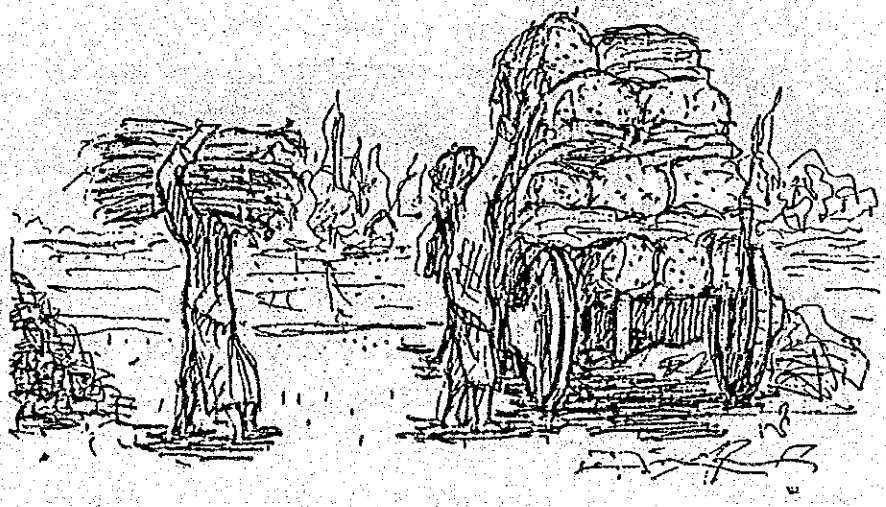
CHAPTER 3 ACTUAL CONDITION OF POSTHARVEST PRACTICES ON RICE



CHAPTER 3 ACTUAL CONDITION OF POSTHARVEST PRACTICES ON RICE

3.1 Postharvest Practices at Farm Level

The postharvest practices at farm level in Pakistan can be summarized as Figure 3.1.

3.1.1 Reaping

In Sind Province, reaping of rice starts at around the end of September, continuing for a long period until the beginning of December, and its peak time is around the middle of November. In Punjab Province the reaping time for IR varieties rice begins from the end of October to the middle of November, and reaping for Basmati varieties is from the beginning of November to the beginning of December.

In both Sind and Punjab Provinces, reaping is done manually. As an exception, big combine harvesters were introduced in Punjab Province last year, but only about 100 machines are now operating. Areas where these combine harvesters introduced are relatively small to all rice producing areas. The operation of big combine harvesters will be explained in detail later.

In both provinces, saw-edge sickles with a blade length of 25 cm are used for cutting stems. Stems of IR variety are usually cut at a height of 10 cm from the ground, and Basmati varieties, which are taller, are cut at a height of 20 to 30 cm from the ground. Basmati variety is tall and easily lodging. Many lodging Basmati plants can be seen in the rice field during reaping.

3.1.2 Drying, carrying and heaping in rice fields

In Sind Province, stalk paddy that the stalk is used as green fodder are carried to threshing places the same day they are reaped. About 40 to 50 kg of stalk paddy make one bundle and these bundles are carried on worker's heads or by carts pulled by donkeys. As farmer reap rice plants which it's stalk is used green fodder, they do not reap any more than their needful fodder.

On the other hand, stalk paddy which are not used for green fodder are dried on stubbles after they are reaped. They are then heaped and

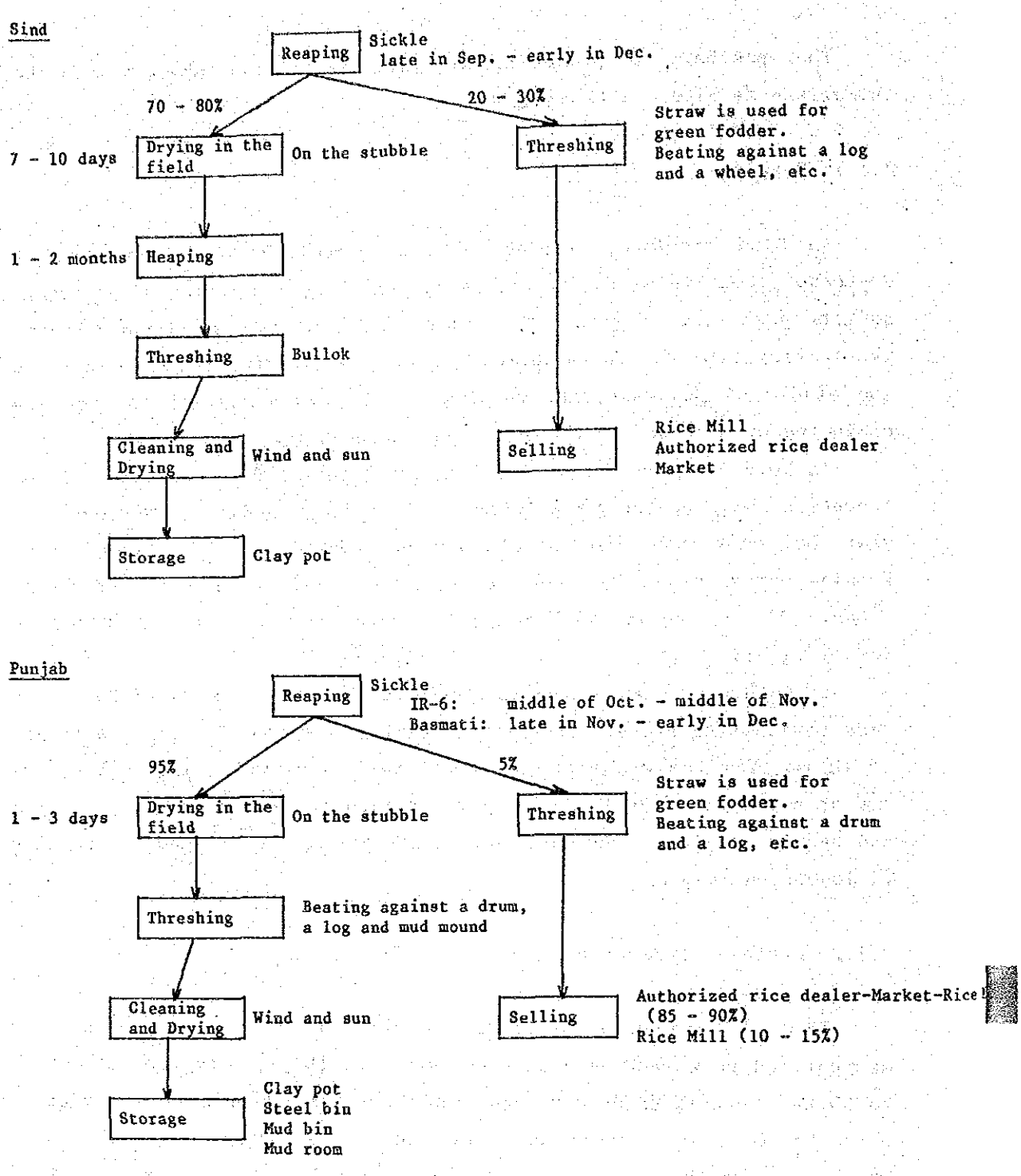


Fig. 3.1 Rice Postharvest Practices in Pakistan

temporarily stored for one to two months in the rice field. These stalk paddy are usually heaped in a cylindrical form, with a diameter of 8 to 11 meters and a height of 2 to 3 meters.

Heaping is made at threshing places, designated by landowner and called "Dera". These places are usually paddy fields with good drainage or at roadsides. Although heaping places are decided depending upon the relationship between landowners and tenant farmers, landowners prefer to have tenants heap at "Dera" to prevent tenant farmers from tampering with the quantity of stalk paddy or to prevent theft. It is quite a sight to see several tons of heaped rice standing side by side at a big landowners' "Dera."

One of the main reasons for heaping is to avoid to concentrate labor power at the busiest time when the harvesting of rice and preparation of wheat crop are done in same period. In Sind Province, farmers often heap wheat too. In the harvest time of the crop other than rice, at the busiest time for the harvest, which overlaps the preparation of next crop, reaping and threshing works often is interrupted and in Punjab Province, stalk paddy is dried on stubbles for one to three days to make threshing work easier when stalk paddy are threshed the day after they are reaped. Part of the straw may be used as green fodder, but it is usally dried and stored for five to six days after threshing. In Punjab Province, the custom of heaping does not exist, in contrast with Sind Province. Stalk paddy for green fodder are threshed on the day they are reaped as in Sind Province, but most of the stalk paddy are threshed in the paddy fields.

3.1.3 Threshing

In both Punjab and Sind Provinces, stalk paddy which are threshed without being dried soon after they were reaped, are beaten by farmers for threshing. However, little difference was observed between methods in Sind Province and those in Punjab Province.

In Sind Province, stalk paddy collected at "Dera" or on roadsides without making a bundle are beat by hand against logs, wheels or the beds of carts.

In Punjab Province, stalk paddy which were dried after they were reaped in the paddy fields are gathered into three or four bundles. These bundles are then bound together by straw ropes and beat against used drums.

The traditional threshing method is to beat stalk paddy against a "Toi", which is made by mounding soil firmly in the paddy fields along ridges between the rice fields. In recent years, however, drums are predominantly used, for they are handy and convenient for carrying.
In Punjab Province, stalk paddy dried in paddy fields are beaten or hit like undried stalk paddy, but in Sind Province, heaped stalk paddy are undone after the winter crop is planted. These stalk paddy are tramped on by bullocks.

When bullocks are used, stalk paddy are spread out in the form of a circle with a diameter of six or seven meters on a place which is made by solidifying soil to the hardness of a threshing floor. The thickness of this place or the base is about 60 cm at the center. The base is thickest at the center and becomes thinner in proportion to the distance from the center. A pole stands in the center to which four bulls are usually fastened, these bulls trample on the spread out stalk paddy many times. Stalk paddy are turned over many times by farmers bands while bulls are walking on them. This threshing process is repeated twice on the same stalk paddy. Straw is sifted after plants are threshed and care is taken to not leave any unthreshed plants.

3.1.4 The drying and cleaning of paddy

Both in Sind and Punjab Province, most paddy is sold to the market without being dried and cleaned by farmers. This indicates that farmers are not active enough in improving paddy quality, for the costs required

for drying and cleaning are not reasonably reflected in the market price.

In addition, as paddy-field work (such as reaping, heaping, and threshing) is carried out under high temperatures and dry climatic conditions, moisture contents of paddy rapidly evaporates during these processes, and the moisture will be 18% or so when paddy is brought to the market. Paddy continues to lose its moisture naturally. This means that paddy quality does not quickly deteriorate in the distribution process as seen in other rice-planting countries in Asia.

In the meantime, rice for home-consumption is dried under the sun at threshing places in Sind Province, and in the yards of farm houses or on roofs in Punjab Province. Paddy is spread on earth floors, mats and the like are seldom used.

Paddy for farmer's home-consumption is cleaned, dried and stored. In Sind Province, paddy is thrown up high above by a wooden scoop called "kharai" and wind-cleaned. This work is usually done by old men. In Punjab Province, a winnower called "chaj" is used for wind-cleaning. This work is usually done by women.

3.1.5 Transportation and sale of paddy

The selling routes of paddy from the farmer to the market are shown in 3.4.4(2).

Farmers can select any route in principle; however, buyers are restricted in reality due to transportation distance, means, financing required for operating their farms and other various factors. In Sind Province, farmers sell their paddy to various buyers and one farmer sells paddy to an unspecified number of purchasers, which means that the flow of merchandise does not concentrate on one specific route. In Punjab Province, however, most paddy is distributed through a specific route: authorized rice dealer, the market and to rice millers.

Paddy sold by farmers to the market is usually packed in gunny bags which are transported by carts pulled by donkeys or bulls. The widespread use of tractors in recent years has enabled paddy to be bulk-loaded in tractor-trailers.

3.1.6 Storage by farmers

Although paddy for home-consumption is stored in the form of paddy in Sind Province, it is usally stored in the form of milled rice in Punjab Province, making a great contrast. This difference in storage methods can be ascribed to the fact that in Punjab Province Basmati is used for home-consumption and Basmati becomes more fragrant and tasty if stored for a certain period of time.

In this case, paddy is dried and the moisture contents is reduced 10 to 11% in about a week. Paddy is milled by "chakkies" (or "hullers") located in a village and it is then stored in clay pots called "parola" or metal containers in the farmer's house. In this case, turmeric powder, sodium chloride and rapeseed oil are mixed with milled rice as an repellent. Rice milling is completed by the end of December and rice consumption starts around March.

In Sind Province, paddy is stored in clay pots called "gundi" or clay cylindrical containers called "pari" which are placed outdoors. The green leaves of Nim and red pepper are mixed with the paddy as an repellent.

The average annual quantity of rice stored by each family is five to six mounds in Sind Province and two to three mounds in Punjab Province.

3.1.7 Labor efficiency and wages

Although agricultural work is basically undertaken by family labor, however, such work as trans-planting, reaping and threshing greatly depends on outside labor. Especially in Sind Province, seasonal laborers called "burrei" come from Baluchistan and the number of these laborers is said to be 3,000 to 4,000 every season. These people come to work when rice or wheat is being reaped.

Table 3.1 shows the work efficiency of postharvest work labor and wages for each process.

In Sind Province, labor wages are paid either in cash or in kind (such as paddy or straw), but in many cases, cash payment is common. Daily wages for one person is between 20 to 25 rupees on the average and it is on the rise every year. When payment is made in kind, one person gets about 15 kg of paddy a day. In the case of reaping rice for green fodder, wages take the form of rice straw. Straw obtained from reaping

or threshing is given to workers who engaged in each job respectively. Situations are the same in Punjab Province. As explained previously, farmers engage in this kind of work because they want to secure green fodder, and straw, not cash, in exchange for their labor.

In Punjab Province, cash is never paid as wages for reaping. Persons who plant paddy are responsible for reaping and threshing in principle, and they are given 1/11 of the paddy for their labor. Although straw is given to farmers who engaged in cultivation work, a small quantity of straw is given to other laborers as a bonus in some cases. Rice cleaning work is usually done by family members, but when other persons are employed, 1/50 of the cleaned paddy is paid as wages.

In both provinces, there is a farm worker system. Those who work for farmers live with them with three meals supplied. They can obtain 40 mounds of crops (paddy and wheat) and clothes for their labor.

