



Figure 1. Response of ostriches toward caring behavior

Ostrich have a thin layer of down on head and neck whilst their strong legs are featherless. As compared to other birds, ostriches have just two toes on each foot. Outer toe are nail-less [18] whilst inner toe having a larger nail resembling a hoof (an adaptation unique to fast run). Ostrich lack teeth, crop, gallbladder and keel bone. Their beak and sternum is flat, breastbone (sternum) is raft-like lack the keel for attachment of wing muscles, and beak is rounded at the tips. Ostrich reach to sexual maturity during 2-4 years of age. They grow about 10 inches/ month and can gain about 80 kg body weight at one year of age. Male may reach a height of 6 to 9 ft, whilst female can reach up to 5.5 to 6.5 ft at sexual maturity. They live in groups (range 5-50 members) and can be alive up to 80 years. Ostriches have acute eyesight and hearing and can defend themselves either by hiding themselves by lying flat against the ground, or by running away, in most threatened conditions can cause injury and even death with a forward kick from its powerful legs (kicking from the knees). Ostriches are unique in kneecap (double kneecap) configuration [28].

Ostrich farming is a new addition among agricultural businesses in Pakistan. Markets for ostrich eggs, meat, leather, feathers and related products are developing rapidly throughout the globe. However at the present, ostrich producers are merely meeting 10 percent of the consumer demand. This is best/exact time for Pakistan to exploit the resource for ostrich farming to make our big share in the local and global market.

2. Evolutionary History of *Struthio camelus*

The most primitive fossil records of ostrich-like birds is found in the Central European Palaeotia from the Middle Eocene (from 56 to 33.9 million years ago), a middle-sized flightless bird that was originally believed to be a bustard (family, Otidae). Fossil records of the ostriches continue with numerous species of the *Struthio* (modern genus) which are known from the Early Miocene (about 23.03 to

5.333 million years ago) onwards.

The relationship of the African species is relatively uncomplicated, however numerous Asian species of ostrich have disconnected remains and their interrelationships and how they relate to the African ostriches is very puzzling. Ostriches are known to have become extinct. In China and only around/even after the end of the last ice age [the period of the last few million years [12]; images of ostriches have been found there on prehistoric pottery and as petroglyphs (rock carvings). Records in maritime history revealed that *Struthio camelus* (Ostriches) also being sighted way out at sea in the Indian Ocean and when discovered on the island of Madagascar (located in the Indian Ocean off the eastern coast of Africa). These were seen by the sailors of 18th century and they referred to them as “sea ostriches”, although it is based-less. Several of these fossil forms are ichnotaxa; name used to identify and distinguish morphologically distinctive ichnofossils and their relationship with those illustrated from distinctive bones is controversial [6].

- Early Miocene of Elizabethfeld, Namibia (*Struthio coppensi*)
- Liushu Late Miocene of Yangwupuzijifang, China (*Struthio linxiaensis*)
- Late Miocene of Moldavia (*Struthio orlovi*)
- Late Miocene - Early Pliocene of SW and CE Africa (*Struthio karingarabensis* - oospecies(?))
- Laetolil Early Pliocene of Laetoli, Tanzania (*Struthio kakesiensis*) - oospecies
- Early Pliocene of China and Mongolia (*Struthio wimani*)
- Early - Middle Pliocene of Namibia (*Struthio daberensis*) – oospecies
- Pliocene of Ukraine (*Struthio brachydactylus*)
- Pliocene of SE Europe to WC Asia (*Struthio chersonensis*) - oospecies
- Early Pliocene - Late Pleistocene of Central Asia to China, Asian Ostrich, (*Struthio asiaticus*)
- Late Pliocene/Early Pleistocene of Dmanisi, Georgia (*Struthio dmanisensis*)
- Early Pleistocene of Tanzania (*Struthio oldawayi*) - probably subspecies of *Struthio. camelus*
- *Struthio anderssoni* - oospecies(?)

