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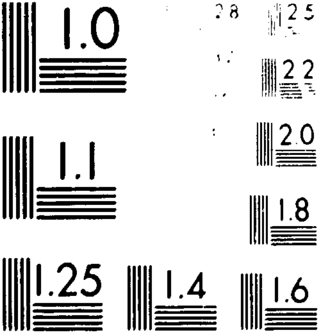


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# FERTILIZER INDUSTRY IN PAKISTAN

## A BRIEF REVIEW*

by

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Pakistan is basically an agricultural country as more than 70% of its population is dependent on land for its livelihood in one way or the other. Most of the foreign exchange earned by the country is derived from the export of agro-based products either in their raw state or semi-finished and finished state.

It is therefore natural that due emphasis should be given to the scientific development of agriculture in the country and it be run like any other industry by more modern and scientific methods in order to increase the per acre yield of various crops which not only will make the country attain self-sufficiency in agricultural commodities but will also increase its foreign exchange earnings, so vitally needed for the overall development of the country.

In earlier years of the history of Pakistan the agriculture was not given its due recognition and more emphasis was laid on industrialization of the country which was also necessary but not at the cost of agriculture.

The result was that whereas industrialization continued at an accelerated rate, agriculture could not keep pace with the demands and requirements of a developing industrial base and needs of an expanding population. Nevertheless, this discrepency was soon realized and agriculture was given its due share and importance in the development of the economy.

A number of steps needed to be taken to improve the agricultural output and to encourage the grower to invest more labour and money by ensuring him handsome returns. These steps were land reforms, supply of better quality seeds, import of large quantities of tractors, increase in the purchase price of agricultural commodities such as wheat, cotton, rice, sugar cane etc. and to enter the market for the procurement of these commodities in case the grower was denied his due price.

All these measures were used as an incentive to the grower to improve his per acre yield and all these incentives will remain infructuous if the two major inputs i.e. adequate supply of water and chemical fertilizers are left out.

Whereas the country inherited a well laid system of irrigation canals at the time of creation of Pakistan in 1947, the use of chemical fertilizers was almost unheard of. In fact, the need for chemical fertilizers was not felt till then as the population of the country was less than half of what it is to-day and the areas which constitute Pakistan were almost self-sufficient in food grains as well as in other commodities. It was only when the pressure on land increased due to an increasing population that the necessity of taking a new look at our methods of agricultural production was felt. One obvious way was the use of chemical fertilizers. The first fertilizer imported and used in the country was ammonium sulphate. The reaction of the farmer to its use was initially not very favourable and took several years before he was convinced of its efficacy.

When the first chemical fertilizer factory to produce ammonium sulphate was planned to be set-up at Daud-khel in late forties to early fiftees, the annual requirement of the country was estimated at 5000 tons of N nutrient.

Since the size of a factory to produce this small quantity of fertilizer was too un-economical, it was decided to instal a plant with a production capacity of 50,000 tons of ammonium sulphate per annum. Till that time the discovery of natural gas at Sui had not been made, it was therefore decided to locate the plant at Daud-khel where raw materials i.e. coal and gypsum were available in plenty and in close proximity.

The Pakistan Industrial Development Corporation (PIDC) played a pioneering role in the setting up of fertilizer industry in the country and within a short span of time from its inception in 1950 it set up three fertilizer factories and also arranged the training and supply of professional managers and technicians for the operation and maintenance of these factories.

Manufacture of fertilizers in early stages was not a profitable venture, that is why the private sector was shy of entering this field. It was only when a breakthrough had been achieved in the technology of ammonia production and sufficient indigenous trained manpower of professional managers and skilled operators and technicians both in supervisory and non-supervisory level was available that the private sector entered the field in collaboration with foreign companies and started setting up fertilizer plants.

## NATURAL GAS

The discovery of natural gas was a great boon to the country as this gas could not only be utilized as a neat and clean fuel to replace coal and fire-wood but could also form a base for several chemical products. One such possibility was the manufacture of fertilizers. The gas find thus opened a new chapter in the industrial development of the country.

