected to be greater. Thus Jordan's potential market for phosphate is promising. Future sales of Jordan's product are expected to be made in the area East of Suez Canal. This however, does not preclude that the country will be able to compete successfully, on the basis of her location - for the East Mediterranean countries. In fact, one third of Jordanian produce will be marketed in this area.

Superphosphate Production

The study indicated that the manufacture of normal rather than triple superphosphate is more profitable for Jordan. The latter requires

a large capital investment and entails more labour and processing costs. However, the normal superphosphate, when manufactured alone, will carry the capital investment for the sulfuric acid plant. Yet the simple manufacturing process and the large revenue realizable from sale of normal superphosphate are two offsetting factors. Moreover, the proposed capacity of the normal superphosphate plant (200,000 tons annually) is less than Jordan's potential market for this product; just to be on the safe side.

Appendices

APPENDIX I

JORDAN PHOSPHATE MINES COMPANY

STATEMENT OF TRADING AND TRANSPORT ACCOUNTS FOR THE YEARS 1963-1964

Items	1963	1964
Cost of production and mining (Brought from table No. 5).....	815248.675	758694.381
Stock of phosphate at Beginning of the Year.....	562458.400	746674.800
Total.....	1,377707.075	1,513502.737
Expenses and Cost of Transportation to Beirut:		
By Trucks to Beirut.....	59192.937	58069.823
" " " Chekka*	16247.085	29805.823
By Train in Jordan	9558.222	19335.120
" " " Syria	27466.520	50982.315
" " " Lebanon	20009.996	41767.742
Expenses at Beirut Port	36749.914	50513.317
Commission paid to Beirut Agents	1710.255	2370.900
Export Declaration Fees and Stamps	219.975	400.925
Transit Fees	3150.949	1010.215
Administrative Expenses at Beirut	1295.652	2780.791
Total.....	173460.781	259177.050
Expenses and Cost of Transportation to Aqaba:		
By Trucks to Aqaba	190602.541	412050.914
By Train to Ras El-Naqab**	39591.310	13120.621
Trans-shipment by Trucks from Ras El-Naqab to Aqaba	12182.524	11755.659
By Trucks from El-Hasa to Aqaba	19918.007	61701.752
Export Declaration Fees and Stamps	11.930	51.610
Port Fees at Aqaba Port	39477.743	48441.380
Overtime to Employees at Aqaba	1446.300	2677.250
Departmental Expenses at Aqaba	10557.536	10179.041
Agents Commission	2601.061	12112.467
Sea Transport Expenses of Jorphos	34047.835	123266.070
Marine Insurance Premiums	867.943	2828.400
Total.....	351304.830	138206. 937
GRAND TOTAL	1,902472.576	2,470864.987

Source: Jordan Phosphate Mines Company, Accounting Department, (Files of the Department.)

* A place near Tripoli where Lebanese Chemical Company is located.

** Where the Hedjaz railway line ends.

APPENDIX II

TABLE 1

OUTPUT OF PHOSPHATE ROCK IN SELECTED WORLD COUNTRIES
(Thousands of Metric Tons)

Country	1952-56	1957	1958	1959	1960	1961	1962
France	99.0	72.4	68.9	41.1	75.0	75.0	22.7
U.S.A.	13,280.0	14,923.0	15,293.0	15,500.0	17,516.0	18,559.0	196,692.0
U.S.S.R.	4,425.0	5,660.0	5,910.0	5,910.0	6,490.0	7,580.0	UA*
India	4.0	9.3	14.8	14.2	14.0	20.0	—
Israel	59.0	213.9	204.9	226.1	221.0	222.0	206.0
Jordan	100.0	261.8	293.9	337.6	391.6	444.9	681.0
Algeria	680.0	613.1	560.9	531.4	554.0	419.0	433.0
Morocco	4,720.0	5,567.0	6,336.0	7,164.0	7,354.0	7,824.0	8,161.0
Senegal	83.0	89.8	104.6	95.3	210.0	200.0	341.0
Togo	—	—	—	—	—	278.0	2 199.0
Tunisia	1,985.0	2,067.0	2,278.0	2,184.0	2,063.0	1,950.0	2,103.0
U.A.R.	552.0	134.2	124.1	123.1	558.0	560.0	561.0
Nau'u Island	1,243.0	1,201.0	1,222.0	1,255.0	1,351.0	1,281.0	1,807.0
Christmas Island	342.0	347.0	368.0	369.0	503.0	694.0	317.0

Source: 1) Data for the years 1952-56 and 1960, 1961 are obtained from: United States Department of Interior, Bureau of Mines, Minerals Yearbook (Washington: U.S. Printing Office, 1961) p. 984.