3. Gender Identification Breeding Behavior, Mating Pattern and Laying

Feathers of *Struthio camelus* are different from other birds as these are fluffy, and do not hook collectively like flight feathers. These feathers are not water-resistant, hence, in the rain, an ostrich usually looks much disheveled and wet [10]. Although the wings of ostriches are long, these are flightless [27], however these feathers are used in courtship behavior (mating displays), submission and can

also provide protection to chicks and eggs [31]. Wings of *Struthio camelus* may have a wingspan of over six feet [16]. primordial Egyptian gods is portrayed/pasteurized in art as wearing an ostrich feather, while ,goddess of law and justice (Ma'at), bore one on her head [9]. Adult male ostriches are mostly black [see table 1], with white wings tips and tail and bright red or blue skin. The female and young male ostriches are dull grayish brown [3]. The appearance of pink color of the beak and shank in male is due to hormone testosterone.

Table 1. Overview of some Physical authentication between male and female ostriches

	Male	Female
Color	Black	Grey
Height	8-9 Feet	7-8 Feet
Weight	50 Kg	130 Kg
Speed	70 Km/hr	70 Km/hr

Ostriches set up breeding attachments in pairs or one male for two females. Mating pattern varies by ecological area, but territorial males fight for a harem of two to seven females. In small secluded populations, monogamous breeding units appear to dominate. Mature female usually complete prenuptial molt sooner than the male ostriches and begin courtship behavior. The chief hen, however demonstrates her domination by attacking others during courtship. Finally, the males become sexually vigorous and there appear a reddish coloration in the neck, thighs and phallus and it is usually the time for competition with other males. Sometime hens provoke male-male fight for mating, increases the likelihood that she will be mated with a male of high vigor. This is malodorous of the behavior of female *Mirounga angustirostris* (elephant seals) [11]. Usually a more confident ostrich hold its head and neck raised, with the front of the body tilted upwards and the tail up, whereas an obedient bird will hold its head low and its tail down [5]. Ostriches usually sit down at dusk and stay almost inactive all over the night except being disturbed [15].

Ostriches start laying eggs around the first of April and continue laying as late as the end of August s [13]. However this breeding season is from February to August in Pakistan [2]. Eggs (glossy and cream in color) are laid about every other day, with an average of about 10-110 eggs produced per year (breeding season). Eggs are usually 6 inches long and 5 inches wide [7] and an omelet made from one egg can feed more than 25 persons.

4. Ostrich Farming: A Wise Approach towards Sustainable Protein Production in Pakistan

Presently, a number of beef producers in the world have switch to commercial ostrich farming due to higher returns compared with traditional livestock. Ostrich excellently

converts the raw resources in to high quality protein as compared to cow that reaches 100kg after one year exploiting high inputs, an ostrich lays 80 eggs/annum and can produce at least 40 chicks annually that reach marketing age after year and yield 2000kg of meat, 50m² of leather and 36kg of feathers each year whereas a cow can produce only one calf every 1.5 years. Ostrich have dressing percentage much higher than that of cattle, sheep and even poultry. Furthermore, production period of ostrich is up to 40 years, therefore ostrich farming is an extremely viable, sustainable and highly economical proposition for Pakistan (Table 2).

Table 2. Overview of some production parameters

Mortality	10-15% during early age about 0% after 3 moths
Food	Balanced Grain Ration and Fresh Fodder or just ostrich chick starter.
Growth	1 Foot Per Month During the 1st 6 Months
Slaughtering Age	One year of age (profitable)
Meat Output	Net Carcass is 50% of Live Weight and 35-40 % pure red meat
Skin Output	14 sq feet

The overall feed to weight gain ratio of cattle is 7:1 and that of sheep is 5:1. The overall feed to weight ratio gain of an ostrich is 2:1 during the first few months of their lives and this climbs to only 3.5:1 during their normal development for processing at 9 months or so [2]. The benefits are considerable: less maintenance, less feed and of course less animal waste.

5. Breeding Management of Ostriches in Climatic Conditions of Pakistan

Ostriches start breeding at about 2-3 years of age [22] and can continue for up to 25 years, however, peak production occurs at 6-11 years of age (Table 3).