Table 3.1 Working Efficiency and Labour Charge

Province / Efficiency and Charge / Operation	Sind			Punjab	
	Working Efficiency (day/acre)	Labour Charge		Working Efficiency (day/acre)	Labour Charge
		in cash (man/day)	In kind		
Reaping Carrying	8 men	Rs 20 - 25	Paddy straw occurred from the work (for green fodder)	6 - 8 men	° $\frac{1}{11}$ of harvested paddy. ° Paddy straw occurred from the work. (for green fodder)
Carrying (field - threshing place)	4 men	Rs 20 - 25		-	
Beating	8 - 12 men	-		8 men	
Making Heap	3 - 5 men (mainly by family labour)	Rs 20 - 25	-	-	-
Bullock Threshing	4 bullocks + 3 men (mainly by family labour)	Rs 20 - 25	-	-	-
Winnowing	2 men (mainly by family labour)	Rs 20 - 25	Paddy 15kg/day	2 men (mainly by family labour)	$\frac{1}{50}$ of winnowed paddy.

Source: The Study Team

3.1.8 The use of straw

Rice harvesting in Pakistan is characterized by utilizing straw, and it is restricted by this necessity in a sense. Unlike other rice producing countries in Asia, there is agriculture with livestock which greatly depends on cattle. Rice straw has an important value as feed for livestock.

As it is necessary to obtain green fodder at the initial stage of reaping, farmer tend to reap earlier. Stalk paddy are threshed on the day they were reaped, and straw is given to animals after it is cut.

In Sind Province, 20 to 30% of all stalk paddy seems to be reaped to obtain fodder. For Punjab Province, however, situations differ greatly according to district. In some districts, almost no reaping is done for green fodder, and in other districts more than 30% of the stalk paddy is reaped for fodder.

On the whole, however, stalk paddy reaped for this purpose are fewer in Punjab Province than in Sind Province, and the amount reaped for this purpose may be about five percent of total production. This ratio is, however, on the rise every year. Moreover, more IR variety is reaped for this purpose than Basmati.

Straw obtained from plants which were not reaped earlier for green fodder is usually cut into 2 - 3 cm pieces after being dried. It is then given to cattle as bulky feed. However, wheat straw called "bhoosa", chips of straw obtained after wheat is threshed, is regarded to be superior to rice straw in terms of nutrition and storage convenience. As feed, rice straw is characterized as a substitute for bhoosa until the latter can be obtained.

Rice straw is also used as straw ropes for binding bundles of straw, wheat or sugar cane, straw mats for cattle, manure, buffer materials for packages, and construction materials, but only little straw is used for these purposes.

In Punjab Province where both IR and Basmati varieties is cultivated, there is a great difference in utilizing these two kinds of rice.

As explained previously, more IR stalk paddy are used as green fodder. However, for dried straw, Basmati is regarded to be superior as feed because the animals prefer the taste. Therefore, farmers try to obtain as much Basmati straw as possible. Moreover, straw ropes made of Basmati is more durable than that made of IR straw. Naturally people make more Basmati ropes.

Therefore, most IR straw is burned in paddy fields, except for what is used as a substitute for Basmati feed, for making straw mats for cattle and for other purposes. Although situations differ according to district, it is presumed that about 20 to 30% is burned in paddy fields. Straw exhausted from big combine harvesters is also burned in paddy fields and regarded as useless.

As most rice straw is used by farmers for themselves or consumed within a village, the amount of rice straw brought to the market is smaller than wheat straw "bhoosa". In Sind Province, the price of undried straw is 4 to 5 rupees/mound at farm. Three to five mounds of straw, threshed by bullocks, which is priced at 20 to 30 rupees at ex-farm term. In Punjab Province, most of the straw sold is dried Basmati. The amount collected from one acre is sold at a price of 100 to 200 rupees at ex-farm price.

3.1.9 The status of harvest mechanization

(1) The mechanization of agricultural work in Pakistan

Due to an increase in agricultural products in recent years and a serious shortage of a seasonal agricultural work force, the mechanization of agricultural work has become an urgent need. Although priority is placed on mechanization in the 6th five-year plan to promote agriculture, and various measures have been taken, however, only little progress has been made, because of many social, economic and technical problems to be overcome.

Agricultural machines, the use of which is now under way, include tractors, irrigating pumps and wheat threshers.

A tractor was introduced around 1950 and came to be widely used around 1974 mainly in the vicinity of Punjab. The number of tractors being used today exceeds 200,000. These tractors are used for various purposes with a high efficiency and a high annual operational rate. Specifically, they are used not only for transportation, tilling and leveling the ground, which used to be carried out by domestic animals, but also as a power source for pumps and wheat threshers. Although situations differ according to region, the majority of tractors are 45 HP

types, followed by 60 HP and 35 HP types in that order. Recently, small, economical general-purpose tractors of 20 to 30 HP began to be used mainly by small farmers. The main attachments for agricultural machines include transporting trailers, chisel plows for tilling the soil and for leveling the ground. As tractors began to be widely used, the number of dealers and manufacturers of agricultural machines has increased to 450. For tractors, 20 to 50% of assembling parts are produced within the country and it is expected that this percentage will reach about 80% by 1988. Parallel to this, remarkable progress is being made in research and development of attachments to agricultural machines.

Precipitation is few in this country and water supplied through the canal from the Indus River cannot meet actual demand. Thus, water shortage is currently a serious problem in this country. The number of irrigating pumps being used today has reached the 250,000 level, with 41% being motor-driven 6-inch pumps and 59% are engine-driven pumps. When this percentage is broken down to shares by each province, 87% is used in Punjab Province, 8% in Sind Province, 2% in N.W.F.P and 3% in Baluchistan Province. As irrigating water is used more effectively in the future and planting areas increase, more pumps will be used in the future. This will, however, entail another problem such as salt pollution.

Wheat threshers have become widespread on account of the following reasons: a) Recent increases in the production of wheat requires farmers to complete wheat harvesting and preparation work of rice planting during a short period before the rainy season begins. b) These wheat threshers are capable of producing quality "bhoosa" preferred by animals.

There are 150 manufacturers which make and sell about 2,500 wheat threshers annually and it is said that about 90% of farmers use these machines. The growth rate is, however, relatively small compared with other agricultural machines.

(2) The present state of the mechanization of rice harvesting

Harvesting can be classified into reaping, threshing and cleaning, and none of these are presently completely mechanized. Since 1976, the IRRI-PAK program has introduced various machines and they have been tested and re-modeled by institutes, universities and agricultural machine makers. Some of these machines have been marketed, but they are not widely used, for they cannot meet all the requirements in Pakistan. The following section describes the present situation of each process.

1) Reaping

Although Japanese binders were introduced some time ago, they were not widely accepted by farmers due to poor efficiency, high price and complicated structure. In 1980, self-propelled reapers and tractor-mounted reapers were developed according to the IRRI-PAK Agriculture Mechanization Program, but they have yet to be commercialized. The only machine used for reaping is a combine harvester to be discussed later.

2) Threshing

In accordance with the IRRI-PAK program, mini-axial flow threshers and standard axial flow threshers were tested in 1977. They were later re-modeled at non-governmental factories, but could not meet actual needs. Then, a Uni-shaft thresher, which is a re-modeled version of a standard axial flow thresher, was announced but a non-governmental company is remodeling it for commercialization. In 1980, a Tractor P.T.O. Operated Thresher was developed as a big thresher. After repeated remodeling, this machine is now capable of processing 900 to 1200 kg of IR rice and 750 to 1125 kg of wheat. This highly efficient machine is capable of threshing sunflowers and believed to be promising machine.

Several companies are now remodeling and repairing this machine and it is already in the market. At the present stage, farmers seem to have prejudices against this machine, and it may be difficult for farmers to accept a threshing machine due to the following reasons:

a) Superior efficiency cannot be guaranteed compared with manual labor.
b) The use value of rice straw will reduce.
c) Undried paddy cannot be processed by a machine.
d) As the machine is driven by a tractor, operating costs becomes high. (It is difficult to obtain 20 to 25 HP engines.)
e) More cracked kernels are caused compared with manual threshing, which leads to an increase in cracked kernels during cleaning.

3) Combine harvester

Although a tractor-pulled type and a mounted-type were introduced, they are not widely used due to a poor operational efficiency in the paddy fields. In 1984, a popular type big combine harvester was introduced on a trial basis to harvest wheat, and an additional 100 machines were introduced in 1985. Now, 98 units are operating in Punjab Province. These machines are possessed by five custom harvesting companies and are used by landowners who do not need to reap paddy and use straw.

An additional 150 machines may be introduced next year, but there are pros and cons about this combine among farmers and cleaning-workers, which tells us that this machine is still in the testing stage.

In Sind Province, most of paddy fields are ill-drained, which make it difficult to operate this machine.

Pros and Cons for using combine

a) The machine will solve the problem of the work force shortage.

b) As combine may thresh raw stalk paddy, paddy contains more moisture contents, farmers think to gain more profits from sale by more paddy weight.

c) As hulled kernels will be increased by two to four percent, paddy market price will drop five to ten rupees per mound.

d) Rental fees are too expensive. (In both rice and wheat, it is Rs 350/acre.)

e) Although yield does not change at the milling stage, the amount of cracked kernels increases.

f) Straw pieces mix with paddy.

4) Cleaning work

Farmers seldom do cleaning, and rice mills clean dried paddy by using one or two cleaning machines. Winnowers are not widely used.

(3) Needs for mechanized harvesting and it's problems

In Pakistan, the amount of production of rice and planting areas are increasing, and many workers go to work in the Middle East. In addition, population is centralized in big cities and more people came to work in industries other than agriculture. All these factors delay harvesting, causing large quantitative and qualitative losses of rice. Farmers tend to miss the best time for sowing wheat, which leads to a decrease amount of productions. All these results can be ascribed to the fact that there is a work force shortage at the peak time of harvesting. Therefore, there is a great need for mechanizing harvesting work among farmers, but there still remains various problems to be solved. As needs for mechanization cannot be grasped uniformly due to different situations in each province, they will be characterized below.

1) Sind Province

a) There are many ill-drained paddy field, and it is difficult to bring in and operate machines.

b) Big landowner system being existing has great influence and neither landowners or tenant farmers are much concerned with agricultural management.

c) Planting areas for winter crops are smaller than those in Punjab Province, and farmers are presently not too interested in mechanization.

d) Most rice varieties produced here are IR varieties. Though maturing time is different depending on area, it does not differ greatly within the same village, and the property of IR varieties is more suitable than that of Basmati. Therefore it is easy to mechanize harvesting works in the province.

e) The recent serious shortage of irrigation water at the time of trans-planting delays trans-planting work and subsequent harvesting work which causes the lodging of the rice plants and phenomenon of yield decline in ripening stage as well as the death of plants caused by brown plant-hopper. For these reasons, harvest declines and planting time of wheat is also delayed.

f) A hot climate shortens farmers' working time.

g) Natural surroundings are more severe in Sind Province than in Punjab Province and farmers are poorer.

2) Punjab Province

a) Social economy and agriculture are more advanced here than in Sind Province, and mechanization is fairly easy.

b) Both Basmati variety and IR variety are planted in the same rice fields, though the maturing time is different. Lack of farm roads and difficulty in machine transportation produces problems.

c) As there are not so many ill-drained paddy fields, machines can be operated without problems.

d) Unlike Sind Province, there are not many big landlords and there are many owner farmers. They are concerned about agriculture management and interested in mechanization. They are also eager to plant winter crop.

e) Basmati 370 variety are vulnerable to lodging at the time of harvesting and unsuitable for machine processing.

f) The traditional harvest sub-contract work involves threshing, winnowing and payment settling work. It is therefore necessary to mechanize all these processes.

g) Labor shortage is more serious than in Sind Province.

The mechanization of agricultural machines in each province can be characterized by those facts stated above. If we take up maintenance and management of a tractor, which is now widely used, as an example, the common factors in each province is that farmers' technical standards are low and they have almost no basic knowledge about machines. There are several reasons for this; such as, not enough instruction manuals are provided, it takes too much time to obtain spare parts, repair shops are far from farms, an insufficient quantity of repairing tools are provided, etc. The fundamental reason is, however, that farmers lack knowledge about machines, as we can see from the example of tractors, most of which are not inspected and serviced. In addition, farmers handle the machine roughly and do not pay careful attention. This means that the only machine which can be accepted by farmers is one which is strong and has a simple structure. What is developed today is unexpectedly fragile in spite of its superficial strong structure. This is another reason this kind of machine is not accepted by farmers.

3.2 Rice Milling Industry

In Pakistan, like any other rice producing country, mills buy paddy, process it into milled rice and sell it, in the same manner as other countries with the exception of the rice milling on commission which is carried out by "chakkies". "Chakkies" is the processing place of agricultural products in villages, engaging in flour milling, rice milling, lumbering, cotton treatment, oil extraction, etc., combining serveral of these processes according to the regional situations. Farmers who asked "chakkie" to carry out these processes pay for the work.

3.2.1 The kinds of Mills and their functions

Mills in Pakistan are classified as follows in terms of function and scale.

(1) Chakkies

"Chakkies" is the agricultural product processing place which exists not only in rice producing districts but in villages all over the country. It mainly engages in flour milling, combining such work as rice milling, lumbering, cotton treatment and oil extraction depending on situations in the district. It also processes agricultural products (such as wheat, paddy, oil plant seeds, etc.) to be consumed by the farmers or villages.

As rice milling work done by "chakkies" is only one of its functions, it is incorrect to call "chakkies" a mill. Incidentally, "chakkie" means "something to rotate", meaning the rotor of a vertical milling machine.

(2) Sheller mills

Most commercial mills which buy paddy, process it and sell milled rice, belong to sheller type Mills. Their name came from under runner disk shellers which they use in the husking process.

(3) Modern mills

Although the machines of sheller mills are manufactured within the country, those used by modern mills are imported. Rubber-roll huskers are used in husking processes. Machines manufactured by Sehüle (in West Germany) and Satake (in Japan) have been introduced in nine existing modern mills.

Nine factories including eight governmental factories and one private factory mainly situated in Punjab District supply Basmati special quality rice.

(4) Semi-modern mills

Although these mills originally belonged to sheller mills, they began to use rubber-roll hullers, manufactured by domestic factories or imported from China, instead of disk shellers. At present, they occupy about 5% of commercial mills, and it is expected that these mills will increase in the future.

3.2.2 The number of mills and processing capacity

Table 3.2 which is based on governmental statistics shows the number of mills and processing capacity.

Table 3.2 The Number of Mills and Processing Capacity

	Hullers	Shellers	Modern Mills	Total
Punjab	505	257	7	769
Sind	1,028	280	2	1,310
NWFP	3	-	-	3
Baluchistan	22	6	-	23
Pakistan	1,558	543	9	2,110
TMC	20,856	16,763	1,440	39,059

TMC: Total milling capacity (ton/hours)

Source: Ministry of Industry, Pakistan Agriculture, September 1984

The actual number is presumed to be about 10,000 hullers and about 1,000 shellers.

