ISSN 1682-8356
ansinet.org/ijps

INTERNATIONAL JOURNAL OF

POULTRY SCIENCE

ANSInet
308 Lasani Town, Sargodha Road, Faisalabad - Pakistan
Mob: +92 300 3008585, Fax: +92 41 8815544
E-mail: editorijps@gmail.com

International Journal of Poultry Science 8 (3): 277-282, 2009
ISSN 1682-8356

Economics of Alternative Incubation Technology in the Development of Subsistence Poultry Enterprise: Evidence Involving Indigenous Knowledge in Katsina State, Nigeria

S.O. Ugwu[1], A.E. Onyimonyi[1], Nicholas Ozor[2] and M. Mkpado[3]
[1]Department of Animal Science, [2]Department of Agricultural Extension,
[3]Departments of Agricultural Economics, University of Nigeria, Nsukka, Nigeria

Abstracts: The study examined sound reasons, principles and techniques employed by subsistence farmers in the art of masterminding Nigerian native hens to incubate, hatch and brood guinea fowl chicks in Katsina State of Nigeria. Ninety subsistence poultry farmers were randomly selected without replacement from the three agricultural zones of the state. Sources of primary data were structured questionnaires, market survey and observations of field activities and interviews. Descriptive statistics, Kolmogorov-Smirnov (K-S) one sample statistics and gross margin analysis were employed in data analyses. Results showed that lack of technical know-how on incubator operations and the breeding of exotic birds, poor capital base and the broodiness of the Nigerian native hens, were the major reasons for farmers adoption of the indigenous technology. Further results showed that 33% and 39% of the farmers each can produce 3,250 and 2,200 guinea fowl eggs respectively per breeding season of about four months per annum. A gross margin of Niara 5875.00 per Nigerian native hen was obtained from the analysis. The paper concludes with emphasis on the need for mass adoption of the indigenous technology by other small-holder farmers in the country because it is economical. This can be achieved through vigorous awareness campaigns on the technology by development agencies that are interested in bettering the living standards of the rural populace.

Key words: Indigenous knowledge, broodiness, sustainable livelihood, Nigeria

INTRODUCTION

Increasing production with minimal resources has been the rationale of many agricultural policies and programmes in Nigeria including that of National Economic Empowerment and Development Strategy (NEEDS). Indigenous knowledge forms a set of easily available resources whose efficient usage is imperative to optimize production. But lack of proper recognition and efficient use of these resources have limited production and development in agricultural sector. Development involves sustainable livelihood and implies efficient use of resources in effecting increase in the capacity of a people to optimize production within definite economic as well as social constraints in order to solve their own problems and meet their needs (Ngoddy, 1991). Issues of development depend on the people's knowledge of their environment, their training and their willingness to manipulate resources in their environment. Development consists of the cumulative process of structural positive changes, sustainable economic and social growth as well as utilization of the products of these changes for the benefit of the populace. Sustainable economic and positive social changes in most cases depends on indigenous knowledge which was broadly defined as "those technologies conceived, planned and designed within the framework of modern scientific disciplines which may be imported, adopted and indigenized, so that local scientists may reconstruct them and improve on the process and quality of the products" (Ikeme and Uvere, 1995). Traditionally, Nigerian indigenous knowledge and technologies are easily directed towards solving basic agricultural and rural development needs. A striking feature of this indigenous knowledge occurs in the peasant poultry enterprise mainly in the northern part of Nigeria.

Katsina State is a typical Nigerian northern state blessed with abundant wild species of birds belonging to Numidae family. The guinea fowl (*Numida melegaris*) is one of them. It belongs to the order galliformes (Encyclopedia Britannica, 2000). It has been domesticated for about 5000 years ago in ancient Egypt by wealthy noble men in garden aviaries as an attractive feature (Appleby *et al*., 1992). But today, guinea fowl is domesticated in Nigeria mainly for its egg and meat. Guinea fowls are monogamous and seasonal breeders. These characteristics are counter-productive for the domestication programme (Oke *et al*., 2005). Domestication starts by introducing eggs laid by wild species of guinea fowls to Nigerian native hens to incubate; hatch and brood. The farmers continue to tame the chicks by providing water and supplements so that their foster mother will always bring them home in an extensive system. The chicks on weaning, copy the life pattern of their foster mother.