Table 3. Breeding Specifications of ostriches

Social Life	1 Male for 2-3 Females
Duration of life	70-80 years
Breeding life	30 years
Sexual Maturity	Female 2 years Male 2.5 years
Laying	70 Eggs/annum
Egg Weight	1200gm-1800gm

As well as hatching process is concerned, it starts when the egg cell is de-attached from the ovary and passes into the oviduct where spermatozoa are present, here fertilization occurs and cleavage starts which results in the formation of a visible embryo that appears as a whitish disk on the surface of the yolk. However, additional development occurs under proper incubation environment. It takes about 24 hours for the egg to be fully formed and after 24 hours discharged from the ovary it is laid.

Ovulation and oviposition are about 2 days apart in the ostriches [25; 26]. The females lay the eggs together in a single large depression in the sand. The male sits on them at night and the female incubates them by day. The weight of eggs on an average ranges 1200gm to 1800gm which is enough to bear the weight of bird. Storing eggs for a period of 7 to 10 days generally results in better hatchability [14]. In practice the major problems associated with transport are high temperature in transport vehicles. To avoid the problem it is advised that chicks should be transported during the cooler parts of the day, early morning or late evening. The heat of vehicle itself and that of loading birds are the cause of stress relate problems, therefore chicks should be carried out calmly ensuring a minimum of predisposed on the loading ramp and not be to loaded at too high a density into vehicle. For a bird's welfare temperature of truck should be kept at 15°C-20°C to ensure bird during transport.

Incubation Specification of Ostrich Eggs

Incubation of egg takes about 38-45 days. In natural environment, eggs are incubated by the females (dull female camouflage in with the sand) during day time and by the male during night (mask in the night). For successful incubation proper facilities should be provided i.e. proper temperature 36.5 C and 36 C and humidity 15-20% and 40% in setter and Hatcher respectively (Humidity should not exceed 45%), fresh air exchange should be at least 20%. For maximum hatchability strict bio-security measure should be adopted. Additional air movement within the room should be supplied by portable fans or some similar mechanism. At the time of internal pipping, the bird has not yet internalized all of the yolk material and the blood vessels that are attached to the inside membranes of the shell (thick shells marked by small pits) have not dried up sufficiently to allow the bird to hatch normally. It may be necessary to remove pieces of sharp shell or to remove dried membranes to assist the chick in this process. Hatchability of ostrich eggs is comparatively poor (50–60%) compared to other birds [8; 35].

6. Production System

Struthio camelus can adapt most of the climates, so long as they are given proper protection and management [33]. Fencing is dependent on personal preference and economics. Chain link is good but may result in problems related to leg and foot injures and is not easily climbed if escape from the pen by egg gatherers is necessary. Tubular "cattle" type fence is suitable and offer some benefits and others types of woven wire or bamboo fencing are routinely used. The ostrich responds well to management systems that establish a routine for it to learn and depend on, and this routine helps to keep stress at a low level. It is vital to set up a set routine within the first six weeks of a chick's

life in terms of feeding, handling and exercise. Ostriches want to be housed during the winter months, while being given access to exercise outside [35] (Figure 2, 3). Group pens consisting of several males and numerous females in larger acre area (similar to a natural situation) appears to provide some benefits with respect to fertility, more egg numbers, and extended laying periods. Several acres of enclosed pasture are needed for this type of operation. Bush-fencing is the economical, however, bamboo, wattle-fencing, post and Wire, stone walls, bush cut down and piled up to the height of a few feet etc. Bush fencing is short lived. Stone wall being permanent is good to be constructed as it has considerable break-wind, however it is costly a wire fence for Ostriches should never be less than 4 feet 9 inches in height. It is desirable to make sure birds are housed in dry shelter at night, and this can be accomplished by feeding in the shelter as a routine.



Figure 2. An ideal farm depicting inside and outside floor for ostriches



Figure 3. An inside area for 15 ostriches

The space that you need for a breeding trio is approximately 30 meters (32 yards) by 50 meters (55 yards) – a total of 1500 square meters and recommended pen size for an ostrich trio varies from 1/4 to 1/2 acre. It is based on the basis of 2 different rearing techniques: Poultry and Cow Farming. Production is a semi-intensive farming, indoors and outdoors (building and free space) (table 3). For better fertility it advised to maintain ostrich breeding flock in 1:2 [trio], may equally consider pairs (one male and one female), quads (one male and three females) or colonies (two or more males to two or more hens) for an average output of 60 eggs per female and 120 eggs per trio for breeding season, and with good rearing techniques one can

get 75 slaughter birds (10 months period). The advantage of a colony is that the birds have more birds to choose from, in seeking a partner.