(1) The number of hullers and milling capacity

The location of "chakkies", which process hullers, is naturally restricted to the rice producing areas. According to an actual observation made by the study team, there is about one "chakkies" among some 100 farmers, and every "chakky" has a huller.

For example, there are three "chakkies" in Dori of Larkana District where a milling test was conducted by comparing them with the existing hullers. There is one "chakky" in Pattan Pura Village where 80 farmers exist, and there are three "chakkies" in the No. 45 Village.

It is difficult to grasp the actual number of "chakkies", for there are many non-specific "chakkies". In the Punjab District, however, the actual number has been correctly determined as huller operation is restricted under the Monopoly Procurement Scheme of Rice. There are many "chakkies" namely 151 in the districts supervised by the Assistant Food Controller Office in Muridke and 171 in Daska. It is easily understood that these figures differs from those shown in Table 3.2. If the above-mentioned situations are taken into consideration based on the number of total rice producing farmers, it is presumed that there are about 10,000 huller nationwide.

The actual processing capacity by hullers is 300 to 400 kg/hour (in case of paddy). In the rice producing areas, approximately 10% to 20% of all "chakkies" have two hullers. However, since special consideration has not been given to increasing the hose power of the prime movers, processing capacity has not been improved, although there is a change in the cleaned rice quality.

(2) The number of shellers and processing capacity

According to Table 3.2, the number of total shellers nationwide is 543. The number of members belonging to the Sind Rice Millers and Traders Association is 478 (as of September 1, 1985). In addition, according to the list of mills which supply milled rice to RECP of the Food Department in Punjab, the number of shellers is about 500.

It is presumed, however, that there are about 1,000 shellers all over the country when we take into consideration the fact that there are non-member shellers and those which are not listed and that there are mills in Buluchistan Province.

According to the transition of the number of shellers in recent years, about 100 shellers in the Punjab Province have or will relocate to the Sind Province. Although the processing capacity shown in this Table seems overated, it would be improper to conclude that unnecessary facilities are being provided from the fact that the operation rate of rice milling machines is low, for millers are rice dealers as well as rice processors.

Although the sheller mills are operated on a private basis. In may cases, operators not only run mills but are also landowners. It is interesting to note that more Hindus are engaged in this kind of work.

Most commercial mills are located along the main railroad near the public markets of cities in the rice producing areas to facilitate in procuring materials and transportation.

Although rice production rapidly expanded in Usta Muhammad in Baluchistan Province which neighbors Jacobabad County in Sind Province, the construction of mills in this district has not progressed.

(3) The number of modern rice mills and processing capacity

At present, there are none modern rice mills, eight of which are governmental RECP-system (PNP and DOABA) mills. There is only one private modern rice mill.

This situation is shown in Table 3.3.

Table 3.3 List of Modern Mill

Name of Rice Mill	Location		Rated Milling Capacity	Drying Capacity	Remarks
PNPCL	Dhaunkal	Punjab	15 t/hr	t/hr	
PNPCL	Shaheed Allah Baksh	Sind	15		Corrugated Steel Silo
DOABA	Hafizabad	Punjab	5	13.2	
DOABA	Sheikhupura	Punjab	5	15-20	
DOABA	Faisabad	Punjab	5	13.2	
DOABA	Mubarakpur	Punjab	5	13.2	
DOABA	Eminabad	Punjab	5	13.2	
DOABA	Siranwala	Sind	5	13.2	
Bari Rice Mill	Kamoke	Punjab	6 - 7		

Source: Industry Research Report

It is presumed that total annual processing capacity of these modern rice mills is 200,000 to 250,000 tons, occupying about 10% of the total volume of distributed cleaned rice. The actual situation, however, cannot be approximately determined.

3.2.3 Nongovernmental mills and rice dealers

Although there are organizations of these industries both in Punjab and Sind Districts, there are no upper organizations to control them.

(1) Sind Rice Millers & Traders Association, Larka, Sind

The number of members is 478 as of September 1, 1985, 324 mills and 154 rice dealers. Although the regulations of this association have been prepared, no data has been announced on the milling facility scale of each member, contents and processed volume. These data are regarded as business aspects.

(2) Supreme Rice Traders Association, Kamoke, Punjab

The number of members is unknown, but it will be the same as in Sind Province. For high-quality rice, Basmati operates in the Punjab Province. The nature of this association is different from that of the Sind Province.

3.2.4 The competent authorities relating to mill operation

Mills are required to obtain the permission of the Food Department concerning the procurement of paddy, the processing of paddy and the sale of milled rice. In the Sind Province, "the Form II License under Section 7 of the Sind Rice Mill Order 1945" is required for the rice milling process and "the Form A" is required for rice dealing. With respect to the labor conditions of workers, the Directrate of Labor superintends various matters such as the number of workers, working time (or working shift), safety measures and medical products to be prepared.

There are no restrictions on the production of milling machines and equipment, which means that there are no obstacle to modernizing mills as far as the development of machines is concerned.

In addition, there are no restriction to the establishment of mills. In principle, mills are constructed based on free competition. Every year, new mills are constructed while there are some mills which are compelled to suspend operation or are sold to others due to poor business operation.

3.2.5 The operation of mills

(1) Operation time

The operation starting time of commercial mills depends on rice harvesting time. Farmers put paddy in the marketing route as soon as they finish reaping and threshing except for the paddy to be consumed by themselves. Paddy is usually handed to mills within ten days through middle-men and public markets.

Mills start operation after they procure paddy necessary for two-week processing. In the Sind Province, operation starts at around the end of October and in the Punjab Province it usually starts at the beginning of November. A difference of about two weeks is seen depending on the mills even in the same town.

Although mills carry out rice milling processing while collecting cargoes, the amount of milled rice does not necessarily correspond to that of collected cargoes.

The ratios of the amount of the monthly presumable quantity of collected cargoes and that of milled rice to the total amount

of distributed rice are shown in Table 3.4. This table shows that about 35% of total milled rice per year is stored in mills in December.

The operating time of commercial mills is from November to April, and the prime is December and January. They usually operate around the clock. Even in this period, however, the actual operation rate will be around 70% when the time lost due to power shortage and the time required for maintaining and controlling the machines are deducted. (As of December of this year, power supplying time ratio is 75%).

Table 3.4 The Ratios of the Amount of Monthly Presumable Quantity of Collected Cargoes and the Amount of Processed Rice

Month	Sind District		Punjab District	
	The Amount of Collected Paddy Cargoes	The Amount of Milled Rice	The Amount of Collected Paddy Cargoes	The Amount of Milled Rice
10	5	2	5	-
11	50	15	40	10
12	40	40	40	40
1	5	25	10	30
2	-	10	5	10
3	-	5	-	6
4	-	3	-	4

Source: JICA Survey Team, 1985

(2) Mills on commission

The situations of "chakkies" differ between the Sind Province and the Punjab Province. This means that the operation of hullers in the Punjab Province is under the control of the Monopoly Procurement Scheme of Rice.

From the standpoint of milled rice quality and work efficiency, however, farmers usually complete all the milling work by the end of March, and later milled rice is stored.

At any rate, cracked kernels is made at the time of milling under extremely low humidity and high temperature. It is said that the time between December and April is the best for milling and the time between March and June is the worst, for it is very hot and dry.

3.2.6 The quality of raw paddy and storage

(1) The milling property of variety

Appendixes C-39 and 40 show the properties of milled rice produced in Pakistan. They refer to the sizes of paddy and milled rice, husk ratio, dried kernels weight, hardness and cooking properties.

Some variety of rice produced in Pakistan are shaped like boomerangs or bows, which are recognized as peculiar variety. They are however, vulnerable to crack at the time of milling.

(2) The moisture content of paddy

Farmers tend to harvest paddy early, around October, for they utilize straw for green fodder. Paddy harvested at this time contains more than 20% moisture contents and is not suitable for winnowing. After the middle of November, however, paddy whose moisture contents is reduced to less than 20% can to be brought to the markets.

Table 3.5 shows the data on the moisture contents of paddy obtained during the studying period.

Farmers do not usually dry paddy for sale after it is threshed and before it is sold due to the following reasons.

- Paddy need not be dried quickly and forcibly in Pakistan where dry climatic conditions are prevalent.
- In general, farmers think that paddy drying degree is not necessarily reflected in the market value of paddy and that drying paddy rather causes losses due to decrease in weight. It is said that one of the motives for using a big combine is that they can sell paddy with relatively high moisture content.

Therefore in Pakistan, the secondary drying work (viz. drying after threshing) all belongs to the mills.

Table 3.5 Paddy Moisture Contents in Postharvest Processing in Sind Province

Time and Place	Moisture Content Value (%)	Remarks
Oct. 19 Jacobabad	16.5 - 29.3 (Average 20.8)	Public market
" "	12.6	Public market for old rice
Nov. 3 Dokri	23.0	Purchase by mills
6 Larkana	14.6	Paddy from threshers
15 "	13.3 - 15.3 (Average 14.3)	Heaped paddy
" "	15.3	After manual threshing
17 Mohenjodaro	13.5	During tramping by bullocks
21 Larkana	13.6	"

Source: JICA Study Team 1985

(3) Foreign matter

Delivered paddy usually contains many foreign matter, for farmers do not usually make enough winnowing as in the case of drying. These foreign matters are usually straw dust and weed seeds: it is rare that gravel, sand and soil clump are contained. Brick pieces are sometimes mingled. In the case of drying, farmers have the following ways of thinking about winnowing.

- With the exception of rice stored for a long period for self-consumption rice is sold in a short time after harvest and need not be winnowed for storage.
- As farmers have only wooden scoops and winnowers and do not have Chinese winnowers, they cannot make perfect winnowing work. It is technically difficult for them to winnow not-dried paddy.
- They have the impression that differences in market price between winnowed paddy and unwinnowed paddy are unreasonable.

Therefore, mills winnow paddy with sloped sieves when they dry it under the sun. In some mills, the two-stage winnowing process is adopted to increase winnowing efficiency and to facilitate the husking process.

According to the study conducted by the team, the winnowing percentage of material paddy to the milling plants was as the one shown in Table 3.6.

Table 3.6 Winnowing Experiment on Cleaned Material Paddy in Mills

Mill Code No.	Brands	Moisture Contents	Foreign Matter Mixing Rate (Rate in weight)
S-4	IR-6	12.4	2.3 %
S-5	IR-6	13.0	2.1
S-6	IR-6	13.6	2.4
P-1	Basmati 370	13.0	0.65
P-2	Basmati 370	9.2	1.41
P-3	KS-282	10.1	3.72
P-4	Basmati 370	14.9	1.44
P-5	IR-6	13.1	1.12
P-6	Basmati 370	13.5	0.35

Testing method: Power Chinese winnower with a net for testing purpose

Source: The Study Team, 1985

As most paddy purchased by mills is winnowed roughly in the drying process as described previously, the foreign matter mixing rate shown in the table above is not that of paddy distributed in markets, but these figures will serve as a kind of standard.

(4) The mixing of red kernels

In the case of red kernels, there are deep crease on the surface of brown rice, and red stripes will remain without well milling. As this kind of well milling causes many cracked kernels, decreasing the milling recovery of milled rice, the existence of red kernels in paddy presents a great hindrance to producing good-quality rice.

Table 3.7 shows the red kernel mixing rate in material paddy the Study Team obtained from mills for comparison test.

Table 3.7 Red Kernel Mixing Rate in Material Milled Rice

Mill Code No.	Variety	Red Kernel Mixing Rate (in weight)
S-1	IR-6	0.01%
S-2	IR-6	0.01
S-3	IR-6	5.9
S-4	IR-6	2.6
S-5	IR-6	5.7
S-6	IR-6	5.0
P-1	Basmati 370	4.21
P-2	Basmati 370	0.16
P-3	KS-282	0.06
P-4	Basmati 370	2.61
P-5	IR-6	0.04
P-6	Basmati 370	4.85

Testing method: Red kernels were selected by hand from brown rice processed by a rubber-roll husker

As seen from this table, the ratio of red kernels to the actual paddy is about 5% in many cases. Red kernels must be removed from this kind of paddy beforehand, for the standard set by RECP for rice purchase limits is to 2 to 3%. There are two kinds of red kernel namely large size and small size. Part of modern rice mills which produce special grade milled rice remove small red kernels at the brown rice stage to lower the red kernel content rate prior to milling. This is because small grains can be more easily exhausted from a machine by means of grain-size selection and gravity selection.

(5) The rate of cracked kernels

According to the experiment on RRI, Kala Shah Kaku announced in the "Pakistan Agriculture", milling recovery by machine drying method is superior to that by sunshine-drying method by 2%, and by 10% of whole kernels. It is said that the main factor for this difference is the amount of cracked kernels in paddy.

As the occurrence of cracked kernels greatly affects the quality of milled rice, they must be a great concern to the mills. However, as it has been impossible to detect cracked kernels from paddy, this situation has not been reflected in the actual price.

This study team investigated the cracked kernels occurring rate in paddy by using an optical cracked-kernel detector, which was developed recently. The results are shown in Table 3.8.

Table 3.8 The Rate for Generation of Cracked Kernels in the Distributing Paddy

Mill Code No.	Cracked Kernels
S-1	21.7 - 24.0
2	
3	19.3
4	19.7 (21.0)
5	18.1
6	13.6
P-1	16.9
2	7.4
3	21.7
4	9.8
5	22.6
6	12.2

(6) The quality standard of paddy

In Pakistan, no quality standards apply to paddy distributed in the private commercial route. Sellers and buyers check paddy quality and determine price based on their experience, and rice transactions are not within the specified range concerning quality. Price differs depending on quality.

Meanwhile, paddy purchased by the government is acutally bought by mills belonging to PASCCO and RECP. The standards in Table 3.29 are used in governmental purchases, but many problems remain due to the lack of inspectors and inspecting equipment.

(7) Paddy storage in mills

As is to be explained in 3.4.1, mills do not have proper warehouses for paddy. However, as paddy cargoes are collected during some specified period and paddy is cleaned at the constant processing capacity for a specified period of time, paddy should be stocked in mills. However, as many mills do not have sufficient storing capacity, they are obliged to store rice outdoors.

To store paddy outdoors, 10 to 100 tons of bulk paddy equal quality are heaped and the heaps are covered by worn-out hemp bags or tarpaulin sheets to prevent night dew. Paddy heaps are placed on the corner of sunny, dry places.

In modern mills, paddy is bagged after it is dried by a paddy drying machine so that paddy temperature will naturally dissipate. Then, these bags are piled so that there is some clearance between rows of bags. These examples, however, are few. In some mills, corrugated steel silos are provided to store paddy.

