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Rodents, lagomorphs, artiodactyle and birds are four major groups of vertebrate pests in Pakistan. Field and roof rats, house mice, porcupine and Murree vole are important rodent pests. The main pest species of lagomorph is the Afghan pika whereas the desert hare is a minor pest. The wild boar is the only pest species of Artiodactyle. Nine species of birds are pests in food crops and grain storage sites. These vertebrate pests caused damage to different crops (wheat, rice, maize, sugarcane, sunflower, orchard crops, etc.) and stored grain. In addition to losses to crops and stored grain, these pests transmit different diseases by contaminating grain and other foods.

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VERTEBRATE PESTS OF PAKISTAN

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INTRODUCTION

The animal kingdom is divided into two big groups: invertebrates and vertebrates. Invertebrates have no backbone or internal bony skeleton, e.g. insects, worms etc. Vertebrates are a higher form of animal having a backbone or bony skeleton which serves to support the weight of their body. Fish, amphibia, reptile, bird and mammals are different classes of vertebrates. Any animal within these five classes that come into conflict with man by reason of its food habit, population number or disease transmitting capability, becomes a vertebrate pest. In practice the most serious vertebrate pests are the rodents, especially rats and mice adapted to live closely with man, and several birds of granivorous or omnivorous species. Occasionally other classes of mammals, such as rabbits and hare, jackals and wild boar are locally important vertebrate pests.

IMPORTANT VERTEBRATE PESTS OF PAKISTAN

The important vertebrate pests of Pakistan fall within four groups of animals of which three are groups of mammals (rodents, lagomorphs and artiodactyle) and the fourth group is bird (Fig. 1; Brooks, 1986).

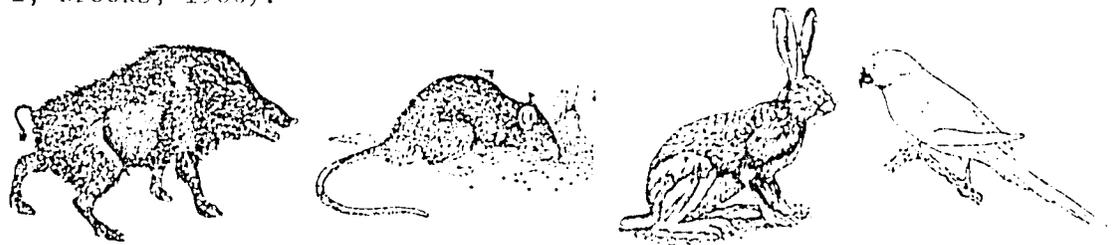


Fig. 1: Representative of Four Groups of Vertebrate Pests in Pakistan: a. Artiodactyle, b. Rodent, c. Lagomorph and d. bird.

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1. Rodent Pests

Rodents can be distinguished from other mammals by their teeth which consist of an upper and lower pair of front teeth, called incisors, a lack of canine teeth and only a few molars on each side. Between the incisors and cheek teeth is a toothless gap called diastema.

Rodents have an acute sense of hearing and smell. All rats are color blind and they cannot see shapes except at close range. Sense of taste is also highly developed in rats. Rats quickly learn to avoid food that makes them ill. Rats are good swimmers and climbers. They can climb up drain pipes, trees etc.

Rodents have a high rate of reproduction. Most species commonly have 6-8 young in each litter and a female can have one litter each month. In many cases females reach maturity at two months of age. The high reproduction rate is balanced by high mortality. Most rats live less than a year.