- The open shelter should offer protection on 3 sides with a door on the 4th side.
- The opening should be minimum 4.5 feet wide. The shelter will be minimum 8 feet high.
- The fence should be minimum 4.5 feet high for the birds and breeders (according to the farm and objectives) with a post for every 12 feet.

Brooding Facilities with Special Reference to Geonetical Conditions of Pakistan

Once the bird has completely exited the shell treat the umbilical area with liberal amounts of 7% Iodine. Immune system of ostrich is much stronger than livestock and poultry. However, to provide good start farmer proper care of the chicks is necessary. Try to provide them a comfortable environment. Clean and disinfect the house properly to give the chicks disease free environment and good start. The shelter should be designed so that birds must enter confidently. Optimum house temperature for poultry birds for efficient performance is 19-22°C for efficient performance [4]. However they require higher house temperature during early period of their life (brooding period). Therefore house temperature at bird level should not be less than 95°F during the first week. Reduce it to 85°F thereafter and after week 3rd, the temperature should be near about 80°F.

For chicks, they really need little space during their first four weeks of age. A cemented floor of 250 ft² is sufficient for 50 Ostrich Chicks age between 2 to 3 months. For this a poultry building ad joint with free space can be used. Afterwards provide 80-100ft²/chick at 12 months when they are adult ostriches. At that time a cow or sheep building along with adjoining free space is enough. For breeders (a trio) of age above 24 months at least 2 Kanals

land is required (table 4). Ideally the chicks should be kept in groups of 20. They like company but they also should not be overcrowded. If chick mortality is 8%, it is exceptionally well. If mortality is under 20% also well, and the industry average is anything around 40% and upwards.

Chick Starter rations very high in protein are not recommended because very high protein diets may be associated with leg abnormalities in turkeys. Breeder rations contain additional calcium. These diets are based on limited scientific nutritional research, therefore addition of roughage sources such as alfalfa hay always advised. To solve the problem Riphah College of Veterinary Science, Lahore (Pakistan) has formulated starter, grower, finisher and breeder rations according to exact nutritional requirements of ostriches. These rations also have cut down the need of Lucerne feeding.

Vaccination

The areas where infectious diseases are common, vaccination with proper vaccines can help to avoid the prevalence of disease and consequent economic losses. Vaccination should be carried out according to the regulations and recommendations of manufacturers. Newcastle disease may cause extensive damage and mortality in ostriches. Ostriches should be vaccinated against ND (inactivated) La Sota via eye drop, wings tip or spray into the eye at age of 3 and 6 weeks and subsequent subcutaneous injection of an inactivated emulsified or alum-precipitated La Sota be given at the 3 months and 6 months of age. Then repeat the vaccine each 6 months interval thereafter. Vaccination should be repeated at 6 months of age and once a year thereafter in breeding flocks. H7N1, H5N9, H5N2 and H9N2 are most commonly pathogenic strains of avian influenza for ostriches. Autogenous inactivated oil-based vaccine against influenza can induce good immunity.

Table 4. Space Requirements (Trio)

Age	Indoor	Outdoor
1-21 Days	Building 2 Sq Feet/Bird	According to the Climate 10-15 Sq Feet /Bird
22-90 Days	3 Sq Feet Per Bird	30 Sq Feet Per Bird Min150 Sq Feet
90-300 Days	Open Shelter 3 Sq feet Per Bird	300 Sq Feet Per Bird Min 2000 Sq Feet
Breeder/Selection	Only Open Space	1500-2000 Sq Feet/Bird
12 Months and Older	Open Shelter 15 Sq Feet Per Bird	Min space 2000 Sq Feet