Guinea fowls are not only smaller in size when compared with the Nigerian native chickens, but its females lay eggs that are equally smaller in size and weigh less than that laid by the Nigerian native hens.

Thus products of guinea fowls are easily affordable than those of the Nigerian native hens. Guinea Fowls eggs are relatively known for possessing harder shells (Encyclopedia Britannica, 2000) while that of Nigerian native hens, possess softer shells. This feature makes handling eggs of guinea fowl less risky and easier. Naturally, guinea fowl can lay up to twenty eggs in a hatch (Encyclopedia Americana, 1995). This is twice that laid by the Nigerian native hens which lay about ten eggs in a hatch (Obioha, 1992).

Conversely, guinea fowls are poor sitters and consequently are characterized by low hatchability. This poses a major constraint to farmers who aim at maximizing their profit from this natural resource without artificial incubator. In order to attain the desired goal, farmers resort to exploiting the physiological characteristics of the Nigeria native hens (broodiness). As Obioha (1992) puts it "native Nigerian chickens are intensively broody"*.

The questions therefore are; what are the challenges farmers face in the art of masterminding the Nigerian native hens to incubate, hatch and brood chicks of guinea fowls? What are the economic prospects of continuous exploitation of Nigerian native hens in this enterprise in rural economy? What are the environmental factors that influence the indigenous practice in Katsina State of Nigeria? And what are the sound reasons for the indigenous practice? This study sets to provide answers to these questions.

Purpose and objective: The overall purpose of the study was to examine the use of indigenous knowledge and resources in economic development of peasant poultry enterprise in Katsina state of Nigeria. Specifically the study was meant to:

- identify the principles and techniques used in masterminding the Nigerian native hens in the enterprise;
- calculate the production and profitability of the indigenous enterprise;
- examine reasons for the indigenous practice and
- draw implications for agricultural development policy.

A null hypothesis of no significant difference among the reasons for the use of Nigerian native hens to incubate, hatch and brood guinea fowls chicks was tested.

MATERIALS AND METHODS

The study area: The study was conducted in three Agricultural Zones of Katsina State of Nigeria. They are Dadra, Funtua and Katsina Zones. The study area is a typical Sudan Savannah in sub-Saharan Africa. The soil type is generally sandy and alkaline in nature though sandy loamy soil exists in Funtua zone. The choice of the area was not just based on its large land area of 23,983 km^2, but on its low population density of 241 persons per square kilometer (NPC, 2006), which support extensive livestock and poultry farming, unlike the southern part of Nigeria where agricultural intensification is the rule (Arene and Mkpado, 2004).

Population and sample: The population of the study comprised peasant farmers in Katsina State who were involved in the extensive system of poultry enterprise. More specifically, they comprised farmers who practice the indigenous technology of masterminding the Nigerian native hens to incubate, hatch and brood guinea fowl chicks in the area. A multi-stage sampling technique was used in selecting the farmers. In the first stage, three agricultural zones in the state were selected. From each of the zones, three communities were randomly selected to give a total of nine communities. In the next stage, ten farmers who adopted the indigenous technology were purposively selected from each of the communities. This gave a total of 90 farmers that participated in the study.

Data collection: Data was collected from both primary and secondary sources. Primary data were obtained through structured interview schedule that was targeted on farmers, observations of field activities, market survey and Focus Group Discussions (FGD). These activities took place between April and October 2006. Information collected includes: reasons for the indigenous practice, production estimates of the enterprises and products prices. Secondary data were collected from relevant literature in libraries and from the Ministries of Agriculture and Natural Resources.

Data analysis: Objectives 1st and 3rd were analyzed using descriptive statistics while objective 2nd was realized using gross margin analysis. The hypothesis was tested using Kolmogorov-Smirnov (K-S) one sample statistics.

The Gross Margin (GM) per native Nigerian hen used to estimate the profitability of the enterprise was given as:

$$GM = \frac{\text{Total revenue (TR) -Total variable cost (TVC) (Naira)}}{\text{One Nigeria native hen used to incubate 15 guinea fowl eggs}}$$

The revenue items were: sales of eggs laid by incubating hens and that laid by guinea fowls at eight and ten naira respectively, sales of cocks not used for breeding and those eventually used for breeding stock at three hundred naira each. The cost items were the eggs of guinea fowls used for incubation at ten naira each and cost of hired labour to collect and clean the guinea fowls' eggs. The K-S statistic was used to determine the independence and hence authenticity of

the reasons for the practice. The format and decision rule are stated as:

$D^* =$ MAX $/Sn_{(x)} - Fo_{(x)} / \leq D_{(1-\alpha;\ n)}$ (Arua *et al*, 1997)

Where:

Max. = maximum

D^* and $D_{(1-\alpha;\ n)}$ = calculated and tabulated K-S statistics at α probability level for n number of observation respectively.