By now the fertilizer consumption had started picking up. It was therefore decided by PIDC to set up another nitrogenous producing fertilizer factory at Multan which was designed to produce 54,000 tons of N nutrient, half in the form of urea and half in the form of calcium ammonium nitrate (CAN). This fertilizer factory set up in 1962 became obsolete in technology soon after its commissioning. Nevertheless, the factory played its role not only in manufacturing much needed fertilizers but also provided trained manpower and thus became a major source for the supply of managerial and skilled manpower for other chemical industries in the country.

Spurred by PIDC's venture in natural gas based fertilizer plants, Esso Chemicals (now EXXON) entered this field and established a factory at Dharki with a capacity of 550 tons per day of urea or 80,000 N nutrient tons per annum. The second fertilizer factory in the private sector based on natural gas was established by Dawood Hercules near Shaikhupura which came into production in 1971 with a production capacity of 1100 tons per day of urea.

## COMPLEX FERTILIZERS

Till early 70's the emphasis in fertilizer production had been on straight fertilizers whether nitrogenous or phosphatic. It was rather more on nitrogenous as the installed annual capacity in the country in early 70's for the two types of fertilizers was:

Contd.....5th.

( in '000' nutrient tons)

| | N | $P_2O_5$ |
|---|---|---|
| 1. Pak-American Fertilizers Ltd., Daudkhel. | 20 | - |
| 2. Natural Gas Fertilizer Facotry, Multan. | 54 | - |
| 3. Lyallpur Chemicals & Fertilizers Ltd., (Faisalabad & Jaranwala) | - | 18 |
| 4. Esso Fertilizer Co., Dharki | 80 | - |
| 5. Dawood-Hercules Chemicals, Shaikhupura. | 160 | - |
| Total: | 314 | 18 |

As the quest for higher outputs and high yielding crops grew, the use of fertilizers also gained momentum. With higher yields the soils became depleted in soil nutrients. Whreas nitrogen nutrient was being constantly fed through nitrogenous fertilizers, the phosphorous content of soil started getting lower and caused worries to agronomists. The dangers of lower phosphorous level in the soil were realized well in time and it was decided to introduce the manufacture of a complex fertilizer in the country as well - a fertilizer which would provide both N and $P_2O_5$ to the soil and crops at the same time.

A scheme was therefore put up to the Government in 1972 again by PIDC under the name of "Expansion and Modernization of Natural Gas Fertilizer Factory, Multan" for the production of nitro-phosphate fertilizer with a nutrient content of 23 - 23. As stated earlier, the Natural Gas Fertilizer Factory Multan had become obsolete soon after its commissioning in 1962/63. This was mainly due to a revolution in the technology of ammonia production by the introduction of centrifugal compressors. The result was that the cost of production of urea and calcium ammonium nitrate (CAN) fertilizer was high and un-competitive. It was therefore essential that something be done to improve the situation. It could be either to build a new plant with modern technology or to modernize and expand the existing facilities, discarding the obsolete and un-economical units and utilizing the competitive production units as well as the available trained manpower and other infra-structure such as a large residential colony, administrative offices, materials and product storages, work-shops, laboratory, hospital etc. etc. The latter alternate being more advantagious was adopted and a fertilizer company under the name of Pakarab Fertilizers Ltd., was formed with the collaboration of Government of brotherly Muslim country Abu Dhabi. The equity was thus provided by the Government of Pakistan through National Fertilizer Corporation of Pakistan Ltd., (NFC) which inhereted the factory from PIDC in 1974 and Government of Abu Dhabi through Abu Dhabi National Oil Co. (ADNOC) in the ratio of 52 : 48. The factory was designed to produce 304,500 tons of NP, 450,000 tons of CAN and 59,400 tons per annum of urea respectively at a total capital investment of about Rs.2500 million (U.S. $250 million) out of which Rs.1100 million (U.S. $ 110 million) was in foreign exchange - provided partly by ADNOC (US $ 31 million) and the rest by financial institutions such as the World Bank, Asian Development Bank, OPEC etc. This factory came into production in 1978-79.

Because of the handsome returns ensured to the farmers for their crops, the interest in the use of fertilizers continued to grow at a rapid pace with the result that need for production of more & more fertilizers was felt and immediately afterthe approval of Pakarab Fertilizers Ltd., 3 more medium to large size fertilizer factories - all for the production of urea fertilizers, 2 in the public sector through NFC and one in the private sector by Fauji Fertilize Co. were planned and approved. One of these namely Paksaudi Fertilizers Ltd., at Mirpur Mathelo (built by NFC) has started production since 1980, the other two namely Hazara Urea Fertilizer Co., at Haripur (an NFC project) and Fauji Fertilizer Co. at Sadiqabad are

Contd....7th.

in the process of commissioning. A list of the installed fertilizer factories with their per annum nutrient capacities is given in Table 1.