Table 5. Production Cycle

	Age	Housing
Starters(Chicks)	1 day to 3 months	Poultry Building-Adjoining Free Space
Fattening Ostriches	4-12 months	Cow or Sheep Building and Adjoining Free Space
Selection For Breeding	12-24months	Free Space, Building is Optional
Breeders	+ 24 Months	2-3 Kanals Land for one trio (Building is Optional)

Table 6. Recommended Vaccination schedule for ostriches

Necrotic Enteritis	6D 7D 4W 7w	Enterotoxaemia (oil) 0.5cc S/C Lamb dysentery 0.5cc S/C Enterotoxaemia (alum) 1cc S/C Lamb dysentery 1cc S/C
Anthrax	In areas where it occur	A single dose of cattle anthrax vaccine is effective
Avian pox	2W	commercial fowl pox vaccines by wing-web puncture
ND	3W	Inactivated (La Sota) (oil) 0.25cc wing tip
	6W	Inactivated (La Sota) (oil) 0.25cc wing tip
	3M	Inactivated (La Sota) (oil) 1cc wing tip
	6M	Inactivated (La Sota) (oil) 1cc wing tip
	After 6 month interval	Inactivated (La Sota) (oil) 1cc wing tip

Bio-security Measures at Ostrich Farm

Like other poultry birds ostriches are vulnerable to a wide range of bacterial and viral diseases, the best way for prevention of disease is application of bio- security measures.

Following bio-security measures should carefully be considered at Ostrich farm

- Avoid anything being brought onto your farm
- For vehicles, construct a vehicle dip, where the wheels of the incoming vehicle have to pass through an authorized disinfectant. Try to prevent further movement of the incoming vehicle, by designing parking near the opening gate.
- In any case, the person with appropriate footwear should pass through a foot dip, containing a disinfectant.

Problems/Disease during Rearing Phase

Omphalitis, or infected yolk sac, is a common disease of hatchlings. It has been treated by surgical removal of the yolk sac followed by antibiotic therapy. Infected yolk sacs are a result of bacteria penetrating the egg shell. It should become a less common problem as egg gathering and sanitation practices improve. The "fading chick syndrome", or mal absorption syndrome, is a usually fatal disease of young ostriches that strikes most often between 1 and 3 months of age but may affect chicks as old as 6 months. Chicks become listless, stop eating and drinking and die. The cause is unknown. Aggressive intravenous fluid and/or oral fluid therapy has been successful in some cases. Impactions occur in birds of all ages. Treatment can be surgical or non-surgical. Preventive measure include acclimation of chicks to a variety of substrates very early in life and avoiding sudden feed changes or sudden additions of high roughage feedstuffs.

Often wet chicks have difficulty placing their legs under them at this stage and a condition called "spraddle leg" develops. Most birds can be treated by hobbling the legs together in a normal position with tape, tubing, stunt or Vetrap until the chick is able to stand on its own (Figure 4)



Figure 4. Treating spraddle/splayed legs at Outdoor clinic of RCVetS, Lahore, Pakistan

Parasitic Infestation

Both internal and external parasites affect ostriches. *Eimeria* spp. (protozoa), *Houttuynia struthionis* (cestoda) and *Libyostrongylus douglassii* (nematoda) cause serious production losses in ostriches [36]. Abbas et al. [1] use Ivermectin and Piperazine citrate in poultry and recommended that Piperazine citrate is more effective. These anthelmintics and other drugs given a 1-month intervals beginning at 1 month of age will prevent nematode infestations. Ivermectin also may be affective against quill mites and sucking lice with repeated dosing. Histomoniasis infection can be controlled with furazolidone and treated with metronidazole. Carbaryl (5 percent) dust is being used by the USDA at 14-day intervals to treat tick infestations in chicks and adult ostriches. Levamisol for wire worms, *Struthiolipeurus nandu* (Arthropod) infestation in ostrich causing feather loss. Unidentified feather mite belonging to family Pterolichidae infesting ostrich successfully treated with ivermectin.