Important rodent pests in Pakistan are field and house rats, house mice and porcupine. Following rodent pests have been reported from Pakistan (Roberts, 1981):

a) Lesser bandicoot rat	<u>Bandicota bengalensis</u>
b) Short tailed mole rat	<u>Nesokia indica</u>
c) Soft furred field rat	<u>Millardia meltada</u>
d) Indian gerbil	<u>Tatera indica</u>
e) Indian sand rat	<u>Meriones hurrianae</u>
f) Libyan sand rat	<u>Meriones libyicus</u>
g) Roof or house rat	<u>Rattus rattus</u>
h) Brown or Norway rat	<u>Rattus norvegicus</u>
i) House mouse	<u>Mus musculus</u>
j) Murree vole	<u>Hyperacrius wynnei</u>
k) Indian porcupine	<u>Hystrix indica</u>
l) Striped squirrel	<u>Funambulus pennanti</u>

a) The lesser bandicoot rat is the most common field rat of Pakistan. Bandicoots are medium sized dark brownish-grey colored rats with nearly bare tails slightly shorter than the head and body. They live in ground burrows and are solitary in habits. They usually occur in moist conditions. They are known to occur in Thatta, Badin, Hyderabad, Larkana, Sukkur and port of Jacobabad in Sind; Faisalabad, Sheikhpura, Gujranwala, Sialkot, Jhelum and Rawalpindi in Punjab; Swat Hazara, Abbottabad and around Peshawar in NWFP (Roberts, 1977;

Smiet et al., 1978). They appear to have extended up the Jhelum valley into Azad Kashmir.

Bandicoots damage a variety of crops including wheat, rice, sugarcane and groundnut.

b) The short tailed mole rat is a medium-sized brown rat similar in appearance to the bandicoot rat but is smaller and has a proportionately shorter tail and small ears. It spends most of its time in underground tunnels and burrows rarely venturing above the ground.

Mole rats are found throughout Pakistan where the soil is damp and hard packed. It is found in the entire Sind, the Punjab and most parts of Baluchistan whereas in NWFP it is found near Bannu, Kohat, Mardan, Peshawar and parts of Swat (Roberts, 1977).

Mole rats feed exclusively on plant roots, bulbs and tubers. Damage caused by the mole rat is underground. They cut roots of nursery trees, eat sugarcane from underground, damage root crops and perforate canals causing loss of irrigation water.

c) Soft-furred field rats have soft, silky fur. They are smaller than the house rat but larger than the house mouse. Their backs are grey in color and the belly is white. Their ears are larger and nose is long and pointed.

Soft-furred field rats are mainly confined to southern Sind and the north eastern part of the Punjab, they do not occur in NWFP (Roberts, 1977). They are most abundant in irrigated lands and damage wheat, rice and sugarcane.

d) The Indian gerbil is a medium sized rat with long hind legs. The back is sandy brown and the belly is white. The tail is hairy, with long tufts near the end and with a lateral light colored band running down each side of the tail. They dig burrows and burrow openings are always open.

Indian gerbil is found throughout the irrigated canals colonies of the Punjab and in some villages it has become commensal. It is present throughout Sind, in some parts of Baluchistan and in NWFP is found in Peshawar, Bannu, Kohat and Mardan areas (Roberts, 1977).

The Indian gerbil is known to damage wheat, sugarcane,

rice, groundnut and other crops, but are never very abundant as compared to the other field rats.

e) The Indian sand rat is smaller than the Indian gerbil and can easily be distinguished by its much smaller ears and a creamy colored but not white belly. They are gregarious animals and live in large colonies with many burrow openings and well marked trails. They are active in the day time, feeding in hot weather in early mornings and late evenings.

Indian gerbils prefer sandy soil and are not normally found in irrigated fields or damp ground. It is probably the most abundant rodent in the Indus plain and is found in the sand dune areas in the sea coast around Karachi and extends westwards into Mekran. It occurs in the barani areas as well as desert areas from NWFP through Punjab and Bolhari in Sind (Roberts, 1977).

Indian gerbils have been seen to damage young growing wheat and other crops and store it in their underground burrows. They have been found in abundance around grain storage bins/shells near Bahawalpur in Punjab and Bolhari in Sind.

f) The Libyan sand rat is similar in appearance to the Indian sand rat but is slightly larger in size. The belly fur is pure white, not creamy as is the case of the Indian sand rat. Libyan sand rat is highly gregarious and colonial. They occur in scattered colonies both in stony unclutivated slopes as well as valley bottoms around cultivated fields.