## FERTILIZER USE

Some of the factors which affect agricultural production and fertilizer consumption can briefly be described as:

- Basic factors such as soil, seed, irrigation, fertilizer use, farm management, plant protection and weather conditions.
- Supportive/Policy factors, such as supply of essential inputs, government agricultural commodity price support, market development efforts, extension services, availability of credit facilities to farmers etc.

We shall confine here to only one factor i.e. the fertilizer. The consumption of nitrogenous, phosphatic and potash fertilizers is given in Table 2 from the year 1961-62 and the consumption of nitrogenous fertilizers alone is drawn in Fig 1. A look at Fig 1 will show that the consumption rate remained almost static from early 50's to 60's, had steady growth till mid 70's when it showed a rapid increase from this period onwards. There is almost an increase of 25 times in the use of nitrogenous fertilizers and 460 times in the use of phosphatic fertilizers from 1961-62 to 1981-82 respectively. The main factors contributing to this remarkable growth have been:

- Introduction of high yielding crop varieties mainly dwarf wheat and rice.
- Extension services provided by Government Exte-agencies and by the fertilizer manufacturing companies to promote the use of fertilizers.
- Well co-ordinated research efforts to evaluate crop responses (particularly wheat and rice) to NPK and the economies of fertilizer use on these crops.
- Establishment of a network of sales dealers in the agricultural areas by the fertilizer manufacuring companies.

Since the manufacturing capacity of various fertilizer factories in the country falls short of the rapidly growing consumption, the deficiency has to be met by the import of fertilizers. Table 3 gives the production and imports of fertilizers in Pakistan.

## PROBLEMS OF FERTILIZER INDUSTRY

The problems faced by the fertilizer industry in Pakistan are the same as faced by any developing country. One could summarise them as below: (Since the writer of the paper belongs to public sector, the experiences narrated here generally pertain to his own situation)

### 1. UNREALISTIC COMPLETION TARGETS/COST OVER-RUNS

It has been generally experienced that the large size chemical fertilizer plants in Pakistan have taken 4-5 years from the date of signing of the contract with the Engineering Contractors to their commissioning and completion of guarantees. There might be some exceptions. While quoting the price of plant & machinery for a complete individual unit or the whole fertilizer complex, the engineering contractors depict very rosy pictures for the delivery of equipment and its erection. The total period generally quoted varies from 30 to 36 months. Once the contract has been awarded and the procurement orders placed on very attractive delivery periods, there starts and endless game of delays in the delivery of plant/equipment, on one pretext or the other, ultimately leading to delays in completion schedules and cost over-runs. The estimated costs given by the engineering contractors in tenders are seldom realized while placing the actual purchase orne and if a clause is inserted in the engineering contract for cost over-runs, it is couched in such words and phrases and with so many conditions that at the end the contractor gets away without sharing a peny on the cost-over-runs. Similarly it is very rare that penalty clause incorporated almost in every purchase order for late deliveries is ever invoked. The engineering contractor becomes the best advocate of the vendor justifying the delays and gives him full protection much to the disappointment & discomfort of the client.

## 2. COST OF SPARE PATS & REPLACEMENTS

At the time of giving a quotation on international competitive bidding, the vendors of plant & machinery offer the most attractive prices to secure the purchase order. Any spare parts purchased at that time will also be quoted at very favourable terms. But once a client has been netted any subsequent requirement of spares is quoted and supplied at very high prices. Since these parts are generally of proprietory nature and the client does not know their specifications, material of construction and other details he has no option but to pay these high costs or suffer shut-down of the plant. The delivery periods quoted are very long and force the client to carry a heavy inventory. It is seen that the rate of inflation on these parts is 30 - 50% per annum and after a few years, the vendor claims that the part being no more on the manufacturing line, will cost almost as much as the original machine. It is generally seen that the cost of spares purchased in a period of 3 - 5 years equals the cost of original machines. One could cite a few examples:

1. At the time of placing orders for the ammonia plant machinery in 1974-75, 3 heavy duty pumps for the boiler feed water at a cost of $ 70,000 each were purchased. Last year the management decided to purchase a fourth pump and approached the original vendor. The price quoted for the same pump was $186,000 i.e. 2.64 times the cost of the original pump or almost equal to the cost of 3 pumps in 1975.