$/Sn_{(x)} - Fo_{(x)} /$ = absolute value of difference between observed ($Sn_{(x)}$) and calculated ($Fo_{(x)}$) frequencies respectively.

The decision rule is: if D^* is $\leq D_{(1-5\%;\ 90)}$, then the null hypothesis that there is no independence or difference among the reasons for the practice is accepted, else, the alternative hypothesis that the reasons for the practice are independent is accepted.

RESULTS AND DISCUSSION

Principles and techniques used in masterminding the Nigerian native: The breeding period in the study area starts at the on-set of rainy season in June and ends in September. During this period, seeds begin to sprout, grasses grow, young insects and lizards become abundant, all serving as food for both the Nigerian native hens and the guinea fowls, which live in flocks and can travel up to thirty-two kilometers in a day (Encyclopedia Americana, 1995). The farmer provides enough water and supplementary feeds, mostly household refuse as he can. He also ensures the maintenance of a sex ratio of one male to eight female guinea fowls. This is to ensure that all eggs laid are fertilized because their production is not just only for use as table eggs but also for incubation. The farmer also ensures that there are Nigerian native hens that have come to point of lay or old layers. The flow chat showing the stages of operations in the enterprise is presented in Fig. 1.

The acid test of the farmer in masterminding the Nigerian native hen to incubate, hatch and brood chicks of guinea fowls is by introducing the guinea fowls' eggs to laying Nigerian native hens in such a way that the laying hen will neither desert their chosen site of laying and incubation nor break and drink the guinea fowls' eggs. This is because the eggs of guinea fowls vary in colour from white to reddish brown (Encyclopedia Americana, 1995), while that of Nigerian native hens are usually white in colour. Even if there is variation in egg colour, it cannot be reddish brown as found in guinea fowls' eggs. Again, the eggs of Nigerian native hens are usually larger than that of the guinea fowls.

Once the Nigerian native hens begin to lay, the eggs of the guinea fowl can be introduced/substituted in any of the following systematic ways. First, if the eggs are much similar in colour, substitution can take place as soon as the Nigerian native hen lays its first egg. Additional eggs other than the one substituted for can be introduced gradually as the laying progresses. Secondly, if the eggs of guinea fowl to be introduced vary greatly from that of the Nigerian native hen (incubating hen) substitution for one egg only can take place as soon as the Nigerian native hen lays its second egg. Substitution/addition of eggs other than the one initially substituted can continue from the time of lay of the third egg. No eggs of the Nigerian native hen will be incubated with that of guinea fowls because such eggs will hatch in just twenty-one days and this will disturb the incubation process as the guinea fowl eggs are hatched in just 28-31 days. Each incubating hen will have approximately fifteen guinea fowls' eggs or more which it will incubate in 28-31 days. Thereafter it will brood the chick for about eight to ten weeks. At the end of the brooding period the stock is selected while others are sold (Fig. 1). Eggs of both Nigerian native hens and that of guinea fowls, which are not used for incubation, are then sold off.