In any case, the fact that there are few actual serious problems even though there are few paddy storing facilities can be attributed to the phenomenon that it is relatively cool during the milling season subsequent to harvesting time and that it seldom rains during this period.

(8) Paddy drying work at mills

We have already started that the moisture contents of paddy brought to mills is not necessarily constant and that there is much paddy with much moisture contents. In addition, the most suitable moistuire content of paddy to be processed at mills in Pakistan is 10% according to test results of IRR. Therefore, the drying process is an indispensable process for mills. According to the test conducted by the study team, the actual moisture content of paddy to be processed by mills is 13% to 14% as shown in Table 3.6. However, the moisture content of paddy to be consumed by farmers themselves is about 10% at the time of milling. This kind of paddy is dried under the sun for several days immediately before it is milled. Consideration is given to the large occurrence of cracked rice caused by a huller type machine and to the necessity of storing processed rice for a long time.

In Pakistan, paddy is usually dried under the sun. Drying machines are used by some mills, mostly in Punjab Province. The number of these is presumed to be 20.

1) Sun-drying

In Sind Province, the drying place of a mill is on the premises of the mill. Its area is about one to four acres. The drying place is made by laying bricks on the floor and filling in clay in clearances. In another method, bricks are not used, but plaster, made by mixing straw with clay, is coated and solidified on the ground to a height of about 5 cm from the ground. Either type does not have the bearing capacity of soil and vehicles cannot be driven on the floor, non-manual work causes damage to the floor. The natural slope of the floor is not intended for artificial drainage. Paddy is spread on the floor with a thickness of 2 to 3 cm and this paddy is turned over three to four times a day by feet or tools. In winter, it takes three to four days to dry paddy to a suitable moisture contents.

At night, to avoid dew, a paddy mound with a size of about one gummy bag is made, and each mound is covered with an empty bag. The next day, paddy is dried under the sun again. Fully dried paddy is temporarily packed in bags to be stored near milling equipment. It is said to be a good method to leave paddy as it is for 2 to 3 days prior to milling process in order to decrease the occurrence of cracked rice.

The sun drying method adopted in Punjab Province is almost the same as that in Sind Province. The difference is that the main public markets for crops in Punjab Province have attached sunshine-drying places which are rented or sold to mills. The area of the drying place of one mill is about 4 acres and in Kamoke, a 60-acre wide square for 16 mills is used as a drying place. Mills transport paddy bought at public markets to drying places and carry dried paddy to mills again. This series of work is usually done by sub-contracting groups.

In Punjab Province, for serveral days around the middle of December when the study was conducted, a spell of bad

weather continued, with cloudy days and precipitation of about 15 mm. This caused paddy mounds to absorb water and they became wet, but this did not cause germination. When the weather improved, however, these mounds of paddy dried naturally and defective paddy was not observed on the surface. According to the team's study, however, a deterioration of quality was observed and the occurrence of cracked kernels reached 50%, leading to an increase in broken kernels.

2) Machine drying

In Sind Province, there are no mills which adopt machine-drying. This is because the weather is stable during the rice milling season and farmers can depend on sun-drying.

On the other hand, in Punjab Province, about 20 mills have drying machines. It is presumed, however, that about half are in operation. The specification of this drying machine can be summarized as follows:

Maker: G.T. 370 DRYER
Agent: Millat Tractor
Accommodating capacity:
About 6.65 tons of paddy, forcible circulating method, heated air dying
Fuel: Light oil or natural gas

The reasons that these machines do not operate at full capacity are that more cracked kernels occur during machine drying than sun-drying and fuel cost is high. It is known in Pakistan, however, that theoretically, machine-drying is superior to sun-drying as can be seen in Table 3.9. At present, problems may exist in usage and performance. In fact, there are some mills where the same type of machines are well accepted.

Table 3.9 Percent Rice Recovery under Two Different Methods of Drying

Method of Drying	Basmati 370		IR-6	
	Total Milling Recovery	Head Rice	Total Milling Recovery	Head Rice
Sun-drying	68.0	53.0	68.5	54.0
Mechanical drying	70.0	58.7	71.0	60.0

Source: Annual Repot 1975, RRI Kala Shah Kaku

Natural gas (called "Sui gas") or light oil is used as the fuel for drying machines. As only light oil can be used for the burner of a GT dryer, the burner must be remodeled when gas is used. Although gas is cheaper, there are restrictions for gas piping and users. Those who use gas acknowledge that there is no difference between sunshine drying and machine drying as far as cost is concerned. (Rate of Sui-gas for dryers: Rs86 per 100 m^3 (1984), Rs140.36 (1985)

It cannot be denied that the costs of natural gas, light oil and labor will affect the diffusion of drying machines.

3.2.7 Milled rice processing cost

Milled rice processing costs weight much in operating mills. This cost includes labor wages, power expenses, depreciation and maintenance/management fees of equipment and building, and profits. According to the materials the study team obtained, the processing costs are not constant, changing between 2 and 5 Rs as shown in the following Table 3.10.

Table 3.10 Milling Cost

Type of Mills	Area	Milling Charge	Remarks
Huller	Dokri	Rs1.5 - 2/40 kg	
"	Near Kalashahkaku	Rs4/40 kg	
Sheller	Sind District	Rs2.37/40 kg	Assigned to PASSCO, 1984
"	Muridke	Rs5/40 kg	
Semi-modern	Kamoke	Rs2.86/40 kg	A rubber-roll huller was used.
"	Daska	Rs3.47/40 kg	"

According to the trial calculation made by the Sind Rice Miller & Traders Association in 1985, this cost is Rs7.71/40 kg. According to the above calculation, electric power costs weigh much. At present, mills in Pakistan are operated by motors with some exceptions, and steam-engine driving is not common. As people are requested to save electricity by 25% during this season, steam or diesel engines are once again gaining popularity.

3.2.8 Laborers and work surroundings

Most hullers employ two or three workers. The same laborer engages in milling and lumbering. Most owners work as operators.

In case of sheller mills including semi-modern mills, the standard number of workers required for operating the milling equipment is: one operator, one mechanic and 3 to 4 laborers. In case of two shifts, the number will be double. In general, one or two laborers engage in paddy preparation, one in arranging cracked rice and bran, and one in arranging cleaned rice. Fewer people are required than for drying work. Paddy preparing work involves sanitary problems for laborers; dust mingled in paddy is spread. Some improvements are seen by means of the paddy winnowing method.

As these machines are operated in an intermediate axis transmission method, many transmission belts are used. As these belts are exposed, they may be very dangerous in terms of labor safety.

In Sind Province, like any other industry, the labor safety of mills is superintended by the Directrate of Labor of the District Government.

Mills are obliged to perform seasonal operations. Although the life of an operator or a mechanic is guaranteed by mills every year in some form, laborers are employed by near-by tenant farmers during the season on a temporary basis.

3.2.9 Milling recovery and the occurrence of broken kernels

Milling recovery and the occurrence of broken kernels depend on various factors, and it is impossible to obtain a constant result. In Pakistan, the milling recovery and broken rice occurring rates shown in Tables 3.11, 3.12 and 3.13 are accepted as ordinary standards.

(1)

Table 3.11 Milling Recovery

(%)

Items	Milling Recovery Sheller		Huller	
Head rice	40	)65	30	)62
Brokens	25		32	
Bran	10		15	
Husk	23		20	
Wastage	2		3	

Source: PARC (Rice-Science)

(2)

Table 3.12 Milling Efficiency of Rice as Affected by Different Milling System

Component	Hand Pounding	Huller	Sheller	Rubber Roller
Husk	-	-	24.0	22.0
Bran	-	-	8.5	8.0
Total husk and bran	40	36.6	32.5	30.0
Head rice	40	46.5	55.9	62.0
Broken rice	20	16.9	11.6	8.0
Total milling recovery	60	63.4	67.5	70.0

Source: Pakistan Agriculture. April 1985

(3)

Table 3.13 The Milling Recovery

Carried in rice	11,268 tons	
Winnowed paddy	11,199	100.0%
Complete rice (quality suitable for export)	5,091	45.46
Cracked rice	2,445	21.84
Bran	1,093	9.76
Small cracked rice	49	0.44
Husk	-	22.5

Source: PNP Rice Mill Dhankal

3.2.10 The sale of milled rice

Rice milled by huller mills is returned to and consumed by farmers, consignors, or workers who gain paddy as wages.

On the other hand, milled rice produced by sheller mills and modern mills is brought to RECP or private distribution markets. Standards and gradation of milled rice are detailed in Section 3.4.3. This section describes the work of mills relating to the sale of milled rice.

(1) Weight methods

In Sind Province, scales are used for rice/paddy. As measuring containers, baskets are used for paddy and gunny bags for milled rice. In Punjab Province, platform scales are used in principle, and containers are gunny bags. Paddy is put in large sheets hung from the necks of laborers and then put into gunny bags very quickly. The work is every efficient, that is, two actions make one gunny bag full.

According to the survey conducted by the team, measurement by scales was always larger by 0.1 to 0.3%. This measurement error can be ascribed to the fact that measurers intentionally overmeasured to quicken work speed and to avoid later shortage problems rather than to defects in the scales.

(2) Cargo mark

Milled rice delivered by mills is all contained in 95 kg bags. Cargo marks are printed on new gunny bags. Bags containing milled rice to be delivered to RECP must bear the specified marks. An example of this mark is shown below.

(Surface) (Back)

KS-282 (brand)
LOT No. (lot number)
1985/86 (production year)
KMF (The name of a rice mill) KT (Rice dealer's name)

3.2.11 By-products

By-products from mills are husk and bran.

Huller type mills produce a mixture of bran and husk, the ratio depending on the performance of machines. Huller type mills milled rice on commission basis, and mixed bran is usually given to consignors who use it as feed for cattle.

Commercial mills sell bran to feed dealers or oil makers. In Pakistan, two or three cone-type milling machines are usually placed in series. Therefore, the quality of bran extracted from each machine is different. In bran markets, bran is classified into red bran and white bran (polished), and the former is cheaper. In many mills, however, this classification is not used due to a bran removing system or convenience in handling bran. Although the freshness of bran is an important factor in determining its quality, its importance depends on usage. (Especially in the case of oil production, acidity is important.) On the present bran market, however, freshness is not reflected in market prices. The ex-mill prices of bran were as shown in Table 3.14 during the survey period.

Table 3.14 Ex-mill Rice Bran Prices

Date	Place	Classification of Bran	RP/40 kg
Dec. 16	Daska	Mixture	30
Nov., 10	Larkana	Red bran	38
		White bran (polished)	48
Nov. 20	"	Mixture	32 - 40

Source: Survey Team

In Sind Province, about 2 to 3% of all bran is used as materials for oil. In Sing Province, there are two oil extracting factories (in Kotri and Karachi), and in Punjab Province, there are four factories including Murid. They all produce only industrial oil and do not produce cooking oil. These factories collect material bran packed in bags through their agents.

To inspect the quality of rice bran, the survey team conducted sampling at two or three mills. They analyzed the composition of oil, water, acidity (FFA) and grain size. The results are shown in Table 3.15.

Table 3.15 Quality of Bran

		Oil (%)	Mois-ture(%)	FFA (%)	Distribution of Mrsh(%) >14	~36	~42	~48	~60	~80	80>
Sheikhupuva (Modern mill)	Mixture	14.4	9.7	7	3	32	8	10	7	10	30
Siranwali (Modern mill)	Mixture	15.2	9.5	9	3	40	11	11	8	9	18
	Red bran	19.6	9.5	24	3	31	14	14	11	11	17
	White bran (polished)	10.9	9.5	12	9	26	6	6	6	7	40
Saeed (Sheller type)	Mixture	14.4	10.6	6	1	30	6	8	7	11	38
	Red bran	15.9	10.6	7	1	18	5	7	11	10	49
	White bran (polished)	11.5	10.6	11	1	26	4	5	5	6	52

Husk is another important by-product produced by mills. At mills husk is usually stored outdoors temporarily along with straw dust exhausted from winnowers. Mills used to pay charged necessary for disposing husk, but presently, husk can be sold to brick factories as fuel. Brick factories which use clay as materials are located in rice producing districts, namely near mills. Therefore, it is convenient to transport husk to these factories. The ex-mill prices of husk are as shown in Table 3.16, showing a great difference depending on districts.

Table 3.16 The Market Prices of Fine Broken Rice and Tips

Date	Place	RP/ton
Dec. 3	Kamoke	75 - 100
Dec. 6	Daska	75 - 90
Nov. 20	Larkana	25 - 35

In addition, fine broken rice or tips are treated as by-products. In Sind Province, about 75% is used for chicken feed, 22% as food and 3% for producing glucose. The market prices of fine broken rice and tips are shown in Table 3.17.

Table 3.17 The Market Price of Fine Broken Rice

Date	Place	RP/40 kg
Nov. 20	Larkana	68 - 70
Dec. 16	Daska	70 - 75

As ordinary broken rice is consumed as food, prices differ between Basmati rice and IR, but there is almost no difference in prices of fine broken rice and tips.

3.2.12 Mill facilities

Although facilities differ naturally according to the classification described in Section 3.2.1, no basic regional differences can be observed between Sind and Punjab Provinces.

(1) Huller type mills

Huller milling machines are installed at village agricultural product processing factories called "chakkies". "Chakkies" mainly engage in milling (viz. power production) and rice milling in addition to lumbering and ginning. Some "chakkies" are provided with oil extracting machines. Lumbering machines and ginners are usually put outdoors. All these processes are done on a wage-payment basis.

The prime mover is usually driven by one motor (about 20 hp) Through intermediate axis transmission. Some "chakkie" use low-speed diesel engines, though the number is small. In Sind Province, one "chakkies" has two or three huller milling machines and in Punjab Province, most "chakkies" have one machine. Attached equipment are scales and latitudinal sieves. As the usage of these attachments is different between Sind and Punjab, the usage is exemplified below.

(Sind Province) ... The combination of two hullers and one longitudinal sieve

	1st time		2nd time			3rd time	
Paddy →	Huller type	→	Huller type	→	Longitudinal sieve	→ Huller type with a rice polishing machine	→ Cleaned rice
					Husk powder		

(Punjab Province) ... Only one huller

	1st time		2nd time	
Paddy →	Huller type	→	Huller type	→ Cleaned rice

(2) Sheller type mills

The main facilities of this type of mill consist of brick-laid or earth-floor sun-drying places (1.6 to 2.4 hectares), small warehouses where materials and products are temporarily stored, milling machines and buildings for them. Some mills are provided with dryers and par-boil plants.