2. In 1975 the cost of one decantor used to remove $SiO_2$ from the solution was $80,000. To day the cost of spares per annum is $50,000.

3. The cost of one centrifuge procured in 1975-76 was $90,000. The consumption of spares on the same machine now costs $55,000 per annum.

4. The total cost of spares consumed on 3 decanters and 4 centrifuges is thus about $400,000 per annum. The original cost of these machines was $600,000.

5. Graphs and charts etc. for the process recorders if purchased from the manufacturer directly cost $1750 in one year. The same charts purchased from the instrument vendor in previous years were costing $6,600.

6. The spare rotor of an NO gas expansion turbine was purchased for $56.000 in 1975-76. Last year the rotor in service got damaged and had to be replaced by the spare one. The new rotor cost $104,000. It may be mentioned here that the operating rotor got damaged only after about 27 months of service. A specialist from the vendor was called at our request. After inspection and examination of the damaged rotor he could not give any reason for a pre-mature failure and advised the management to send it to their works for repairs. The repairs would cost another $88,300.

3. <u>SUPPLY OF OBSOLETE TECHNOLOGY</u>

Sometimes, the developing countries are supplied obsolete technology and equipment with the machinery. When the client approaches the vendor for the purchase of spares/

replacements, he is informed that this part is no more in production and has been replaced by a new one which will be several times more expensive than the original. This happened in the case of vibration probes installed on some of our steam turbines for their protection and security. The vendor told us that the original probes were 10 years old in techrology. The client in a developing country being un-aware of the advances being made in the various technologies has no means to protect himself against such excesses. In another case it was observed that one of our turbo-generators when loaded beyond 40 - 50% of the design load, starced giving vibrations. A specialist from the vendor was called who checked the alignment and found nothing wrong with it. When pressed to spell out the cause, he said that a similar situation had been experienced in 1973-74 in one of the South American countries where the gear box assembly between the steam turbine and the generator had to be replaced by an assemly of new design. It may be mentioned here that our turbo-generators were ordered in 1975. The design defect must have been known to the vendor but still he did not care to change it. The cost of the new gear assemblies was very high.

It is also observed that when the price of an equipment is negotiated, the vendor reduces it to make it attractive and gives an impression of being reasonable. Once the deal has been made, he starts cutting corners and supplies sub-standard equipment.

4. LACK OF BACK-UP SERVICES

Sometimes, it is experienced that once a system has been purchased and the client experiences some problems and difficulties due to its operation, the vendor starts with a luke-warm response and ultimately backs out. We have had a costly experience of this situation on our coooling water treatment system. Inspite of a very rigid chemical control, we lost/damaged a number of very expensive heat exchangers in our 910 tons per day ammonia plant due to severe corrosion with in a period of 6 - 12 months of the commissioning of the plant. At least 4 major heat exchangers had to be replaced at a total cost of about $500,000. Even the material of construction of the tubes had to be changed. The chemical treatment system was also discarded and replaced with a new one. This cost lot of money in the form of new chemicals and technical advice.

5. UN-TRIED TECHNOLOGIES

Another handicap with the developing countries is that sometimes the plants supplied to them are used as pilot plants because the technology used in them had not been tried before on an industrial or even pilot plant scale. When such a situation arises it is found that the design & engineering of the plant was based on results obtained in the laboratory.

When such a plant is commissioned, the client to his horror finds that it is incapable of delivering the quantity and quality of the product contracted. Sometimes this capacity is just 50 - 70% of the rated capacity. Then starts an endless chain of experiments, arguments and discussions with the engineering contractor and the client continues to suffer. After having spent hundreds of millions of dollars on the plant, the client finds that the capacity is just about half of the designed and the quality of the product far below the specified standards. Loss of production has to be absorbed all through as experiments and modifications are going on. The penalties provided in the contract to cover such eventualities are far too less. If the contractor cares for his international reputation he may share a part of the additional cost required to improve the performance of the plant and to bring it to desired standards, otherwise he may get away paying a meagre amount of penalty or just run-away leaving the client at his mercy. We have had experience of all these situations.