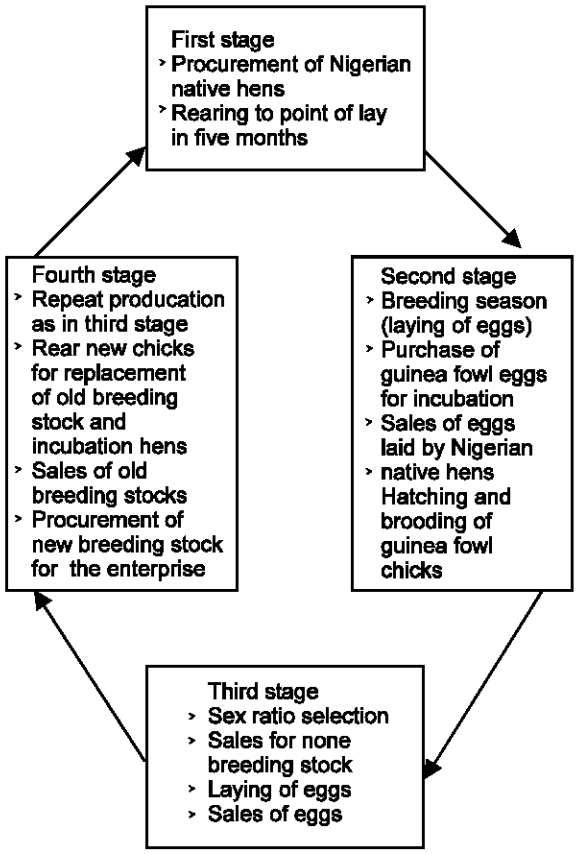

Fig. 1: A flow chart showing the stages of operation in the indigenous poultry incubation enterprise, Source: Field Survey, 2006

Production and profitability of enterprise: Farmers are able to gain more eggs over the usual number laid by guinea fowls for a hatch by prohibiting them from

Table 1: Percentage distribution of respondents according to the number of Nigerian native hens used, the number of eggs produced and the number of guinea fowl eggs hatched

Sr. No.	No. of farmers	No. of hens for incubation	No. of male chicks hatched+	No. of female chicks hatched+	No. of eggs laid by incubating hens	No. of eggs laid by hatched guinea fowl females
1	15 (16.6)*	1-3	17	22	30	1100
2	35 (39.0)	4-6	34	44	60	2200
3	30 (33.4)	7-9	52	65	90	3250
4	10 (11.0)	10-12	68	88	120	4400
Total	90 (100)		171	219	300	10,950

*Values in parenthesis are percentage scores, +Figures exclude 14% mortality rate, Field Data, 2006.

brooding. This is achieved by removing all the eggs they laid and by not allowing them to incubate any egg. An increase of five times over the usual number laid by Nigerian native hens has been reported (Obioha, 1992). With respect to guinea fowls, the low output of fifty eggs which is two and half times over the normal lay for a hatch is likely due to short breeding season in the study area as a result of limited rainfall and its variations; the desiccating effect of the weather after the peak of the rainy season as well as little care given under the extensive system of production. These result in irregularities in the frequency of eggs laid per breeding season. However, most of the respondents (39%) belong to the class that makes use of four to six Nigerian native hens. Each of them can hatch about 34 guinea fowl males and 44 females which in turn can lay up to 2200 eggs. Only eleven percent of the respondents have a larger scale of operation, each of them making use of ten to twelve Nigerian native hens that can hatch 68 guinea fowl males and 88 females which in turn can lay up to 4400 eggs (Table 1).

One major market holds in each of the rural communities used for the study every four days. In one of those market days, middle men come to buy eggs and excess from the farmers at reduced rates at ten naira and three hundred naira respectively. The middle men convey cocks and eggs to cities to maximize their profit. Only eleven percent of the farmers who are using 10-12 incubating hens make up to Niara 26,400.00 and Niara 11, 400.00 from the sales of eggs and cocks respectively per breeding season per year (Table 2).

Gross margin analysis result: This was calculated for a farmer who uses one incubating hen to start the breeding season. The revenue generated are from sale of: (1) an average of ten eggs laid by incubating hen (2) at least five guinea fowls cocks not used for breeding (3) old breeding stock of seven guinea fowl females and a male and (4) 350 eggs laid by breeding stock. This gives total revenue of Niara 6400.00 per Nigerian native hen used. The cost of production include (1) fifteen guinea fowl's egg used to raise breeding stock and (2) hired labour to collect and clean the eggs which is estimated at fifteen percent of proceeds from egg sales. These gave a total variable cost of Niara 525.00, the difference gives a gross margin of Niara 5875.00 per Nigerian native hen used to incubate at least fifteen guinea fowl's eggs to raise chicks for egg production.

Table 2: Percent distribution of respondents according to income derived from sales of their products

Sr. No.	No of farmers	No of hens for incubation	Cock sales+ (Niara)	Sale of used breeding stock (Niara)	Egg sales (Niara)
1	15 (16.6)*	1-3	4800	9000	11000
2	35 (39.0)	4-6	9900	52500	22000
3	30 (33.4)	7-9	15000	72000	32500
4	10 (11.0)	10-12	20100	93000	44000
Total	90 (100)		49800	226500	109500

*Values in parenthesis are percentage scores, +Figures exclude 14% mortality rate. Field Data, 2006.