Milling machines are usually comprised of a paddy winnower, huller, husk wind-winnower, husk selector, milling equipment, plan shifter, motor and other attachments. Although models and the number of machines differ depending on the mill, the basic configuration of machines and the flow of processes are the same in Sind and Punjab Provinces. The typical flowchart of machines and equipment is shown in Figure 3.2.

In each mill, the following differences can be observed.

1) One paddy selector is used or two selector is used; difference in sieve surface area and a net.

2) Sheller mills (about 50 places) are replacing disk hullers with rubber-roll hullers in some places. In Sind Province, 6-inch rolls (made in China) are introduced whereas in Punjab Province, 10-inch rolls (made in Pakistan) are introduced.

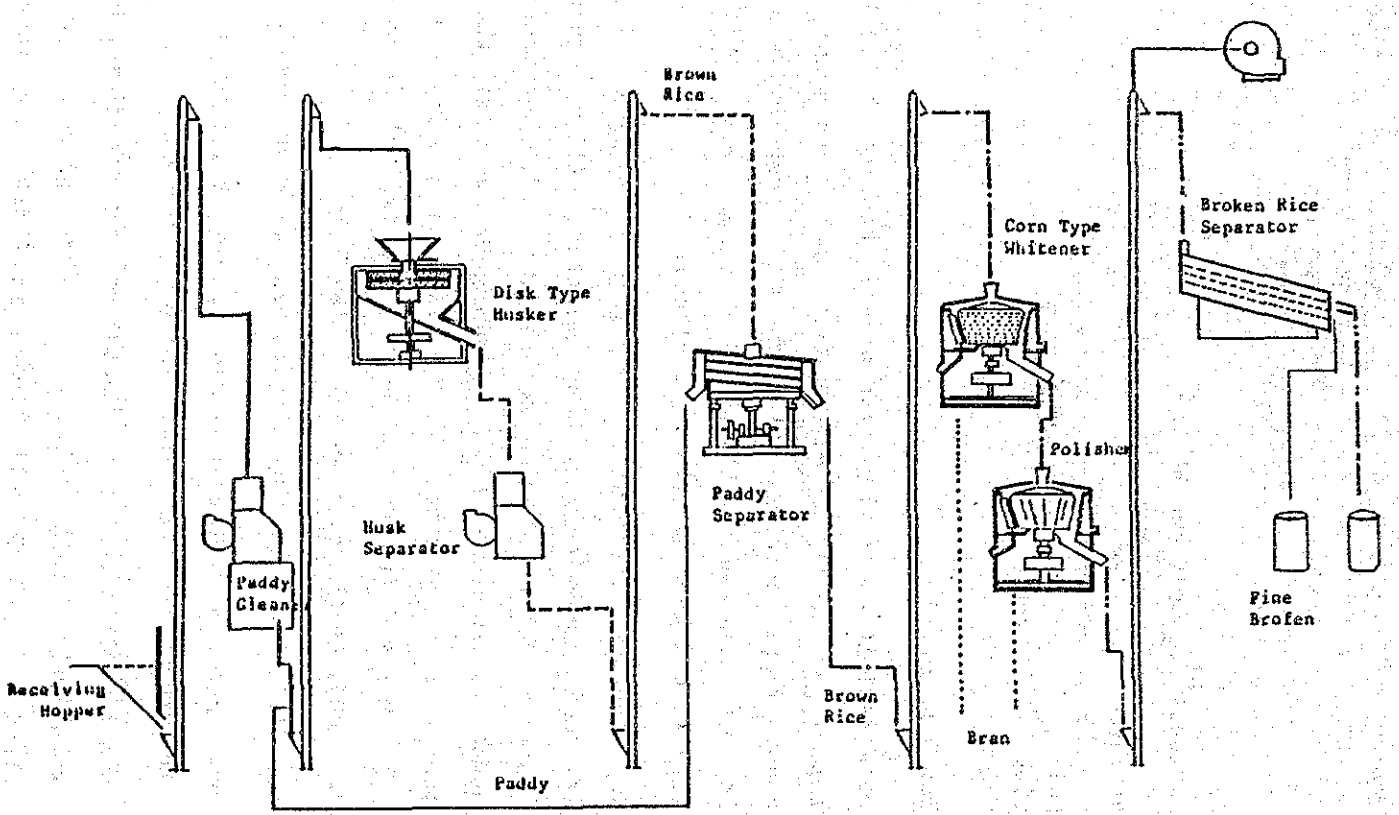


Fig. 3.2 Flow Chart of Sheller Type Rice Mill in Pakistan

3) Broken kernel powder exhausted from a paddy wind-winnower is thrown into the first milling machine or it is exhausted from the machine after mixed with bran.

4) Two sets of cone-type milling machines are usually used, but three sets are sometimes used.

5) Difference in the net of a plan sitter

6) Broken rice taken out of a plan sitter is put in bags or it is transported to a cracked rice room through an elevator.

(3) Parboiled rice producing plants

Parboiled rice is produced to increase recovery and because of its taste. To improve the quality of milled rice, parboiled rice is produced both from Basmati and IR rice.

There is a big difference in technology in the methods adopted in Pakistan, ranging from primitive to modern. In Pakistan, parboiled rice has been used for ceremonial dishes, and it is sold and displayed with ordinary rice at retailers.

Commercial mills which possess parboiled plants are less than 10%. Most of these facilities are at an intermediate technical level. The method is similar to the one adopted in India, that is, paddy is soaked in hot water (76°C) contained in cement tub for ten hours or in cold water for two or three days, then it is taken out manually, thrown into a cylindrical container with a cone-shaped bottom, and steam from a team pipe is blown to it. Facilities consist of a paddy boiler, four to six water tubs, 16 to 24 steaming tanks and a sunshine-drying place.

In another method, soaking in hot water and steaming are carried out in the same container, and paddy is manually dried. There are two or three parboiled plants of this kind, but a full performance cannot be extracted due to technical resons. Rather, these plants produce defective rice due to incorrect operations and some plants are not used at all.

The most primitive method commercially adopted is as follows: One to 1.5 tons of paddy are put in a large

semi-spherical iron pot and boiled for two or three hours. Boiled paddy is taken out and spread on a heated iron plate (similar to a flying pan) with a diameter of about 2 meters and it is heated for 15 minutes. While paddy is heated, water is poured to the necessary quantity which is then covered with a hemp bag as soon as possible so that it may be steamed evenly. This method is, however, used by only a few people.

As it is hot and paddy can be dried easily in Sind Province, producing parboiled rice is the best method for preventing the occurrence of broken rice caused by over-drying. In reality, however, it is difficult to make all paddy parboiled, for all people do not like parboiled rice.

(4) Drying facilities

Most material paddy brought to mills has not been dried. Therefore, drying facilities are indispensable to mills. These facilities are explained in Section 3.2.6 (8).

(5) Buildings for machines

Buildings for the machines of sheller-type mills consist of a paddy preparation room, a main machine room, a temporary storage of milled rice and broken rice and a bran room. In many cases, the paddy preparation room is provided with a paddy separator and this room is partitioned from the main machine room so that dust may not enter the main machine room. It is the worst possible condition for paddy preparers to work in a stifling room filled with dust. It is therefore necessary to install a ventilating window.

As the port of the disk sheller in the main machine room is exposed, much dust is exhausted. However, no measures are taken at this stage.

The temporary storage of cleaned rice and cracked rice is 5 x 5 meters in area. Rice is heaped like a pyramid in this room to adjust for broken rice separation and to pack milled rice in bags. These rooms are dark due to a lack of sunshine and it is difficult to check milled rice properly.

The machine building is structured with iron struts and reinforced trusses, and is iron-slated in a wave form. There are no lighting windows except at the entrance and the exit. Pits are installed only at a the preparing elevator and they are not usually installed at the elevator of the main machine room.

There are some paddy preparation rooms which have only side walls without roofs as measures against dust. As it seldom rains in Pakistan during the rice cleaning season, it is possible to use rooms like this.

(6) The warehouse of paddy/milled rice

As explained before, mills in Pakistan are not usually equipped with warehouses. The reason is: 1) Rain does not cause serious damage even if paddy is stored outdoors. 2) It is customary to sell cleaned rice without storing it.

Therefore, mills have small warehouses of about 200 m^2 which are mainly used as paddy spreading places.

3.2.13 The manufacturers of milled rice processing machines

In Pakistan, European style models have been manufactured, and at present, though not satisfactorily.

The above-mentioned modern-type mills mainly use imported equipment. The imported machines are made by Shüle in West Germany and Satake in Japan. Huller types are made in Pakistan or are Chinese machines. (The names and addresses of makers in Pakistan are shown below.) The machines sold by machine dealers are priced between Rs.10,000 to 12,000 per unit.

Furthermore, 6-inch rubber-roll hullers are made in China and 10-inch hullers are manufactured by a domestic maker which makes sheller types. Motors made in China and Pakistan are used. Rubber-rolls for 6-inch hullers are Chinese and rolls for 10-inch hullers are Pakistani. Some 10-inch rubber-rolls are imported from Taiwan.

Huller type:

Domestic machines
- Special TAT Rice Machine, Lahore
- Taji Foundry Machinery Works, Lahore

Sheller type:

Domestic machines
- Mahafi & Industry, Chadara Mole, Lahore
- Allied Industries, Shahadara Mole, Lahore

3.3 Rice marketing channels

Rice flow was analized based on the following sources.

- Government rice flow; Data collected from RECP
- Private rice flow; Estimated based on data of rice production, consumption, exportation and transportation by zone.

For analysis, the country was divided into 11 zones taking administrative boundaries and characteristics of the area such as production and consumption of rice, into consideration. Zoning results are shown in Figure 3.3 and Appendix C-43. Analized data is for the year of 1984.

3.3.1 Rice production

Rice production by zone was allocated by district production by the Federal Bureau of Statistics. Rice Production in the country was 3,3339.5 thousand tons. In Punjab and Sind provinces it was 1,409.4 and 1,478,8 thousand tons, respectively. Especialy in Labore, Larkana and Nashisrabad, which are major production areas, 1,012.4, 1,079.4 and 331.2 thousand tons of rice were produced, respectively, (See Appendix 3-18 and Figure 3.4)

3.3.2 Rice consumption

(1) Population by Zone

Population by zone in 1984 was estimated based on data from the population census in 1982 and 1981. The results are shown in Figure 3.5 and Appendix C-44.

(2) Estimation of per Capita Consumption of Rice

Per Capita consumption of rice by zone was estimated recompiling original data of "Household Income and Expenditure Survey 1979" by the Federal Bureau of Statistics. The results are shown in Table 3.19.

Per Capita rice consumption was very high it reached 5.39 kg per month. In comparison, it is much lower in Quetta and Peshawar and rice consumption is approximetary 9.5 kg per month (see Figure 3.6.) However, the Study Team obtained rice consumption data by interviewing farmers and per capita consumption was 15.7 kg and 31.4 kg per month in Punjab and Sind province, respectively. Comparing this data, it can be said that figures based on the survey are rather conservative.

(3) Rice Consumption

Rice consumption by zone was estimated by multipling the population and the per capita rice consumption which was explained in the previous section. The results are shown in Table 3.18. High consumption zones are Hyderabad and Lahore and consumption is 354.6 thousand tons and 345.2 thousand tons, respectively. A low consumption zone was Quetta with only 30.6 thousand tons.

3.3.3 Estimation of rice OD table by zone

(1) Estimation of rice distribution for export

Distribution of rice for export by zone was estimated based on the rice transportation quantity by transportation mode, which was procured by RECP.

(2) Estimation of rice distribution transported by Pakistan Railways (PR)

Distribution of rice transported by PR by zone was estimated based on transportation records of PR.

(3) Estimation of private rice distribution transported by National Logistic Cell (NLC) in Punjab

Distribution of private rice by zone transported by NLC was estimated based on records from NLC.

(4) Estimation of private rice distribution transported by Private Tracks (PT) in Punjab.

Distribution of private rice by zone transported by PT was estimated based on records of permission for transportation issued by the Food Department.

(5) Estimation of private rice distribution transported by PT in Sind.

Distribution of private rice by zone was estimated combining data of (1) - (4) production and consumption. A summary of rice flow in Pakistan in 1984 is shown in Table 3.18. Moreover, a detailed flow of rice in explained below.

(6) OD rice table

Rice distribution in Pakistan by zone is shown in Table 3.20 and Figure 3.7. The biggest destination of rice was karachi, where rice for export was concentrated and 1,325 thousand tons of rice was transported to. Other major destinations were Lahore and Hyderabad and 436 thousand and 355 thousand tons of rice were transported there.

Origins of rice were Larkana and Lahore districts, which are rice producing areas, and 991 thousand and 867 thousand tons of rice are transported out thousand.

Basic OD patterns of rice are connected between rice producing and consuming areas.

However, Rawalpind is a rice consuming area and also transports rice to secondary destinations.

OD table of rice by government/private sector is shown in Appendix C-45. In Karachi, 93% of total transported rice was by government.

(7) Classification of rice transportation

Classification of government rice by variety and transportation mean is shown in Appendix C-46. From Panjab, not only Basmati but also IR-6 is transported by PR and NLC. From Sind, rice transportation was divided by PR, NLC and PT. There is no big difference of classification of rice between Basmati and IR-6. Classification of rice by transportation mean is shown in Figure 3.8.

In Pakistan, the share of PR, PT and NLC is 43%, 37% and 20% respectively. From Punjab, especially from Lahore to Karachi, 81% and 19% of rice was transported by PR and NLC respectively. PT was not employed for transportation because the government considers transportation by PT to be less reliable.

From Sind to Karachi, the share of PT was high because PT has an advantage in short distance transportation and rice producers transport rice by themselves. In Larkana, 60%, 21% and 19% of rice is transported by PT, PR and NLC respectively. But in case of rice procured by the government from rice producing areas, PT was not employed, same is true in Punjab.

OD chart for the distributing milled rice through private channel by transportation means are shown in Appendix C-47. Out of total amount of the distributing milled rice, only 28,000 tons of milled rice is transported by NLC truck in Lahore zone, and it is only equivalent to 6% of total distributing milled rice through the private channel.

The PT share was very high of the total OD volume and 385 thousand tons of rice were transported, coresponding to 76% of the total.

Comparisons of classifications of private rice transported to Karachi is shown in Figure 3.9 and the share of PT, NLC and PR in Pakistan was 76%, 23% and 1% respectively.

By zone, from Lahore, NLC transported 70% of the rice, and from Larkana, 99% of the rice was transported by PT.

Major transportation means for rice are trucks regardless of NLC and PT.