2) Data for the years 1957, 58, and 59 are obtained from: Food and Agricultural of the United Nations, Fertilizers (Rome: 1960) p. 73.

3) Data for 1962 obtained from: Mamduh Abu Hassan, Report Submitted to the JPMC Board of Directors (Unpublished Report written in 1960), p. 22.

* Unavailable.

APPENDIX II

TABLE 2

CONSUMPTION OF PHOSPHATE FERTILIZERS IN SELECTED WORLD COUNTRIES

(Thousands of Metric Tons)

Country	1955	1956	1957	1958	1959
France	629.3	674.2	760.2	764.4	783.0
West Germany	473.5	566.5	584.0	617.9	706.9
Italy	419.7	391.4	384.2	380.8	389.0
Poland	150.6	156.4	148.8	256.0	296.0
Spain	268.1	271.8	281.9	316.0	278.0
U. K.	369.2	356.9	354.8	372.0	428.0
Yugoslavia	19.7	27.5	57.2	76.3	95.9
Canada	107.5	112.9	125.9	124.5	—
Mexico	27.0	22.1	29.1	27.7	28.0
United States	2129.0	2179.0	2163.0	2406.0	2314.0
Chile	—	35.0	34.0	27.0	29.0
Ceylon	1.5	2.9	2.2	2.6	1.7
China	30.8	26.2	27.9	35.3	37.2
India	12.1	17.7	25.9	34.6	41.7
Japan	318.0	337.0	290.0	389.0	436.0
Lebanon	4.0	4.7	6.8	8.4	9.1
Union of South Africa	119.0	142.8	132.4	134.8	132.1

Source: Food and Agricultural Organization, Fertilizers (Rome: 1960), p. 80.

APPENDIX III

APPROXIMATE DISTANCES BETWEEN SELECTED WORLD PORTS

(Hundreds Of Nautical Miles)

TO	FROM Aqaba Jordan	Tampa Florida	Sfax Tunisia	Casablanca Morrocco	Beirut Lebanon
Hull, U.K.	37a	44	25	16	34
Barcelona, Spain	19a	46	6	7	17
Piraeus, Greece	9a	56	7	17	6
Karachi, Pakistan	28	89a	41a	51a	—
Calcutta, India	46	108a	59a	69a	—
Yokohama, Japan	78	91b	91a	101a	—
Wellington N.Z.	90	78b	102a	105c	—
Sydney, Australia	82	90b	95a	105a	—
Capetown, South Africa	51	69	62	50	—

Source: U.S. Navy Department, Hydrographic Office, "Table of Distances Between Ports" (Washington, U.S. Government Printing Office, 1943), pp. 10-12.

a. Via Suez Canal
b. Via Panama Canal
c. Via Strait of Magellan

APPENDIX IV

TABLE 1

REQUIREMENTS TO MAKE ONE TON OF SULPHURIC ACID BY THE ANHYDRITE PROCESS*

Materials	
Anhydrite (94% Purity)	1.60 - 1.80 Tons
Shale (as quarried)	0.35 - 0.36 Tons
Coke (as received)	0.14 - 0.15 Tons
Nondulizing water	0.22 Tons
Service and Fuel	
Coal	0.25 Tons
Water	3600 Gallons
Electricity	280 - 300 KWH
Oil	32 lbs.
Labor	
Mine	36.5
Preparation Raw Material	8.5
Klin Operation	7.5
Gas Cleaning	4.0
Cement Production	4.5
General Labor	4.0
Maintenance	22.5
Laboratory Control	10.5
Supervision and Overhead	2.3

* Supplied by the chief chemical engineer of the JPMC superphosphate plant at Russeifa. Interview April 16, 1964.

APPENDIX IV

TABLE 2

COST OF MAKING ONE TON OF SULPHURIC ACID (100%) USING VARIOUS SOURCES OF SULPHUR

	Elemental Sulphur	Pyrite FeS_2	$CaSO_4$ Anhydrite
Raw Material	$ 10.32	$ 13.16	$ 6.16
Conversion Cost Including Fuel	2.82	6.16	11.48
Overhead, Interest, Depreciation	3.26	7.00	10.92
Total	$ 16.40	$ 26.32	$ 28.56
Credits	0.84	0.84	5.88
Net Total	15.56	25.48	22.68

Ibid.