Rationale for the practice/kolmogrov-smirnov-statistics results: The Kolmogrov-Smirnov-Statistics result was significant. At 95% confidence interval, the calculated K-S statistics (0.7777) was greater than the tabulated value (0.1434) for 90 observations (Table 3). The alternate hypothesis is upheld. It implies that the reasons for the practice are independent of one another and hence are authentic.

Major problems confronting farmers

Low capital: The problem of lack of financial empowerment to purchase an incubator, exotic breeds, feeds, drugs and other modern poultry farming equipment were presented by 50% of the respondents (Fig. 2). The income of farmers involved in enterprise would have increased but for lack of effective marketing channel and the activities of middlemen. On market days the middle men purchase the bulk of guinea fowls and their eggs at three hundred naira and ten naira respectively and sell with a margin of Niara 70.00 per guinea fowl and Niara 3.00 per egg to retailers in urban areas (i.e. at three hundred and seventy naira and twelve naira for each guinea fowl and egg respectively). The retailers in turn sell to consumers at fifteen naira per egg and about four hundred and fifty naira per guinea fowl depending on size. Thus farmers continue to have low income, low savings and low investments, which is a major reason for their being entrapped in the vicious circle of poverty.

Lack of technical know-how: Thirty percent of the respondents claim that they lack technical know how to

Table 3: Kolmogrov-Smirnov-Statistics showing independence of reasons for the use Nigerian native hens in incubating guinea fowl eggs

	Low capital (1)	Lack of technical know-how (2)	Hatchability of hens (3)
Frequency	45	27	18
$Fo_{(x)}$	1/90	2/90	3/90
$Sn_{(x)}$	45/90	27/90	90/90
$/Sn_{(x)}-Fo_{(x)}/$	0.4889	0.7777	0.03333

Field Data, 2006

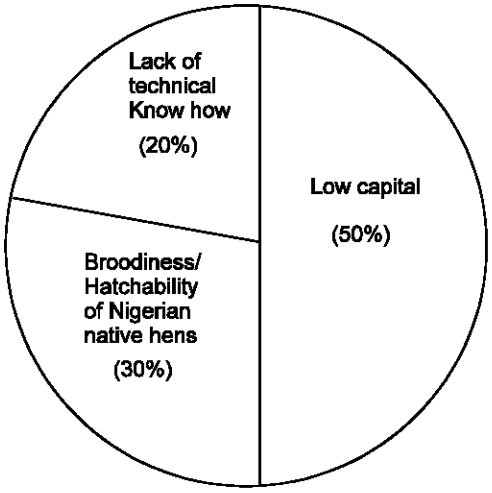

Fig. 2: Pie chart showing percent distribution of respondents according to the primary reasons for the indigenous practice.
Source: Field Data, 2006

either operate an incubator or rear exotic breeds of poultry from brooding stage to adulthood. This finding is in consonance with that of Obioha (1992) who found out that modern incubators have undergone a very high degree of sophistication and complexity in function and size and so small-scale farmers may find it difficult to operate. Secondly, rearing exotic breeds of poultry requires intensive care in feeding, housing and medication. However, under the extensive system practiced, very little care is given to indigenous native species. The native Nigerian hens incubate, hatch, and brood the guinea fowl chicks, under extensive condition. The chicks which are fully covered with down feathers are able to run about immediately they are hatched (Tracy and Robert, 1965). No additional brooding apparatus are provided. The major task at this time is to protect them from predators such as hawks, kites snakes and so on.

Hatchability of Nigerian native hens: Only twenty percent of the respondents gave the major reason for the practice to be that the Nigerian native hens hatch eggs readily (Fig. 2). Hatchability is the proportion of fertilized eggs that are hatched per breeding cycle. This is a measure of efficiency of incubation process for both artificial and natural incubators. It has been reported that when birds which are good brooders sit on their eggs to hatch them, they achieve a hatching rate of nearly ninety five percent, but when the same types of eggs are put into artificial incubators, the hatching rate is drastically reduced. Scientists in England were studying this problem to improve on efficiency of incubators (Awake, 1977). A hatching rate of at least 67 percent has been reported for modern incubators (Obioha, 1992).