Libyan sand rats occur only in the high cold plateau regions of NWFP and Baluchistan (Roberts, 1981). They are known to damage wheat fields and fodder crops. They also store the cut parts of plants inside their burrows.

g) The roof rat is by far the most common rat pest in cities and villages throughout Pakistan. They are dark grey-brown with a white or creamy grey belly. The tail is dark colored and nearly naked in appearance. The tail is one and one quarter times as long as the body size. Ears are prominent, large and naked. They are agile climbers into roofs, drains, ceiling beams and trees.

Roof rats are well-adapted to living in man's structures and exists largely on refuse from households as well as stealing his food. They are major pests in grain stores, poultry farms, food stores and farmer houses.

h) The Norway rat is also known as brown or sewer rat. They are large heavy bodied rats with broad blunt muzzles and small naked ears. They are distinguished from roof rats as the tail is shorter than the head and body and they have smaller ears. Their body fur is dark brown on the upper surface and generally greyish on the belly.

Norway rats are relatively restricted in distribution, being confined mainly to Karachi city, there is a small population in Pasni and Gwadar sea coasts and also around Lahore railway station (Roberts, 1981). It is also a pest of the grain market, food shops, etc.

i) The house mouse is probably the most common rodent pest in farm and village housing. They are small with light, brownish-grey backs and white bellies. The tail is naked in appearance. House mice are good climbers and inhabit the upper part of rooms and structures.

House mice occur throughout Pakistan, including the northern Himalayan regions. They do occur in field crops, such as sugarcane, rice and groundnut, but apparently do little damage. They are the most frequently encountered pest rodents in grain storage centres.

j) The Murree vole is a small sized, very dark brown burrowing rodent with short velvety fur, long cylindrical body and well developed blunt head with powerful protruding incisors. The tail is very short. It spends most of its life underground and, as a consequence, has very tiny eyes and very small ears. It is adapted to live in the pine forest zone at quite high elevations (1850 to 3000 m) in the Punjab and NWFP hills.

It is a serious pest of apple orchards, as well as maize and potato crops grown at mountain elevations. It damages apple trees by gnawing the bark, either just below the soil surface, or in winter time, upto a few inches above the ground surface. It gnaws maize stalks, cutting them just at or below ground level.

k) The crested porcupine is the largest rodent in Pakistan. Normally they weigh from 15-18 kg but they can attain weight upto 27 kg (Hanney, 1975). Porcupines have powerful limbs and claws which assist them in digging. Ears and eyes are relatively small. The incisors are extremely broad and powerful. Their back is covered by long hollow quills which are barred in black and white.

Porcupine live in family groups sharing one very extensive and deep burrow system, which if undisturbed will be continuously occupied for many years.

Porcupine occur over most of Pakistan, even into mountainous areas and juniper forests in Baluchistan as well as irrigated tracts in Sind and Punjab. In NWFP they are found in Hazara, Bannu, Kurram, lower Chitral and Swat valley. They are also found in the forest above Shogran upto 8650 ft elevation (Roberts, 1977).

Porcupine cause serious damage because of eating barks of certain trees, such as mango, apricot and orange as well as many forest trees. They damage succulent root crops like potato and sweet potato and vegetables and fruits, i.e. cucurbit and muskmelon. They cause breaches in the embankments of water channels. They are serious pest of groundnut, maize and wheat also.

1) The striped squirrel also known as five striped palm squirrel is easily recognised by their bushy tail, banded irregularly in grey and black. Ears are small and round covered with fur.

It is common in large cities, villages and semi-desert areas. It is found throughout the NWFP except in higher mountain regions and found abundantly in the Punjab and Sind extending into the Mekran Coastal region in Baluchistan (Roberts, 1977).

They live mainly on seeds and berries of trees and cause damage in vegetable gardens in towns and villages and also eat maize seedlings.

2. Lagomorph Pests

This group includes rabbits, hare and pikas. In many respects lagomorphs are closely similar to rodents. They are distinguished, however, in having two pairs of incisors in the upper jaw, one secondary pair directly behind the main pair. The lagomorph's tail is very short and tufted or entirely absent. The collard or Afghan Pika (Ochotona rufescens) and desert hare (Lepus nigricollis) are the main pest species of lagomorphs (Brooks, 1986).

a) Collard pika are smaller than rabbit or hare. In appearance they are attractive looking animals with soft silky fur of a reddish-grey color and furry rounded ears. Their legs are short and they have no tail.