Viral Diseases

Newcastle disease virus is highly virulent causing high mortality in ostriches. Virus isolated from brain reported highly pathogenic. Vaccination of ostriches against ND is quite different to those associated with vaccinating other poultry. Little is known of the immune response of vaccine

in ostriches; yet, some researchers have reported the successful use of vaccines under controlled experiments. Allwright [37] reported the efficacy of vaccines (at 4 and 14 months of age) but also observed some reactions with adjuvant vaccines, especially oil-based vaccines. Verwoerd et al. [39] reported no clinical signs or deaths in ostriches of up to ten months of age that had been vaccinated with live La Sota vaccine at 6 and 10 weeks of age, whereas unvaccinated ostriches showed 100% morbidity and 25% mortality in the same conditions. Bolte et al. [38] recommended a schedule of live La Sota given by eye-drop and two doses of oil emulsion inactivated vaccine of Talovac 105 ND, Lohmann Animal Health, for high antibody levels in susceptible ostriches (8- to up to 12 months old)

Pox virus recovered from skin lesion and Spongy form encephalopathy is also reported. Crimean-Congo Haemorrhagic Fever Virus is also reported worldwide. Report of virus isolation from human thought to have acquired infection from handling slaughter ostrich. However, Avian Influenza and Newcastles Disease are two main ostrich diseases in globe whereas up till now there is not a single report of these diseases in Pakistan.

Bacterial Diseases

Staphylococcus hyicus in an ostrich may cause conjunctivitis. Colobacillosis was reported for mortality (more than 20%) in young ostrich in flock imported from Belgium at RCVetS Lahore. Tuberculosis in ostrich and other ratites is also reported. *Pasteurella multocida* infections may cause generalized and pulmonary infections in ostriches.

Treatment for Bacterial Diseases

Gentamicin 2 mg/lb, Amoxicillin 5mg/lb, Tetracycline 7.5 mg/lb, Tribriksen 2ml/kg, Sulfadiazine 48% 20 mg/lb

Fungal Diseases

Aspergillus (Fungal) infections caused by *A. flavus* and *A. niger* are also reported in ostriches however there are no evidence of aspergillosis as a flock. Birds show signs of depression, anorexia and stunting. Some of the birds walked with their heads close to the ground and moved lethargically compared to the healthy chicks

Treatment

- Fumigate the hatchery with formalin and potassium permanganate
- Change of litter (hay or sand) frequently.

Nutritional Deficiency Disorders

- Vitamin E and selenium deficiencies
- Parsley-induced photosensitivity in captive ostrich.
- Anasarca and myopathy in ostrich chicks.
- Nutritional muscular dystrophy in ostrich chicks.

Treatment

Provide mineral and vitamin supplements

7. Suggested Diets

Struthio camelus are grazing bird of the open woodland habitat, hence can be reared in paddock along with sheep, goat and cattle [36]. These are omnivores and can eat shoots, shrubs, leaves, seeds and fruit as well as insects and lizards [22]. The Ostrich are reared worldwide for their feathers, skin, eggs and meat. The diet of the Ostrich mainly consists of seeds and other plant matter, though occasionally it also eats insects such as locusts. They are known to eat almost anything and can carry about 1 kg of stones in its stomach [2].

Table 7. Nutritional specifications

Calculated Analysis	Starter 0-8 wks	Grower 9 wks-17 months	Layer 18 months+
% Protein	28.0	18.0	24.5
% Crude Fat	3.0	3.5	3.5
% Calcium	1.35	1.35	2.40
% Available Phosphate	0.72	0.64	0.70
% Crude Fiber	6.0	11.0	11.0
Salt (NaCl)	0.90	0.50	0.60

Profitability Analysis

What profit do ostrich gives on return is the first question usually asked when anyone going to farming. It depends upon level of planning and scientific management, however roughly a return of up to 50% of capital investment is good return.

Table 8. Gross sales after one year of production

	Cattle	Ostrich
Hide Value	\$38	\$14
Meat (live body weight)	\$450	\$680
Plumage Value	Nil	\$20

Table 9. Cost – Chick to Breeder:

Cost of One Trio Chick (1 month age)	\$428
Feed Cost First Year @15000/chick	\$450
2nd Year feed cost	\$760
Labor + miscellaneous	\$1500
Total Cost	\$3138

Table 10. Ostriches products

Products	Characteristics	Outlets
Leather	Pearl or grain suppleness Rusticity	Luxury -Leather Goods Baggage, Brief Cases, High Fashion Shoes
Meat	Red, Tender, Tasty, Dietic	Roasted, grilled, like young beef
Feather	Suppleness, Anti-Static	Decoration, Brushes, Festivals Show-Farm,
Infertile Eggs	Light Yellow	Natural, carved, painted or natural egg shells.