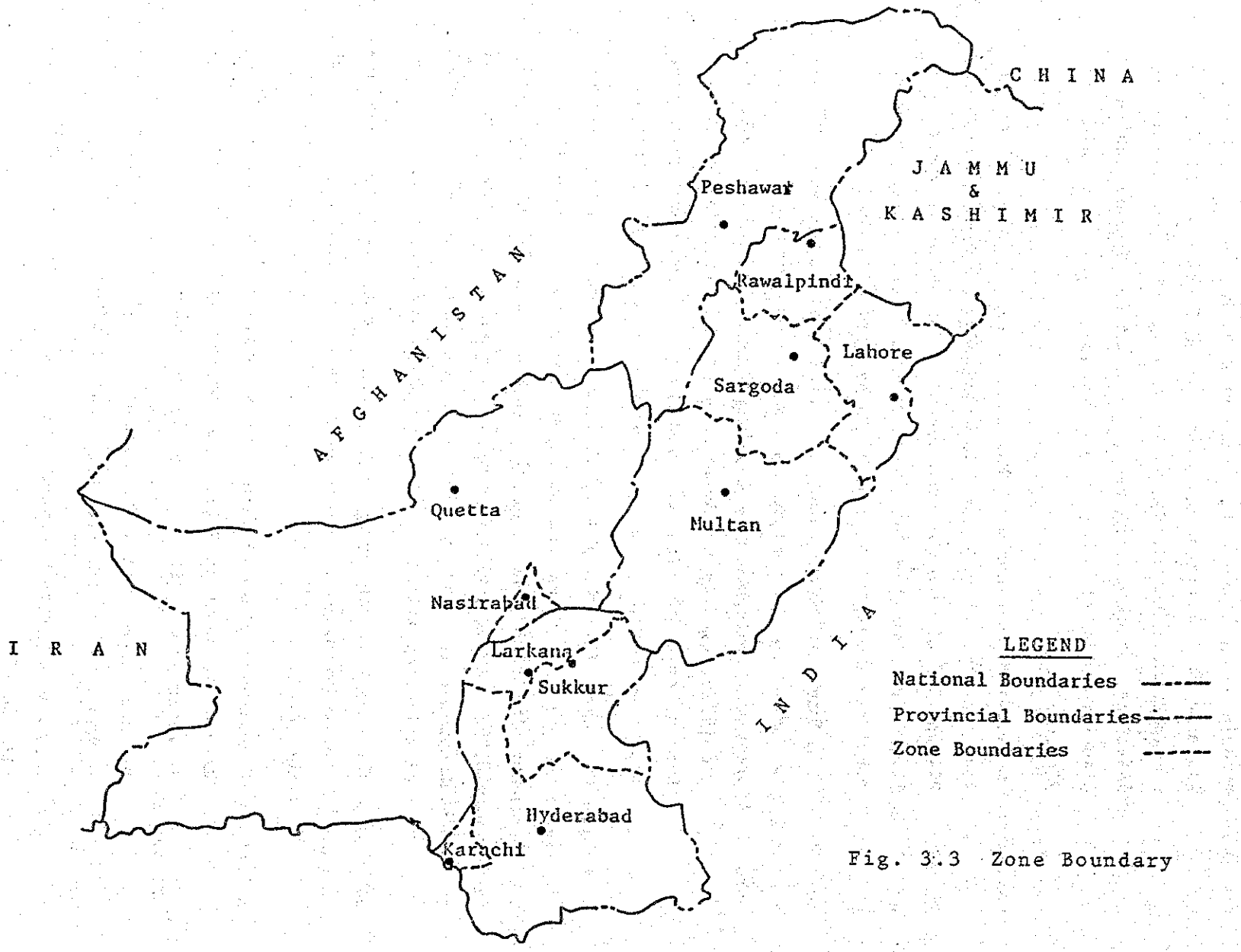


Fig. 3.3 Zone Boundary

Table 3.18 Summarized Rice Flow by Zone in 1984

(Unit: 1000 ton)

Zone	A) Production	B) Inflow	C) Local Consumption	Outflow		D)	2/
				Local Transport	Export	Sub-Total	Unknown A)-B)-C)-D)
Pakistan	3,339.5	1,732.3	1,634.7	506.4	1,225.9	1,732.3	478.9
Punjab	1,409.4	121.0	699.4	167.1	472.6	639.7	191.3
1. Rawalpindi	0.5	100.8	51.0	50.3	-	50.3	-
2. Sargoda	158.1	-	121.3	-	35.0	35.0	1.8
3. Lahore	1,012.4	9.9	345.2	115.1	401.0	516.1	161.0
4. Multan	238.4	10.3	181.9	1.7	36.6	38.3	28.5
Sind	1,478.8	1,525.1	791.6	170.5	736.4	906.9	79.5
5. Sukkur	41.7	118.5	157.8	-	2.4	2.4	-
6. Larkana	1,070.4	-	180.1	170.5	640.3	810.8	79.5
7. Hyderabad	366.7	81.6	354.6	-	93.7	93.7	-
8. Karachi	-	1,325.0	99.1	-	(1,225.9) 1/	(1,225.9) 1/	-
NWFP	115.8	57.3	72.0	-	-	-	101.1
9. Peshawar	115.8	57.3	72.0	-	-	-	101.1
Balchistan	335.5	28.9	71.7	168.8	16.9	185.7	107.0
10. Quetta	4.3	28.9	30.6	-	-	-	2.6
11. Nashirabad	331.2	-	41.1	168.8	16.9	185.7	104.4

Note:

1/: Exported Portion from Karachi and not included in total figure.

2/: Include Losses

Source: Production ; Federal Bureau of Statistics
Inflow ; Study team's estimation
Local consumption; - do -
Local transport ; - do -
Export ; R.E.C.P.

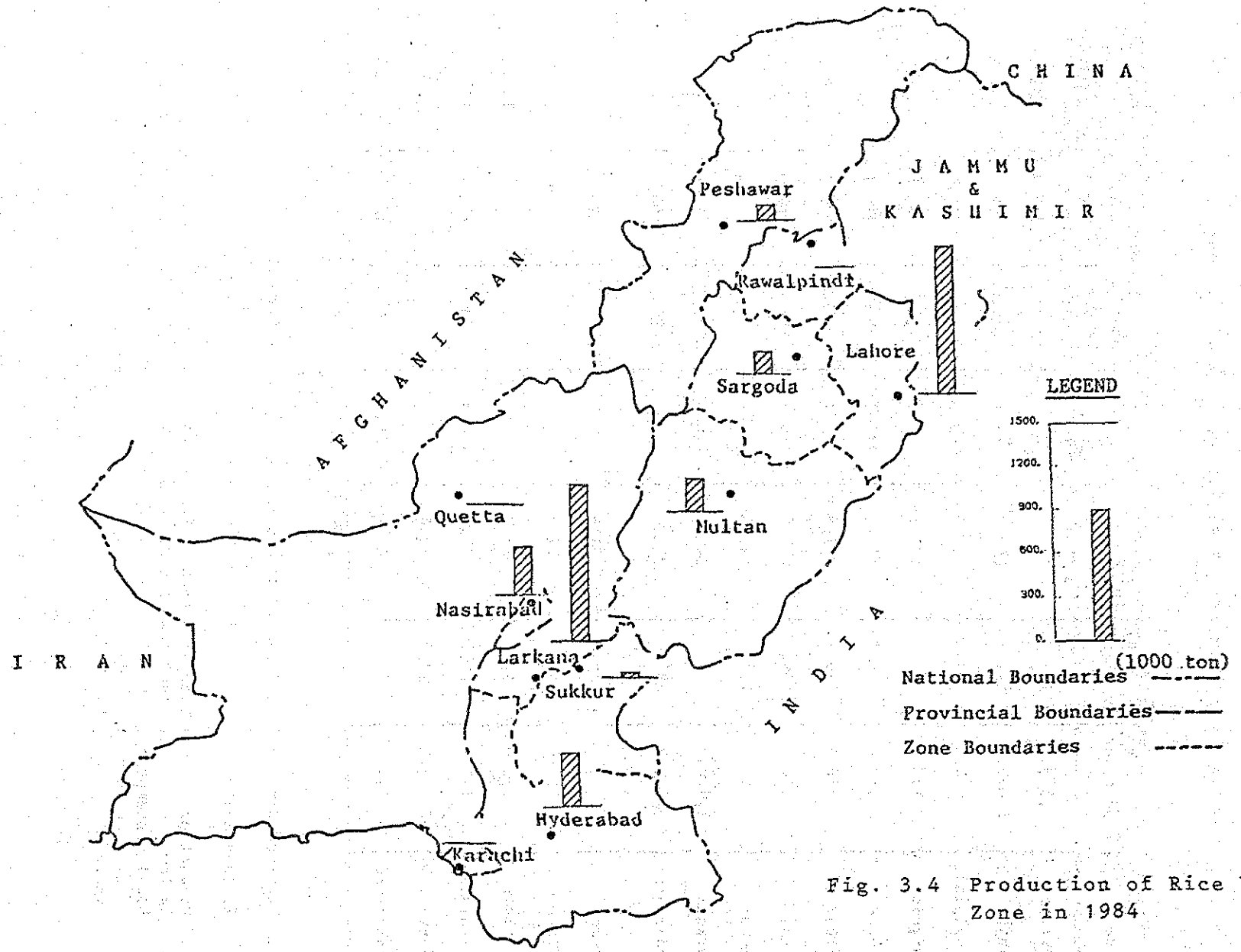


Fig. 3.4 Production of Rice by Zone in 1984

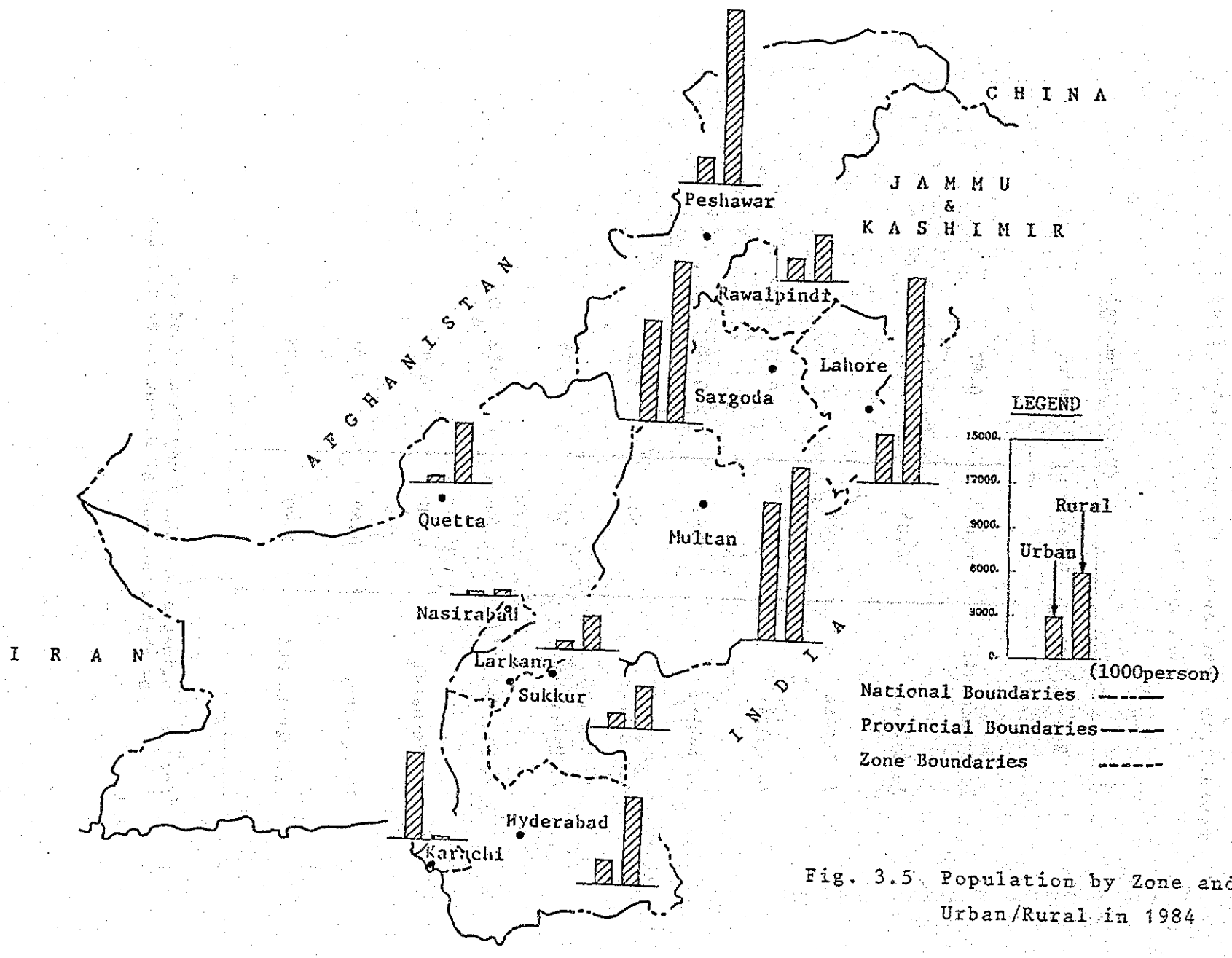


Fig. 3.5 Population by Zone and Urban/Rural in 1984

Table 3.19 Percapita Consumptional Rice by Zone in 1979

(Unit: kg/month)

Zone	Urban	Rural
1. Rawalpindi	0.85	0.87
2. Sargoda	0.85	0.87
3. Lahore	1.34	1.74
4. Multan	0.85	0.87
5. Sukkur	1.52	3.76
6. Larkana	2.90	5.39
7. Hyderabad	1.66	4.36
8. Karachi	1.32	1.32
9. Peshawal	0.40	0.42
10. Quetta	0.49	0.57
11. Nashirabad	2.90	5.39

Source: Estimation by the Study Team based on the data from Federal Bureau of Statistics