Afghan pikas are confined to mountain steppe areas, i.e., dry rocky slopes above 6000 feet elevation and they live among loose rock falls or under the roots of juniper trees. They are found in all the higher valleys of northern Baluchistan including Ziarat and Fort Sandemon and in the higher mountain ranges of Waziristan, in the upper Kurram valley in NWFP (Roberts, 1977).

Pikas have been a minor pest of young green wheat, fodder and vegetable crops. They cause serious damage to orchard trees in winter when greens are unavailable and they gnaw bark on apple and cherry trees.

b) The desert hare is a large greyish-brown animal with long well developed ears. The tail is short and tipped with black. The hind legs are elongated for a speedy bounding gait when running.

The desert hare occur throughout Sind, Las Belas, Sibi and the Punjab. It also occurs in the desert regions of Cholistan, Thal and Thar and in NWFP it extends through Peshawar, Dera Ismail Khan and the lower part of Kurram valley (Roberts, 1977).

The desert hare has been found to be a minor pest of groundnut and chickpea in barani areas of Punjab.

3. Artiodactyls

Artiodactyls are even-toed hoofed mammals, such as sheep, goat, camel, cattle and the wild boar. The wild boar (Sus scrofa) is the only pest species of this group that occurs in Pakistan. They are omnivorous mammals having incisors in the upper and lower jaw and prominent canines form tusks which are used for defence and intra-specific aggression. They have four toes on each foot but outer ones are short and non-functional.

The wild boar in Pakistan was originally restricted to the riverine habitat, but as agriculture spread beyond the riverine zone with the opening of the canal system, a variety of habitats for the wild boar appeared in isolated patches all over the Indus plain. Besides the riverine forests and flood plains, scattered blocks of irrigated forest plantations are now available, as

are reedy and grassy vegetation bordering canals and drainage ditches. The widespread creation of these new habitats has brought the wild boar into close association with croplands.

Wild boar damage a variety of field crops, of which the most important are sugarcane and maize, but also wheat, rice, potatoes, sweet potatoes, groundnuts, clover, chillies, peas and water melons.

4. Pest Birds

The majority of granivorous (grain-eating) birds tend to be gregarious and gather together in small or large flocks for foraging and feeding. Frugivorous (fruit-eating) birds also tend to occur in groups, although not so large as the granivorous birds. Some species, such as the crow, are omnivorous, and feed upon whatever is at hand. Some nine species are pests in food crops in Pakistan (Brooks, 1986). These are listed below:

House sparrow	<u>Passer domesticus</u>
Baya weaver	<u>Ploceus philippinus</u>
Rose-ringed parakeet	<u>Psittacula krameri</u>
Red-vented bulbul	<u>Pycnonotus cafer</u>
Rosy starling	<u>Sturnus roseus</u>
Collared dove	<u>Streptopelia decaucto</u>
Rock pigeon	<u>Columba livia</u>
House Crow	<u>Corvus splendens</u>
Asiatic or jungle crow	<u>Corvus macrorhynchos</u>

a) House sparrows are the familiar town and village bird, being a common parasite of man. They roost communally in noisy chattering flocks in untidy nests in bushes, trees or often placed on buildings. They gather in large flocks to raid wheat, millet and sorghum fields. They are the most common and abundant birds at grain storage centres.

b) Baya weavers nest in distinctive colonies with large globular hanging grass nests with long hanging entrance tunnels. In riverain areas they inflict considerable damage to standing wheat and ripening rice.

c) Rose-ringed parakeets are the noisy bright green birds that feed in large flocks on sunflower, maize and orchard crops. Nesting takes place in tree holes. This species is absent from purely desert or high mountain areas. They are particularly abundant throughout the Punjab.

d) Red-vented bulbuls are garden dwellers and can be serious pests of vegetables and soft fruits. They occur throughout the Indus plains and sub-montane areas in Pakistan.