Points to Ponder before Starting an Ostrich Enterprise

- Start an ostrich chick farm of 300 birds.
- Select breeders, 100 hens and 60 males after one year age.
- Design a small level hatchery
- Have chicks and sell chicks for rearing at low rates to different farms at 2 months age.
- Have a medium size feed mill to make feed for own farm and selling to private farmers.
- Buy back ostrich when they are 12 months old.
- Slaughtering and selling 12 months old in the market at cost to cost basis.
- Welcome visits of the private farmers and extend necessary training to farm ostrich farming.

8. Why Ostrich Farming in Pakistan

Punjab is the most suitable place for ostrich farming due to cheap labor, suitable climatic conditions, inexpensive fodder, and low business cost, critical number of businessmen, farmers and investors that can be involved in this business. The shifting trends in poultry production

regions and resultant closing of small sheds replaced by controlled sheds have provided the unavailable labor jobless. This idle capacity can best be utilized for the purpose. The comparative economics of ostrich v/s beef cattle indicates that ostrich farming has an edge over cattle farming in terms of high returns on investments. Ostrich farming is a u turn in poultry industry due to its superiority over other farming. The birds need no dipping, drenching, milking and shearing. The adaptability of the bird is equally high on annual and perennial pastures.

Table 11. Comparison

Particulars	Beef Cattle	Ostrich
Land	30,000sq feet per pair	4800 feet per pair
Gestation	280 days	42 days
Offspring per year	1	30
Meat Production Time	10 months	10 months
Meat Production Per Annum	120Kg	1350 Kg
No of Hides	1	30
Cost of Feed Per Day	\$ 0.7- 1.00	\$ 0.40
Breeding years	10-11	40-45
Meat Price Per Kg	\$ 5.5	\$ 14

9. Future of Ostrich Farming in Pakistan

In Pakistan, poultry production is one of the most dynamic and well organized sectors which has emerged as a source of employment for more than 1.7 million people. Poultry industry is playing a significant role in poverty alleviation in the country. It contributes 1.7% of GDP of Pakistan. Eggs and poultry meat are considered to be one of the best sources of animal protein of high biological value. Poultry Production on commercial scale was established in Pakistan in early 1960 and since then this sector has shown spectacular progress and development. The growth rate in this sector has been about 10% to 12% per annum for about last one decade. Poultry production has assumed the status of one of the leading sectors in the country. Like Pakistan, the province of Punjab has been showing a tremendous contribution in the poultry production sector which can be appreciated from the fact that the major share in poultry production at national level has been from this province which comes to about 70 percent.

Poultry production is presently in the active phase of transformation from its conventional housing and management in to modern high-tech housing. There exists a strong correlation (89.0%) between the human population and poultry growth in Pakistan and Poultry industry is playing a pivotal role in bridging the gap between the supply and demand for protein. Besides of its high poultry production potential country is facing a vast gap between

meat supply and demand however this gap can be filled by exploiting high production potential ostriches.

Ostriches are now not considered as wild birds and in Pakistan. They have been declared a part of livestock/poultry and gaining fastest popularity toward commercial ostrich farming. This is a fruitful effort to country demands for meat, hide, eggs, feathers and other products in local and foreign market in future. Demand for Ostrich meat is increasing in the country day by day because of healthy meat (zero percent fat, low cholesterol, richness of iron and protein) and good taste. Ostrich is gaining popularity over other leathers because of its luxurious purses, high fashion shoes, brief cases, handbags etc. Similarly cosmetic industry is also seemed to be interested to exploit ostrich products (ostrich oil, fat and feather) to boost their recognition in fashion. However, ostrich producers are only meeting 10% of the customers demand. Therefore, it is high time to capture our share in the local and international market.