Conclusion: It has been shown that the use of Nigerian native hens to incubate, hatch and brood guinea fowls' chicks for meat and egg production is still profitable in the extensive system of poultry production in Katsina State of Nigeria. The major reasons why the scale of operation has not increased were financial constraints and lack of technical know-how. Based on the small scale nature of farmers' enterprise in the area, the hatchability of Nigerian native hens proves to be more economical than the artificial incubators. Since human population is always on the increase, the possibility of this extensive small-scale poultry enterprise meeting future needs is doubtful. Consequently, the following recommendations are made: (1) farmers should form cooperative societies to limit the activities of middle men and gain more income which can be used to increase scale of operation. (2) Agricultural Development Programmes (ADPs) in various states of the federation should intensify their efforts in educating farmers on the importance and techniques of intensive poultry keeping, so that they can practice it not only to achieve its optimum production, but because the extensive system of poultry enterprise cannot meet the meat demands of people owing to population explosion. Also, the ADPs should encourage farmers by improving upon the indigenous knowledge of the people (3) Governments should give financial assistance to farmers to increase their scale of poultry enterprises as well as set up efficient modern hatcheries in strategic places so that farmers can make use of their services and increase production, income and their general livelihoods.

***Endnotes:** This paper uses the name "Nigerian native hens" for the females because the appropriate scientific nomenclature of Nigerian native chickens has been controversial. Obioha (1992) argued that they do not fit the classical definition of breeds but are vaguely referred to as strains a classification that has doubtful scientific basis. Other names like "native Nigerian chickens", (Obioha, 1992) "Nigerian native fowl" (Oluyemi *et al.*, 1973) and "Nigerian native chickens" (Obioha *et al.*, 1983) have been used.

REFERENCES

Appleby, M.C., B.O. Hughes and A.H. Elson, 1992. Poultry Production Systems: Behsviour, Managetment and Welfare. C.A.B. Internationl Wallingford Oxon, U.K.

Arene, C.J. and M. Mkpado, 2004. Counter-Urbanization and Agricultural Productivity in Nigeria. J. Rural Development, 23: 73-81.

Arua, A.I., W.I.E. Chukwu, F.C. Okafor and F.I. Ugwuowo, 1997. Fundamentals of Statistics for Higher Education: Fijac Academic Press Nsukka, Nigeria.

Awake, 1977. Watching the world: learning about eggs" *Awake*: September, 22: 30-31.

Encylopedia Americana, 1995. 13: P: 88

Encyclypedia Britanica, 2000. 5: P: 556.

Ikeme, A.I. and P.O. Uvere, 1995. Mobilizing indigenous technology for agricultural and rural development In: Eboh E.C., C.U. Okoye and D. Ayichi (Eds.) Rural Development In Nigeria: Concepts, Processes and Prospects. Auto Century Publishing Company, Enugu, Pp: 89-102.

Ngoddy, P.O., 1991. The role of indigenous technology in agricultural development In: A.I. Ikeme, A. Okorie, P.O. Uvere (Eds.). The Challenges of Agriculture in National Development, Optimal Computer solutions Nsukka Nigeria, pp: 322-335.

National Population Commission of Nigeria, 2006. Census Report.

Obioha, F.C., C.O. Nwosu, F. Gowen D.E. Etim, Z.E. Obaanu, E. Ihemeandu and G.I. Onura, 1983. Comparative meat yield and anthropometrics indices of the Nigerian native chickens and an exotic strain. World Review on Anim. Prod., 19: 59-64.

Obioha, F.C., 1992. A Guide to Poultry Production in the Tropics. Acene Publishers Enugu, Nigeria.

Oke, U.K., U. Herbert and K. Joseph, 2005. Photo-stimulated changes in egg production and reproductive performance of the Guinea fowl in a sub-humid tropical environment. Nig. J. Anim. Prod., 33: 315-320.

Oluyemi, J.A., S. Soipe and V.A. Oyenuga, 1973. Yields and qualities of the meat of the Nigerian indigenous fowl as compared with those of exotic breeds. Nig. Agric. J., 10: 59- 62.

Tracy, I.S. and L.U. Robert, 1965. General Zoology 4th Ed. Hil Publishing Co. Ltd, Bombay New York.