e) Rosy starlings are migratory and come through Pakistan in late spring and in the post-monsoon months. They travel in large flocks and are known to attack millet in Sind province. They are highly gregarious during migration and occur mostly over Sind and southern Punjab provinces. They are omnivorous and can be beneficial in feeding on young locusts when swarms are hatching.

f) Collared doves are resident in Pakistan and widespread in the Indus plains and desert border regions. They are adapted basically as seed-eaters on the ground. They are pests of post-harvest wheat on the threshing grounds and can be pests on sprouting maize.

g) Rock pigeons are resident in Pakistan and are the wild counterpart of the domestic pigeons kept by villagers. These birds are serious pests of grain (wheat and rice) on threshing yards and just after harvest while the bundles are still lying in the fields. They are common around grain storage centres where they feed mainly on spilled grain outdoors.

h) House crows are resident throughout Pakistan, commonly seen in cities, towns, villages and in the countryside. They are highly gregarious. They can be a pest of sprouting wheat and maize.

i) The Asiatic or jungle crow is migratory through Pakistan, arriving in the lower plains following the beginning of the cool season in the higher mountains. At this time they are pests of groundnut in barani areas of Punjab and a serious pest of ripening maize.

EXTENT OF LOSSES DUE TO VERTEBRATE PESTS

1. Wheat

Wheat is the most important grain crop grown in Pakistan. Production has averaged between 10 and 13 million metric tons during the last 5 years (F.B.S., 1986). Damage assessments were carried out by the Vertebrate Pest Control Laboratory (VPCL) staff in 1978 and 1979 - the damage caused by rodents

amounted to 2.9% and 2.0%, respectively, in the same surveys, damage by birds (house sparrows and parakeets) was recorded and losses from both species ran 5.6% in 1978 and 2.2% in 1979 (Fulk et al, 1980). Thus the combined losses due to rodents and birds in 1978 were 8.5% and in 1979 ran 4.2%.

A study of bird damage to wheat was done at the University of Agriculture, Faisalabad and the observers found that sparrows accounted for a 2.26% loss and parakeets only a small amount i.e. less than 0.34% (Anonymous, 1972).

Beg and Khan (1977) found that rats had cut 7.5% of the wheat tillers in Faisalabad District. The severity of damage appeared dependent upon the presence of *B. bengalensis*. Ahmad et al (1986) completed surveys of rat and wild boar damage to wheat in Faisalabad District and found the damage due to both pests was 5.04%.

What do these damage figures mean in terms of the value of the wheat crop? Rodent losses average between 2.0% to 3.0% countrywide. Losses due to house sparrows and parakeets add another 2.6% to 5.6%. Wild boar within the range of wheat-growing areas can add another 1% to 2% overall losses to wheat production. The total losses due to rodents, birds and wild boar could be as small as 5.6% and as high as 10.6% of total production. Based upon the value of wheat in 1983-84, using whole-sale prices in the Lahore area, this would represent losses equal to 1,128.7 million rupees (U.S. 80.6 million dollars).

2. Rice

Damage assessments in rice fields in eastern Punjab and lower Sind revealed that at least four rodent species were present: the lesser bandicoot rat, short-tailed mole rat, soft furred field rat and the house mouse (Fulk et al, 1981). Damage levels were found to vary considerably from year to year depending upon climate conditions. Heavy rain flooded fields, forced rats onto bunds and led to less than normal damage. The most serious pest was the lesser bandicoot rat. Losses from rodents and birds were estimated to run about 5.1% average year to year (Roberts, 1981). Maturing rice is attacked not only by rats but also house sparrows, baya weavers and parakeets. Wild boar damage rice fields through trampling and a minor amount due to consumption of maturing rice panicles.

3. Sunflower

Damage surveys of parakeet attack on sunflower in the main growing areas of Punjab and Sind showed that the damage averaged 11.7% in seven districts in Punjab and 16.6% in nine districts in Sind (Khan and Shakeel, 1983). An earlier study in Multan District had estimated that parakeets consumed about 30% of the standing sunflower crop (Bashir et al, 1981). The economic losses, based upon 1983 production statistics, amounted to U.S. 1.95 million dollars.