Ostrich dishes are now regularly offered in some of the restaurants and hotels of well-known reputation because of the huge demand for the new taste from their regular customers.

Therefore, major target markets for the proposed project are local buyers, who generally trade for these products. Sale of ostrich bird is mostly made through personal contracts on farm gate basis or supplies to bulk / retailers in urban areas. The key consumer of the ostrich meat is the diabetics and cardiovascular patients. Major clients for meat are Super Stores, Meat Markets, Restaurants and) across the country. Commercial Ostrich farm can be started with a flock of minimum of 25 birds and a single bird can yield 50 kg of meat. The government of Pakistan provide a Rs10,000 subsidy per ostrich and had registered over 10,000 ostriches in the Punjab as a result the number of ostrich farms (fig 5)are increasing rapidly in Pakistan [30].



Figure 5. An ostrich Ranch, 15Km Raiwind Road Lahore, Pakistan

Presently, there are many farmers who are rearing ostrich at small scale in various parts of the country. Ostriches can be raised very easily in climatic conditions of Pakistan. They required some care (proper temperature, a balanced diet and good care etc.) only during the early period of their life. Quality of ostrich products (meat, leather, oil and fats, feathers) are potentially excellent and present the opportunity to develop value-adding activities which could contribute to part of the economic activity of existing farming businesses and in other parts of the rural areas of Pakistan. With the beginning of this enterprise it is suggested that the farming should be started in border of highly populated cities like Multan, Faisalabad, Lahore, Islamabad, Karachi, Peshawar etc., to be established as future target market of the ostrich products.

Due to its high production potential, the ostrich are gaining high attention from poultry scientists in Pakistan. The climatic conditions of Pakistan, good FCR (comparable with poultry) and the breeding output of ostriches make them excel giant birds for future commercial meat production in the country. Ostrich farming can open new horizon for development in the country. By the grace of Almighty, Pakistan will lead the world in ostrich farming. Academia (RCVetS, UVAS, PMAS-AAUR) and L&DD are playing their significant efforts to promote ostrich farming in the country. Academia contributes its pivotal role in research and to train farmers. Riphah College of Veterinary Sciences helps farmers in Punjab and provides them Ostrich feed (prepared by Department of Animal production, RCVetS, Lahore), consultancy services and technical assistance.

Presently Pakistan depends upon the import during its initial phase of ostrich production. However many breeder farm are being to be established in the country and during coming few years, considerable number of ostrich chicks will be produced in the country. For this RCVetS, UVAS, PMAS-AAUR institutes are playing their considerable role in improving the incubation process, chick nutrition, environmental requirements and breeding plans to enhance the production per unit of cost.

10. Future Works

The ostrich farming offers an opportunity to develop a value added products market and is suitable for integrated rural development in Pakistan. The ostrich could be an important domesticated animal, but information about ostrich scientific farming structure is scanty. Therefore, deep scientific research is required for ostrich farming in the areas of nutrition; management, welfare, immunology and health, breeding and genetics etc. Selection for genes of economic concern can cause a sudden u turn in ostrich industry as quoted by Abbas et al. [2] and others [Doosti et al. [17]; Komano et al. [24] which may cause production of plenty (low fat and low cholesterol) of favorite meat for the

people without fear of cardiovascular and other health problems. Subsidies for breeding stock and research grants for genetic improvement may have high contribution for the development of new poultry industry (Ostrich industry) to lead the world.

11. Conclusions

Parallel to the well-developed poultry industry, ostrich farming can open new vistas for development of healthy meat industry in Pakistan. Environment of Pakistan is very suitable for ostrich farming: suitable weather, cheap labor and cheap feed availability are favorable. However certain constraints like high early mortality in chicks and difficult marketing etc. are weaknesses of this enterprise. Growth of ostrich industry needs support to increase knowledge of the ostrich farming. The ostrich industry needs support in rising/expanding markets for ostrich products through a reliable framework supervised by GOP to generate the concept of eating ostrich meat. Similarly research for different welfare considerations of ostriches in climatic conditions of Pakistan should be promoted at universities level and the results be implemented.

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