## 6. TECHNICAL ADVISOR

Sometimes either by compulsion or by choice, a client acquires the servies of Technical Advisor to safeguard his interests. Their role generally covers a review of the designs, calculations, drawings etc. of critical equipment. They are also required to oversee the supply of equipment from the vendors' shops, particularly the testing of critical machines and to review/monitor the progress of construction phase and advise the client to take corrective measures. It has generally been our experience that a Technical Advisor does not perform his role properly and leaves the client in the lurch whenever he is confronted with difficulties while dealing with the engineering contractor. Another interesting aspect of the role of the Technical Advisor is that in case of acceptance of his advice, he will not be held responsible or accountable if the advice given by him does not achieve the desired results. His argument being that the advice was imparted in good faith. It is also our experience that sometimes the Advisors do not have any experience in the industry for which they are sent as advisor. They also thus learn at the cost of the client for which they get handsomely paid.

7. HIGH COST OF SPECIALISTS

The specialists called for the erection of machinery or its servicing have become very expe The cost of a specialist varies from $300 to *6L . day in addition to his cost of travel, accomodation, conveyance, living etc. In many cases the duration of his stay is also determined by him or his company. Sometimes the client does not get the services of a specialist when he (the client) wants him but has to adjust even his annual turn-around to the convenience of the vendor although enough notice might be given to the vendor in advance.

## 8. MANAGEMENT AND MANPOWER PROBLEMS

Amongst the major factors on which the success or failure of any enterprise depends to a large extent is the quality of its management not only at the top but even more at the middle and lower levels. The function of the management is to synthesise the resources both material and human and put them to profitable use. A good management would always try to attract the best talent available and retain it to ensure continuity of operations. Managements in the public sector organisations suffer in this area due to their inability to compete with employers in the private sector as they cannot pay the salaries and other benefits to their employees at par or even close to them. The drain of the trained manpower and professional managers to the Middle East at fabulous salaries is another factor which has created a serious problem for the developing countries.

Our Company has suffered badly due to this problem as we lost about 50% of our trained and experienced engineers to the Middle East and the private sector within a short span of 3 - 4 years.

Training of fresh graduate engineers, plant operators and technicians seems to be the only answer to this challenge. We have successfully weathered the drain storm and have trained over 50 engineers and 200 technicians in 3 - 4 years to tide over the gap. Although we did get serious set backs initially, by and large the situation has been controlled & stabilized by organising a training centre and also by improving the salary structure.

TABLE 1

## INSTALLED CAPACITY OF FERTILIZER FACTORIES IN PAKISTAN

| A. PUBLIC SECTOR | N | P |
|---|---|---|
| 1. Pak-American Fertilizers Ltd., Daudkhel. | 18,900(a) | - |
| 2. Pakarab Fertilizers Ltd., Multan | 214,300(b) | 70,000 (b) |
| 3. Paksaudi Fertilizers Ltd. Mirpur Mathelo. | 256,220(c) | - |
| 4. Hazara Urea Fertilizer Factory, Haripur. | 44,000 | - |
| 5. Lyallpur Fertilizers & Chemicals Ltd., (Faisalabad & Jaranwala). | - | 18,630 (d) |
| Sub-Total: | 533,420 | 88,630 |
| **B. PRIVATE SECTOR** | | |
| 1. Exxon Chemicals Ltd., Dharki | 82,800(c) | - |
| 2. Dawood Hercules Ltd., Shaikhupura | 158,700(c) | |
| 3. Fauji Fertilizer Co., Machi Ghot | 256,220(c) | |
| Sub-Total | 497,720 | |
| Grand Total | 1,031,140 | 88,630 |

a. as ammonium sulphate

b. as nitrophosphate, calcium ammonium nitrate and urea.