4. Sugarcane

Cane from 250 farms was examined at four sugar mills for rat damage in 1978 and 1979. These mills represented two districts each in Sind and Punjab. Overall, rats had reduced sugar production by 10.7% in 1978 and 7.7% in 1979 (Fulk et al, 1980). Some 11% of the farms had suffered more than twice this average loss.

In 1985, the staff of the Vertebrate Pest Control Project checked sugarcane fields in Faisalabad District for damage by wild boar. Some 81 fields in 24 villages drawn at random were examined. Wild boar damage to sugarcane was estimated at 5.26% of all stalks and 60.5% of all fields showed evidence of wild boar attack (Brooks et al, 1986). The estimated value of the lost production in this one district due to wild boar was U.S. 2.85 million dollars.

5. Maize

Maize is particularly subject to attack by wild boar, porcupine and pest birds, primarily parakeets and crows. Damage assessments indicated that overall damage averaged an 8% loss of yield (Ahmad et al, 1987). Based upon 1983 maize prices this would be equivalent to a loss of Rs. 12.6 million (equal to U.S. \$900,000 in 1933).

Maize is also damaged by rose-ringed parakeet and house crow when in the ripening stage. Damage assessments in NWFP and Punjab found that pest bird attack was mainly on the field edges. The average level of damage of all the fields surveyed ran between 20% to 30% (Khan and Hussain, 1987).

6. Orchard Crops

The collared pika, Ochotona rufescens, was found to be a serious pest of apple trees and juniper nurseries in the Ziarat Valley of Baluchistan. Normally the pikas live in crevices between rock and stone; occasionally they excavate burrows under juniper tree roots and between bushes of Artemesia. Normally this is on open stony soil in the higher plateau country in central Baluchistan.

Some of these lands have now been converted into farming areas, especially the narrow mountain valleys, and subsistence crops like barley, wheat, potatoes and animal fodder are grown. In higher valleys it was found that fine quality apples could be raised to provide a cash crop. Apple orchards have increased in popularity and acreage every year.

During the winter months when native vegetation is lacking, foraging pikas feed on apple tree trunks and branches, sometimes completely debarking trees from 25 to 40 cm above the ground. The amount of damage varies depending upon the severity of the winter but it has ranged from as little as 0.13% of trees killed in 1979 to as high as of 5.1% in 1977 and the percent of trees partially damaged, however, runs from 1.5 to 47.1%, depending upon winter weather (Khan and Smythe, 1980). The losses can run into the hundreds of thousands of U.S. dollars.

Other orchard crops are damaged by birds, particularly parakeets and bulbuls. Soft fruits, such as apricots, guava mango and oranges are particularly attacked.

7. Stored Food Losses

Some 4 million metric tons of wheat is procured by the provincial food departments and stored until redistributed into the wheat deficit areas. A recent survey of vertebrate pest infestations at provincial grain storage centres revealed that infestations were rarely severe and actually most were minor in nature (Ahmad and Brooks, 1986a, 1986b; Brooks and Ahmad, 1986a). The most common rodent was the house mouse while roof rats were relatively uncommon. Pest birds, mainly house sparrows and sometimes pigeons, were common at grain storage sites but mainly the birds were feeding on grain spilled outdoors. The overall losses to both rodents and birds was estimated at not more than 0.2% of total wheat in storage, or about 8,000 mt nationally per year (Brooks and Ahmad, 1986b).

At least another 6 million metric tons of wheat is retained at farm and village-level. It is stored under a variety of conditions and in several types of containers or jute bags, many of which are subject to attack by rodents, mainly house mice and roof rats. Estimates of losses at farm and village level are yet to be made but conservatively at least 1% to 2% of the stored quantity is lost throughout the country annually based upon studies of losses at farm and village level in India and Bangladesh.