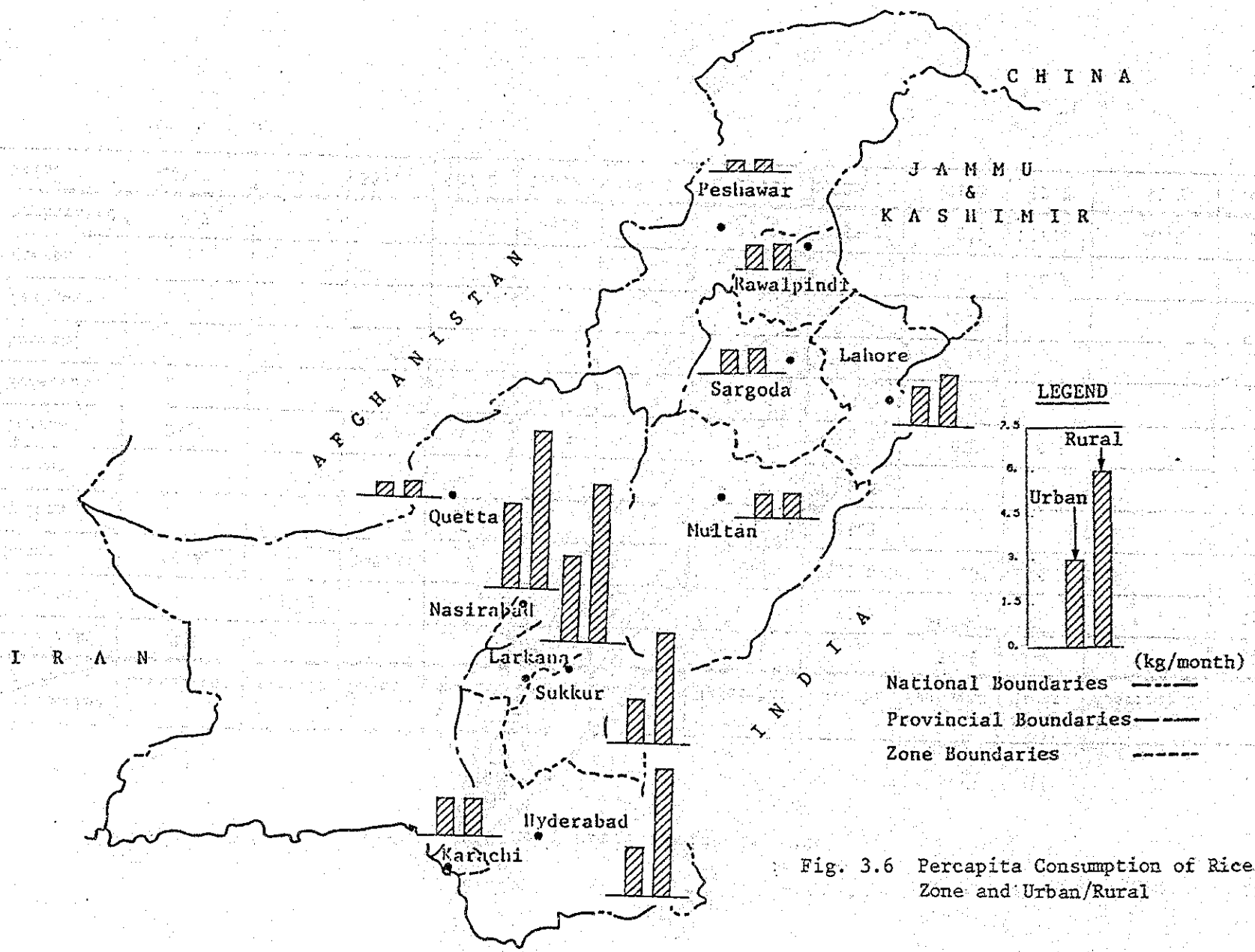


Fig. 3.6 Percapita Consumption of Rice by Zone and Urban/Rural

Table 3.20 Rice Distribution in 1984

Origin \ Destination	1 Rawalpindi	2 Sargoda	3 Lahore	4 Multan	5 Sukkur	6 Larkana	7 Hyderabad	8 Karachi	9 Peshawar	10 Quetta	11 Nashirabad	Total
1. Rawalpindi	0.5								50.3			50.8
2. Sargoda		121.3						35.0				156.3
3. Lahore	36.4		345.2		0.7		40.8	431.8	0.6	5.8		861.3
4. Multan				181.9				38.3				220.2
5. Sukkur					41.7			2.4				44.1
6. Larkana	63.7		9.9	10.3	31.9	180.1	15.1	665.2	6.3	8.5		990.9
7. Hyderabad							354.6	93.7				448.3
8. Karachi								0.0				0.0
9. Peshawar									72.0			72.0
10. Quetta										4.3		4.3
11. Nashirabad	0.7				85.9		25.7	58.7	0.1	14.6	41.1	226.8
Total	101.3	121.3	355.1	192.2	160.2	180.1	436.2	1,325.0	129.3	33.2	41.1	3,075.0

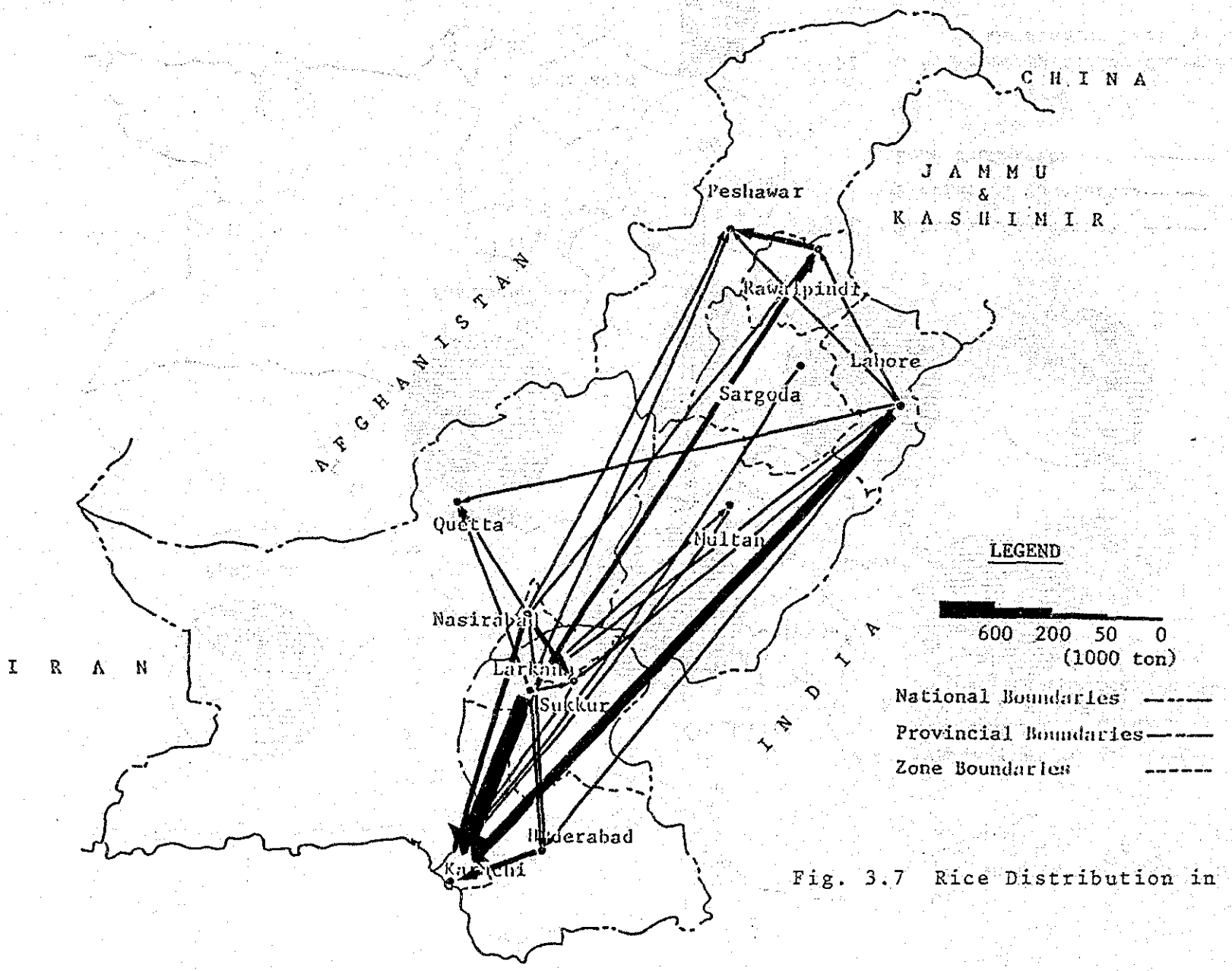


Fig. 3.7 Rice Distribution in 1984

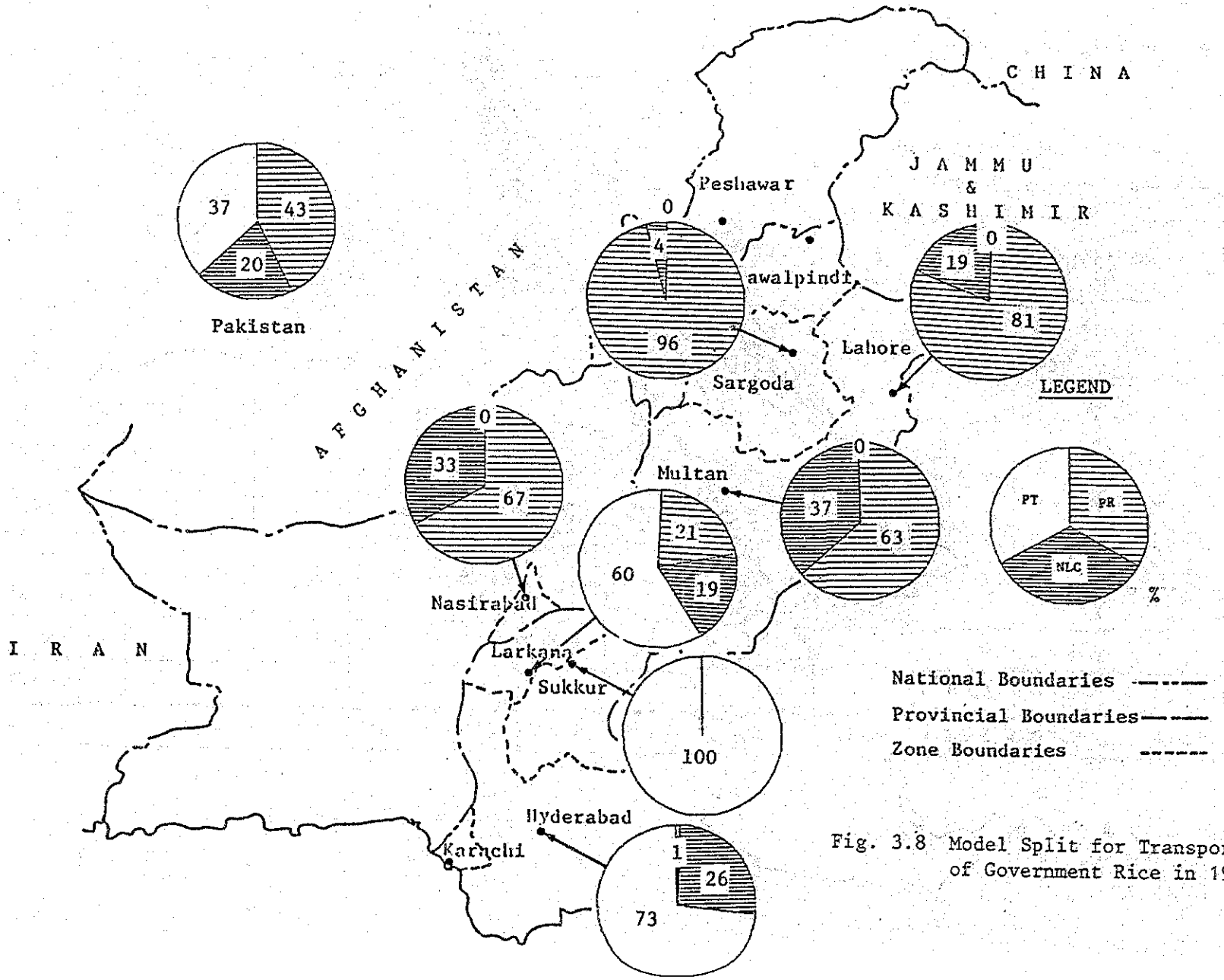


Fig. 3.8 Model Split for Transportation of Government Rice in 1984

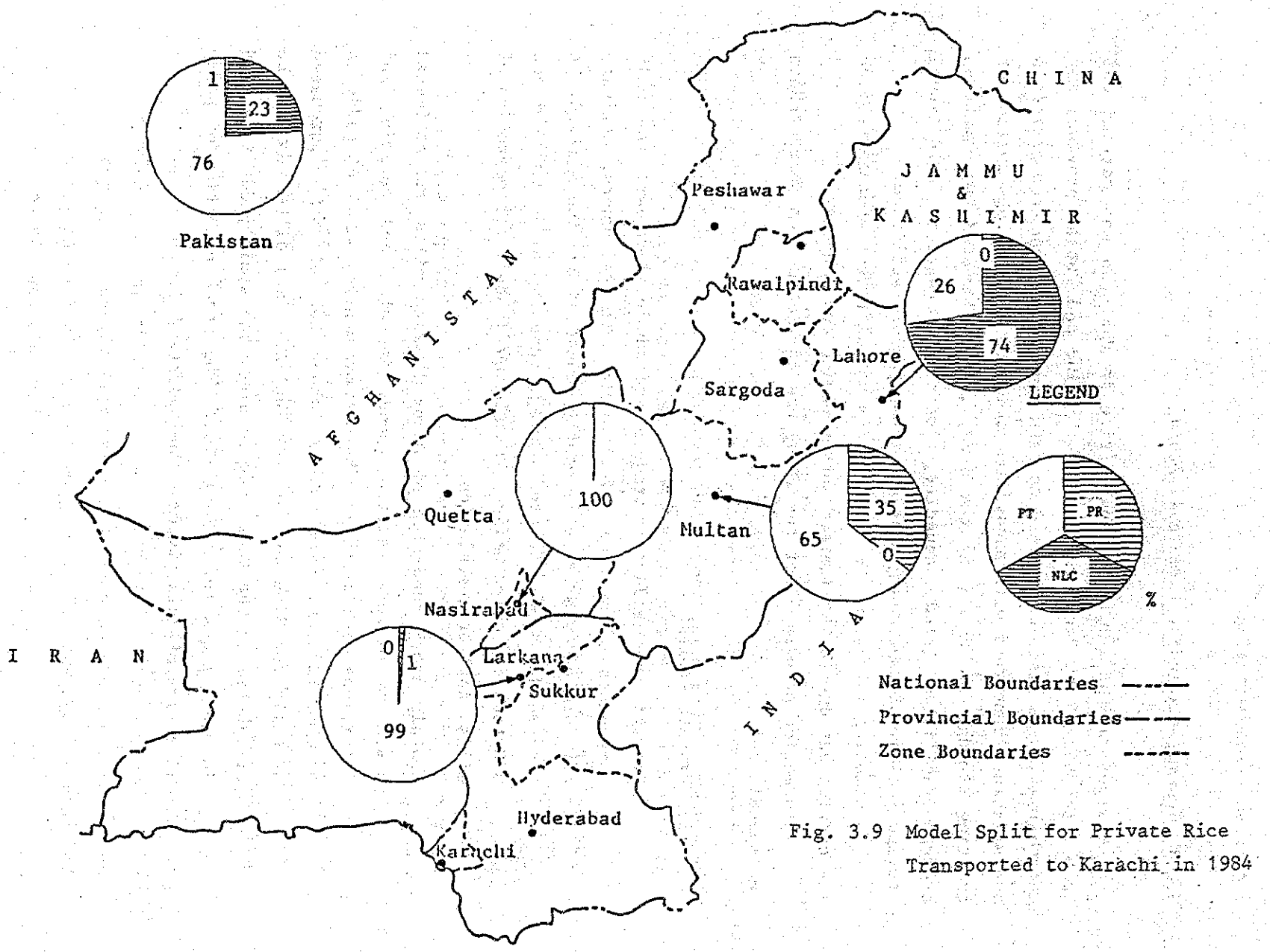


Fig. 3.9 Model Split for Private Rice Transported to Karachi in 1984

3.4 Paddy/Rice Marketing

3.4.1 Storage (excluding farm-level storage)

A study on the storage of paddy/rice in Pakistan was carried out from September 24 to December 20, 1985 in Sind and Punjab province and the following was discovered based on data and information from officials and merchants concerned with paddy/rice storage, and from observation of existing storage facilities by the study team. The study was made on storage facilities (kind, capacity, location) inventory conditions, storage losses, storage management and expansion of facilities.