APPENDIX IV

TABLE 3

ESTIMATED COST OF MFG. TRIPLE SUPERPHOSPHATE (50% P_2O_5) @ PLANT HAVING A CAPACITY OF 450 TONS PER DAY 150,000 TONS TRIPLE SUPERPHOSPHATE ANNUALLY*

DIRECT COST	DAILY COST
900 Ton Phosphate Rock @ $7.00/ton	$ 6300.00
630 Ton Sulphuric Acid @ $11.34/ton	7144.20
693 Ton Wash Water (63M^3) @ $0.025/$1M^3	17.30
136 Kwh/ton Elect. (61200Kwh.) @ $0.02 Kwh.	1224.00
1195 Gallons Fuel Oil @ $0.10/gallon	119.50
Maintenance @ 0.50/ton of Triple Superphosphate	225.00
Total Direct Cost	$15255.00

INDIRECT COSTS	
Depreciation (on $3875,000) @ 10%	1174.20
Interest (on 3,875,000) @ 4$	470.00
Indirect cost (Engr., Acct., Personnel.)	457.65
Contingencies @ 10% of Direct Cost	1525.50
Grand Total	$18882.15

Per ton of triple superphosphate: 18,882.15/450 = $41.96

Per 150,000 tons = $6,2941000/gr.

Realizable sales price per ton = $50.00

Per 150,000 tons = $7,500,000

Net Gaining 1,306,000/yr.

Jordan Development Board, "A Report on El-Hasa Project Prepared by A Team of Jordanian Trainees", Amman, 1963, p. 111. (Mimeographed.)

APPENDIX IV

TABLE 4

ESTIMATED COST OF MANUFACTURING TRIPLE SUPERPHOSPHATE (50% P_2O_5) @ PLANT HAVING A CAPACITY OF 300 TONS/DAY OR 100,000 Tons/Yr.*

DIRECT COST	DAILY COST
600 Tons Phosphate Rock @ 7.00/ton	$ 4200.00
420 Tons Sulphuric Acid @ 12.12/ton	5090.00
462 Tons Wash Water (420M^3) @ \$0.025/M^3	10.50
136 Kwh/ton Elect. (40,800 Kwh.) @ \$0.02/Kwh.	816.00
810 Gallons Fuel Oil @ \$0.10/gallon	81.00
Maintenance @ 0.50/ton	150.00
Labor @ \$0.50/ton	150.00
Total Direct Cost	$ 10497.90

INDIRECT COST	
Depreciation (on \$2750,000) @ 10%	833.33
Interest (on \$2750,000) @ 4%	333.33
Indirect Cost (Engr., Acct., Etc.) @ 3%	319.44
Contingencies @ 10% of Direct Costs	1064.79
Grand Total	$ 13048.79

Total Cost Per ton of Triple Superphosphate
(50% P_2O_5 13048.79/300 = 43.50
Per 100,000 tons/yr. = \$4,350,000
Realizable Sales Price/ton \$50,00
Per 100,000 tons/yr. = 5,000,000.00
Net Earnings = \$650,000/yr.

*Ibid., p. 113.

APPENDIX IV

TABLE 5

ESTIMATED COST OF MFG. NORMAL SUPERPHOSPHATE (20% P_2O_5) AT PLANT HAVING A CAPACITY OF 300 TONS/DAY 100,000 TONS ANNUALLY*

DIRECT COST	DAILY COST
127 ton/day H_2SO_4 @ \$ 11.34/ton	\$ 1440.18
180 ton/day phosphate rock (33% P_2O_5) @ \$ 7.00/ton	1260.00
Labor (8Operators) per shift @ \$0.28/man hr.	53.76
Power (8000 Kwh) @ \$ 0.02/Kwh.	60.00
Water (4,500 gallons or 170M^3) @ \$ 0.25/M^3	0.43
Fuel oil (2,130 gallons) @ \$0.10/gallon	213.00
Total Direct Cost	\$ 3027.37

INDIRECT COST	
Depreciation (on \$624,000) @ 10%	189.09
Interest (on \$ 624,000) @ 4%	75663
Indirect cost (Engr., Acct., Personnel etc.)	90.82
Contingencies at 10%	302.74
Grand Total	3685.65

Cost per ton = $\frac{3685.65}{300}$ = \$ 12.28

Per 100,000 / yr. = 1,228,000 yr.