A summary of the economic value of crop and stored food losses per annum in Pakistan is given in Appendix 1. Most loss estimates are based upon those derived by the staff of the Vertebrate Pest Control Laboratory, Karachi, during the past 13 years of research carried out in the field. The annual toll, and this listing is incomplete, comes to well over 4,800 million rupees, or the equivalent of over 200 million U.S. dollars based upon 1983 commodity prices.

PUBLIC HEALTH AND VERTEBRATE PESTS

Some rodents live in close proximity with man, in fact they are attracted to his houses and food stores. Because these small mammals harbour many diseases which can be harmful to the human race, much research has gone into the understanding of what disease producing organisms are carried by rats and how they can be transmitted to man.

There are over 20 known diseases which are directly transmitted to man from rats - usually through the agency of blood-sucking parasites such as fleas, ticks and mites which live in rats fur, or through direct bites from rats or through their faecal and urine contamination of grain and other foods. In Pakistan 'Salmonella' causes dysentery and comes from faecal contamination as well as tapeworms. Such contamination has been observed in both large and small grain stores. Scrub Typhus is a dangerous and often fatal disease carried by Rickettsial mites which normally live on rodents. Even man's livestock can be affected by 'Q' fever carried by rats, which occurs in Pakistan in rangeland areas inhabited by nomadic graziers. Leptospirosis and the dreaded Bubonic Plague are two other examples of rodent-born diseases which occur in the sub-continent. Fortunately, in this century there have been no outbreaks of Bubonic Plague in Pakistan, but the rat flea essential to the disease's life cycle exists in plentiful numbers on rats which inhabit cities like Karachi and Lahore. The value of controlling rodent

populations, especially in grain stores, can therefore be measured not only in saving food losses but also in lessening public health problems from dysentery to typhus infections.

SUMMARY

Rodents, lagomorphs, artiodactyle and birds are four major groups of vertebrate pests in Pakistan. Field and house rats, house mice, porcupine and Murree vole are important rodent pests. The main pest species of lagomorph is the Afghan pika whereas the desert hare is a minor pest. The wild boar is the only pest species of Artiodactyle. Nine species of birds are pests in food crops and grain storage sites. These vertebrate pests cause damage to different crops (wheat, rice, maize, sugarcane, sunflower, orchard crops etc.) and stored grain. In addition to losses to crops and stored grain these pests transmit different diseases by contaminating grain and other foods.

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SUMMARY OF ESTIMATED LOSSES OF VARIOUS FIELD CROPS
AND STORED GRAINS IN PAKISTAN DUE TO VERTEBRATE PESTS
(Data on Losses from "Handbook of Vertebrate Pest Control
in Pakistan, 1981" and other Sources).

CROP	PRODUCTION: 1983-84 (000 mt)	LOSSES (000 mt)	VALUE OF LOSSES*		PRINCIPAL PEST SPECIES
			Pak. Rs. (Million)	U.S. Dollar (Million)	
Wheat	10881.9	600.7	1,128.7	86.8	Rats, Birds
Rice	3339.5	170.3	449.8	32.1	Rats, Birds
Sugarcane**	34287.3	2760.1	665.2	47.5	Rats, wild boar
Maize	1013.5	90.6	198.6	14.2	Parakeet, crow
Sorghum	222.1	16.0	31.8	2.3	Birds
Barley	139.5	7.8	14.0	1.0	Parakeet, sparrow
Potato	509.8	11.6	23.5	1.7	Porcupine, wild boar
Groundnut	88.0	4.6	35.6	2.5	Rats, wild boar
Sunflower	41.6	-	27.3	1.9	Parakeet
Apples	128.1	6.4	75.0	5.4	Pika, porcupine and birds
Sub Total			4,622.2	195.4	
<u>STORED GRAINS</u>					
Provincial Food Depts.	4,090.0	8.2	15.4	1.1	Rats, mice, birds
Farm & Vill.	6,000.0	120.0	225.5	16.1	Rats, mice
TOTALS			4,863.1	212.6	

* Based on wholesale market price of commodities at Lahore, 1983-84.
1 U.S. Dollar = 14 Pak. Rupees.

** 1983 mill price = Rs. 241 per metric ton.

INTEGRATED PEST MANAGEMENT

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