No sampling survey on storage loss against different storage periods was carried out due to the limited survey period and manpower.

Information necessary for the study was collected from source shown in Appendix B-1.

(1) Private storage

Private rice millers, traders and wholesalers are the main components of private off-farm rice storage owners. Private off-farm paddy storage is mostly conducted by rice millers. A rice miller has a covered storage capacity of around 200 and 300 tons for dried paddy. The storage is only for operation of mills, not for speculation.

Monthly stock condition of paddy in rice mills was estimated based on millers records, paddy incoming and outgoing and interviews with millers. The maximum monthly stock of paddy in a rice mill is estimated at about 20% of paddy purchased annually for Sind and 70% for Punjab. This difference can be attributed to the fact that in Sind, the stalk paddy is stored in open spaces for a long time. The stock condition of paddy in a rice mill is given in Table 3.21.

Table 3.21 Condition of Paddy in a Rice Mill

	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sept.	Total
Sind													
Paddy Purchased (%)	6.3	10.4	21.2	25.4	14.9	15.2	5.2	0.3	-	0.2	0.9	-	100.0
Paddy Processed (%)	3.7	9.2	9.7	23.1	12.3	23.9	11.0	3.5	0.4	1.1	1.9	0.2	100.0
End-Stock (%)	2.6	3.8	15.3	17.6	20.2	11.5	5.7	2.5	2.1	1.2	0.2	-	
Punjab													
Paddy Purchased (%)	-	30.0	45.0	20.0	5.0	-	-	-	-	-	-	-	100.0
Paddy Processed (%)	-	5.0	10.0	10.0	15.0	15.0	15.0	15.0	15.0	-	-	-	100.0
End-Stock (%)	-	25.0	60.0	70.0	60.0	45.0	30.0	15.0	-	-	-	-	

Remarks 1: The above figures show the proportation of the amount of paddy procured in the month to that of total amount of procurement in the season.

Remarks 2: Estimated by the study team based on records of incoming and outgoing paddy in mills and interviews with millers, losses are not counted.

There appears to be no problem in paddy storage at rice mills in Sind due to the dry climate except high temperature and sun shine.

In Punjab, some additional storage facilities for paddy in rice mills are necessary during wet season in a paticular years. The present covers for paddy during rain are tarpaulins which are not effective during heavy rains.

The technical knowledge on paddy/rice storage on the part of rice growers, millers, traders and wholesalers appears to be very poor, judging from the field study by the study team. No extension services of technology on grains storage are provided to the private sector.

The commission agent has a 100 to 130 ton storage capacity for grains but does not use it for paddy/rice. Rice wholesalers have a storage capacity of 120 tons in average, which corresponds to a sales volume of 3 to 4 months.

The off-farm private storage facilities are in house-type structures made of mud-plastered brick or rock wall.

(2) Government storage

There are 3 main government agencies for food grain storage, namely the Provincial Food Departments, PASSCO and RECP. The total government storage facility was 4,240,000 tons in 1982/83 and will become 7,300,000 tons in 1987/88 according to the 6th Five Year Plan. In major rice producing areas, namely Punjab and Sind Provinces, there were 4,148,460 tons of space for food grain storage in 1985/86. Details are given below.

Government Storage Capacity for Food Grain in Punjab and Sind (1985/86)

Food Department	
Punjab	2,177,850
Sind	536,610
RECP	944,000
PASSCO	490,000
Total	4,148,460 tons

Of the 3 government agencies for food grain, only RECP has storage capacity of paddy/rice. No extra storage capacity for paddy/rice is available in Food Departments and PASSCO in the present jurisdiction of administration.

RECP has 3 types of storage, facilities, i.e. house-type godowns, silos and binishells. The breakdown is shown in Table 3.22.

Table 3.22 RECP Paddy/Rice Storage Facilities, 1984/85

Location	Type	Max. Storage Capacity (tons)
Sind		
T.P.X.	house-type	60,000
Landi	"	180,000
Bin Qasim	"	448,000
"	binishell	150,000
Shaheed Allah Bux	house-type	3,300
"	silo	24,000
Punjab		
Dhaunkal	house-type	15,300
"	silo	24,000
Sheikhupura	house-type	8,800
Faizabad	"	6,500
Mubarkpur	"	6,500
Hagizabad	"	6,600
Eminabad	"	5,500
Siranwali	"	5,500
Total		944,000

Source: RECP, 1985

The house-type godowns are typical storage facilities in Pakistan and are designed for bag storage of grain. The house-type godowns of RECP have a normal storage capacity of 1,8900 tons, with 14 layers of bags, a continuous concrete loading deck of more than 3 feet in height, cast-in-place concrete beam columns and a slab roof. The binshell is a dome-shaped bag-storage godown made of reinforced concrete, with a normal storage capacity of 1,500 tons. The binshell's origin comes from the hanger, it has no columns.

Silos are attached to the rice mill and are owned by PNP which is subsidized and controlled by RECP. Normal storage capacity of an individual silo is 2,400 tons of paddy in bulk form. Silos are in metal form equipped with temperature monitoring, mechanical handling and aeration systems.

RECP has a huge amount of carry-over due to unfavorable rice trade in the world. The rice stock at the end of September 1985 was 974,000 tons.

The shortage in storage space for rice in 1985/86 will be about 773,000 tons supposing rice purchase and exports to be

1,200,000 tons and 1,173,000 tons respectively. Details are shown in Table 3.23.

Table 3.23 Expected Shortage in Storage Space for Rice of RECP

(Unit: tons)

Month	Expected Arrival of Rice	Expected Export of Rice	End-Stock	Available Space	Shortage in Space
Sept. '85	-	68,000	974,000	621,000	353,000
Oct.	-	80,000	894,000	621,000	273,000
Nov.	140,000	125,000	909,000	621,000	288,000
Dec.	250,000	125,000	1,034,000	621,000	413,000
Jan. '86	310,000	125,000	1,219,000	621,000	598,000
Feb.	220,000	125,000	1,314,000	621,000	693,000
Mar.	220,000	140,000	1,394,000	621,000	773,000
Apr.	30,000	125,000	1,299,000	621,000	678,000
May	30,000	125,000	1,204,000	621,000	583,000
Jun.	-	75,000	1,129,000	621,000	508,000
Jul.	-	60,000	1,069,000	621,000	448,000
Total	1,200,000	1,173,000			

Source: RECP, 1985

(3) Storage management

In addition to storage facilities, which have already been discussed in the preceding section, storage form, and storage pest control are essential parts of grain storage management. Bag storage is the main form of grain storage in Pakistan. Bulk storage is partially adopted in wheat storage by PASSCO when storage space is insufficient and in silos for wheat or paddy. Open-bulk-storage in platform for wheat with a 5,600 tons capacity is being experimented with by PASSCO, introducing technology from Australia. Stacking in house type godown is normally in 14 layers. Layers of more than 14 is not applied except emergency cases, due to the increase in stacking costs. For RECP rice storage, handling space of 1 to 1.5 m is normally provided between stacks and walls. In a house-type godown, 8

stacks of 2,500 bags (10,000 bags in total) can be stacked, while in a binshell, 4 stacks of 4,400 bags, can be accommodated. There is no system of bonding applied in stacking in order to prevent the stack from collaping or to allow for easy counting of the bags.

Main rice storage insect pests in Pakistan are Phyzopertha dominica (Lesser grain borer), Sitophilus oryzae (Rice weevil), Tribolium castaneum (Red flour beetles), Sitotroga cerealella (Angoumois grain moth) and Coryra cephalonica (Price moth).

No fumigation for grain insect pests is done for on-farm rice storage and private off-farm rice storage. Extension of storage management technology has not been provided to private grain handling personal. In RECP godowns, aluminum phosphide or methyl bromide are used as fumigants for grain insect pest control. Actellic and malathion are also sprayed on floors, walls and doors to control the pests. The aluminum phosphide is applied at a rate of 20-30 tablets per 1,000 cu-ft (27 m^3) of grains for 3 to 4 days and the methyl bromide at a rate of 1-2 pounds (453-906 g) per 1,000 cut-ft for 2 to 3 days. The fumigations are applied to the entire godown or stacks covered with gas-proof covers. For complete godown fumigation, all the windows, doors and ventilators of the godown are sealed with mud-plaster. Other visible cracks and crevices are also sealed with mud-plaster or adhesive tapes. For the fumigation of stacks under gas-proof covers, a gas proof tarpauline is spread over a stack of bags and its end is sealed on all sides with a cover by using sand snake bags.

Fumigation costs are Rs. 3.0/ton (Rs. 1.0 for the fumigant and Rs. 2.0 for labor charge) for aluminum phosphide and Rs. 5.0/ton (Rs. 3.0 for the fumigant and Rs. 2.0 for the labor charge) for methyl bromide. Fumigation by using methyl bromide is carried out at the request of milled rice buyers. In respect to the extension of the paddy/rice post-harvest technology, the government is strengthening the capacity of extension services under the grain storage project funded by the World Bank. There will be no further requirements in strengthening the extension capacity.

3.4.2 Transportation

(1) Transportation of Paddy

1) Transportation means

Major transportation means for paddy are wagons towed by tractors. Also, wagons towed by donkeys, horses, bullocks and camels are employed for short distance transportation, such as from the farm to the market.

The usage condition of transportation means are shown in Table 3.24. It shows that the share of tractor wagons is as high as 75% in panjab and 90 - 95% in Sind.

Maximum distance of transportation by dondeys is approximatery 5 km. But the total share of transportation by means, is unknown because no statistics or records are available.

Table 3.24 Share of Transportation Means for Paddy

(unit: %)

Transportation Means	Punjab	Sind
Tractor Wagons	75%	90 - 95%
Donkey, horses, Bullacks and Camels		

The capacity of each transportation mean is shown in Table 3.25.

Table 3.25 Capacity of Transportation Means

(Unit: ton)

Transportation mean	Capacity
Tractor	4.0 - 5.0
Horse Cart	0.8 - 1.2
Donkey Cart	0.5 - 0.8

2) Transportation costs

Most of rice producers have no transportation means. Therefore, when paddy is transported, transportation mean is rented. The rent charges are simplefied, for example, it costs approximately Rs20/ton per haul. This rate is applied throughout the country with slight modifications in some areas.

Loading and unloading costs vary from Rs 0.25 - 0.5 bag per processing.

3) Shape of consignment

Consignments are either bulk and bagged, and their shares are shown in Table 3.26.

Table 3.26 Shape of Consignment

(Unit: %)

Shape	Punjab	Sind
Bulk	75	50
Bagged	25	50

In bulk transportation, it was often observed that several bags of rice were put on top of the bulk cargo.

(2) Rice transportation

1) Transportation means

Rice transportation can be categorized into short distance transportation; such as from wholesaler to retailer within an area, and long distance transportation; such as from producing areas to big cities.

Short distance transportation of rice is almost the same as that of paddy in aspects of transportation means and costs.

In this section, aspects of long distance transportation are explained. Transportation means employed for long distance transportation are

Pakiston Railways (PR), National Logistic Cell (NLC) and Private Truck (PT). Characteristics of each transportation means are explained below.

a) PR (Pakistan Railways)

PR head office locate in Labore, and makes inter-divisonal arrangements. PR divisions concerning rice transportation are the lahore and Sukkur division, and the PR division office arranges the wagons and daily loading.

Railway wagon arrangement are based on the registration of the rice consignment at loading stations. While registration and arrangement for railway wagons are being made, rice is stored temporarily in open air spaces. The duration of this storage is for 24 to 26 hours. However rice transportation to the railway station is not done on rainy days in order to avoid damage of the rice.

PR capacity for rice transportation is 300 railway wagons a day, based on records from the PR office in Lahore. And capacity per wagon in 23.1 tons. Most wagons prepared for rice loading have been arranged after unloading previous cargoes such as wheat or fertilizer from Karachi.

b) NLC (National Logistic Cell)

NLC plays a role as the nation wide transportation of commodities and is a military organization.

NLC truck models are shown in Table 3.27.

Table 3.27 NLC Truck Models

(Unit: ton)

Band	Country	Capacity
FAIT	Italy	23.5
BENZ	W. Germany	22.3
HINO	Japan	20.0
SAUIM	France	10.0

Source: NLC

Almost all rice transported by NLC is rice procured by the government. The territory of NLC is difined below.

- Mills located more than 10 km from railway stations or
- Rice which PR cannot transport within 48 hours.

NLC trucks are assigned by head quaters at Khairpur in Sind and at Gujranwal a in Punjab. NLC transports rice after unloading previous cargo from Karachi same as that of PR.

c) PT (Private Truck)

PT also employs trucks which have returned from Krachi. The capacity of the trucks employed are from 10 to 11 tons. The top of the truck is uncovered, leading to problems of the damage due to rain and pilferage.

However, PT has lowered its prices, therefore a large amount of private rice is transported by PT.

2) Transportation Costs

Comparison of transportation costs by PR, NLC and PT in shown in Table 3.28.

PT established lower rates than PR for transportation from Punjab.

NLC rate is established by multiplying the distance and the unit rate.

PT rates in sind shown in the table are established by RECP.

The access cost for PR, from the mill to the railway station, is paid by the seller. According to the contract for government rice, terms of delivery are in the form of F.O.R. (Free on Railway)