c. as urea

d. as single super phosphate

TABLE 2

CONSUMPTION OF FERTILIZERS - PAKISTAN
( '000' NUTRIENT TONS)

| YEAR | N | P | K | TOTAL |
|---|---|---|---|---|
| 1961-62 | 37.0 | 0.5 | - | 37.5 |
| 1962-63 | 40.0 | 0.2 | - | 40.2 |
| 1973-64 | 68.0 | 0.7 | - | 68.7 |
| 1964-65 | 85.0 | 2.2 | - | 87.2 |
| 1965-66 | 69.2 | 1.3 | - | 70.5 |
| 1966-67 | 107.8 | 3.9 | 0.1 | 111.8 |
| 1967-68 | 177.4 | 12.8 | 0.2 | 190.4 |
| 1968-69 | 203.5 | 38.6 | 2.5 | 244.6 |
| 1969-70 | 272.5 | 33.8 | 1.4 | 307.7 |
| 1970-71 | 251.5 | 30.5 | 1.2 | 283.2 |
| 1971-72 | 344.0 | 37.2 | 0.7 | 381.9 |
| 1972-73 | 386.4 | 48.7 | 1.4 | 436.5 |
| 1973-74 | 341.9 | 58.1 | 2.7 | 402.7 |
| 1974-75 | 362.8 | 60.6 | 2.1 | 425.5 |
| 1975-76 | 443.4 | 108.6 | 1.8 | 553.8 |
| 1976-77 | 511.2 | 118.2 | 2.5 | 631.9 |
| 1977-78 | 553.6 | 160.7 | 5.7 | 720.1 |
| 1978-79 | 684.3 | 187.9 | 7.6 | 879.8 |
| 1979-80 | 806.0 | 228.5 | 8.9 | 1043.4 |
| 1980-81 | 843.0 | 227.0 | 10.0 | 1080.0 |
| 1981-82 (Target) | 900.0 | 230.0 | 15.0 | 1145.0 |

TABLE 3

PRODUCTION AND IMPORTS OF FERTILIZERS - PAKISTAN
( '000' NUTRIENT TONS )

| | PRODUCTION | | | IMPORTS | | | |
|---|---|---|---|---|---|---|---|
| YEAR | N | P | TOTAL | N | P | K | TOTAL |
| 1963-64 | 43.82 | 1.18 | 45.00 | 5.12 | - | - | 5.12 |
| 1964-65 | 46.61 | 1.44 | 48.05 | 3.20 | - | - | 3.20 |
| 1965-66 | 46.02 | 1.41 | 47.43 | 36.05 | - | - | 36.05 |
| 1966-67 | 50.75 | 0.71 | 51.46 | 106.46 | 16.40 | 0.60 | 123.40 |
| 1967-68 | 49.66 | 2.84 | 52.50 | 103.72 | 49.81 | - | 153.53 |
| 1968-69 | 78.60 | 2.54 | 81.14 | 118.12 | 32.57 | 5.70 | 156.41 |
| 1969-70 | 129.27 | 4.15 | 133.42 | 292.19 | 11.45 | - | 303.64 |
| 1970-71 | 140.13 | 4.15 | 144.64 | 107.81 | 38.55 | 5.00 | 151.36 |
| 1971-72 | 215.14 | 4.86 | 220.00 | 73.02 | - | - | 73.02 |
| 1972-73 | 274.52 | 8.22 | 282.74 | 115.59 | 72.11 | - | 187.70 |
| 1973-74 | 300.07 | 4.19 | 304.26 | 224.94 | 104.30 | 6.31 | 335.55 |
| 1974-75 | 320.60 | 6.30 | 326.90 | 105.53 | 21.88 | 5.96 | 133.37 |
| 1975-76 | 314.90 | 11.80 | 326.70 | 72.28 | 103.91 | 6.60 | 182.79 |
| 1976-77 | 312.37 | 11.11 | 323.48 | 132.81 | 139.16 | 2.49 | 274.46 |
| 1977-78 | 312.6 | 15.0 | 327.6 | 208.5 | 155.9 | 4.0 | 368.4 |
| 1978-79 | 334.007 | 26.961 | 360.968 | 448.84 | 206.84 | 9.36 | 665.04 |
| 1979-80 | 388.9 | 49.6 | 548.00 | 449.81 | 147.01 | 13.72 | 610.54 |
| 1980-81 | 580.9 | 57.4 | 638.3 | 386.65 | 302.26 | 22.05 | 711.06 |

# FIG 1
# FERTILIZER CONSUMPTION IN PAKISTAN