Estimated Realizable sales price per ton = \$ 18.60
Per 100,000 / yr. = \$ 1,860,000.00
Net Earning \$ 632,000 annually

*Ibid., p. 114.

APPENDIX IV

TABLE 6

ESTIMATED COST OF MANUFACTURING SULFURIC ACID (100%) @ PLANT HAVING: I. 750 TON/DAY OR 250,000/yr. II. 550 TONS?DAY OR 182,000/yr.*

	750 ton/day I	550 ton/day II
DIRECT COST		
1. Sulphur 258 tons @ $ 25/ton	$ 6,450.00	
Sulphur 189 tons @ $ 25/ton		$ 4725.00
2. Labor 48 manhours @ $ .28/manhour	13.42	13.42
3. Supervision 24 manhours @ $ .84/manhour	20.20	20.20
4. Water 620 gallons/ton H_2SO_4 (2.8M^3/ton @ $ .025/M^3)	52.50	
Water 620 gallons/ton H_2SO_4 (2.8M^3/ton @ $ .025/M^3)		38.50
5. Power 10 Kwh/ton @ $ .02/Kwh (7500Kwh)	150.00	
Power 10 Kwh/ton @ $ .02/Kwh (5500Kwh)		110.00
6. Maintenance $ 1.00/ton of H_2SO_4 100%	750.00	
Maintenance $ 1.00/ton of H_2SO_4 100%		550.00
Total	$ 6,686.12	$ 5,457.12
INDIRECT COSTS		
7. Depreciation on (2,250,000 @ 10%)	681.61	
Depreciation on (1,650,000 @ 10%)		500.00
8. Interest on $ 2,250,000 @ 4%	272.72	
Interest on $ 1,650,000 @ 4%		200,00
9. Indirect costs @ 3% (Engr., Acct., etc.)	200.58	163.71
Contingencies 10% of direct costs	668.61	545.71
Grant Total	8,509.64	6,866.54

I. Per ton: $\frac{8,509.64}{750}$ = $ 11.34/ton H_2SO_4 100%

II. Per ton: $\frac{6,866.54}{550}$ = $ 12.12/ton H_2SO_4 100%

*Ibid., p. 116.

APPENDIX IV

TABLE 7

JORDAN'S POTENTIAL SALES OF SUPERPHOSPHATE FERTILIZERS*
1967, 1970, 1975
(Thousands of Metric Tons)

Country	Superphosphate Consumption				Jordan's Share %	Exports of Jordan		
	1962	1967	1970	1965		1967	1970	1975
Ceylon	2	2	2	2	100%	2	2	2
Taiwan	2	2	2	2	100	2	2	2
Pakistan	9	9	9	9	100	9	9	9
Indonesia	10	12	14	15	100	12	14	15
Philippines	26	32	40	45	50	16	14	22
Malayo	6	6	6	6	100	6	6	6
Iran	4	5	5	6	100	5	5	6
Iraq	4	5	5	6	100	5	5	6
Syria	2	8	12	12	100	8	12	12
Turkey	6	8	8	10	25	2	2	3
Cyprus	8	9	10	10	25	3	4	4
Greece	10	12	15	15	25	3	4	4
Australia	16	20	20	20	50	10	10	10
New Zealand	12	12	12	12	50	6	6	6
South Africa	15	15	15	15	50	7	7	7
Egypt	20	22	22	28	50	11	11	11
Sudan	1	1	2	4	100	1	2	4
Kenya	6	8	9	11	100	8	9	11
Tanganyka	2	2	2	2	100	2	2	2
Uganda	2	2	2	2	100	2	2	2
Rhodesia	8	9	10	10	25	2	3	3
Mozambic	1	1	2	2	100	1	2	2
Others (#)						41	52	63
Total:						164	191	215

Source: Stanford Research Institute, Markets for Jordan Phosphate (Menlo Park, California, Unpublished Report written in 1963), p. 93.

* Normal Superphosphate fertilizer.

\# Includes Yugoslavia, Hungary, Poland, and Madagascar.

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