Comparative performance of different lines of New Hampshire breed of poultry in Nepal

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ABSTRACT
A study was conducted to evaluate the comparative performance of four different lines of New Hampshire (NH) poultry breed collected from different governmental farms of Pokhara, Parwanipur, Khajura and Khumaltar, Nepal. The study was undertaken for seven months from March to September 2020. The study included 160 chicks with 20 male and 20 female from each line. The experiment was conducted in a Completely Randomized Design with four treatments of different lines and eight replications. The results showed that the highest average weight of day-old chicks was found for Khumaltar line and the lowest for Pokhara line (p<0.001). Similarly, the highest fourth week's weight was found 237.50±16.88 g in Khajura line and the lowest 191.60±26.53 g in Parwanipur line. In case of eight weeks weight, both male and female was the highest in Khajura line, which were 0.72±0.12 kg and 0.52±0.07 kg, respectively. At that stage, the male weight was significant (p<0.001) but non-significant (p>0.05) in female. Similar pattern was found in twelve and sixteen weeks, but the weight of both sex was significant (p<0.001) at twenty and twenty-four weeks. At the final measurement in 24 weeks, the male and female weight was the highest in Khajura line and the lowest in Parwanipur line. The weight of both sexes of Pokhara and Khumaltar lines were similar. Khajura line was better than other lines indicating that this line is more appropriate be used for further improvement of the NH lines of the country.
Keywords: Breeding lines, dual-purpose, productive performance, weight gain

INTRODUCTION

Livestock is an integral part of Nepalese agriculture, where 65% population is engaged in this sector and it contributes 24.26% of the total national gross domestic product (GDP) (MoALD 2021). Poultry keeping as an essential part of the livestock farming system in rural households, is a popular activity that provides family income for the small, marginal, and

landless poor. The poultry products such as eggs and meat help to uplift the living standard of small farmers and the total GDP of the country (Kattel 2016). Poultry sector alone shares 43.58% meat and 98.80% egg production of the nation. The number of poultry and eggs production was increased by 62.65% and 87.19%, but in case of meat production, the increment was 462.53%, respectively during last ten years (MoALD 2021).

The common poultry species reared in Nepal are chicken, pigeon, geese, turkey and ostrich, contributing to the available meat supplies (Shrestha 2014). Within chickens, there are different types of breeds available in our country. The Broiler chicken is reared for meat purposes and layers for eggs. Similarly, New Hampshire, Giriraja and Black Australorp are exotic and Sakini, Naked Neck and Frizzle feathers are indigenous dual-purpose breeds. The indigenous breeds are hardy, adaptable to harsh conditions and have more tasty eggs and meat than any of the exotic breeds (Parajuli 2008). The exotic breeds are high-yielding commercial strains that have been imported and mainly utilized for commercial productions, and are often failed to sustain their inherent production performance under adverse and multi-stress environmental conditions in rural areas whereas all above mentioned dual-purpose breeds were reported to perform better in low-input and scavenging conditions (SARP 2010). Further, it has been observed that these birds are equally hardy, require less management attention and having better performance in terms of egg and meat under village conditions in comparison indigenous chickens (Phiri 2004, Lemlem and Tesfay 2010).

In Nepal, several lines of NH breed of poultry was introduced from different countries at different times. Currently, they are found at four government farms; two are under the Nepal Agricultural Research Council (NARC): National Avian Research Program at Khumaltar and Directorate of Agriculture Research in Parwanipur, and under Department of Livestock Services: National Livestock Breeding Center (NLBC), Pokhara and Poultry Development Farm. Khajura. Since the introduction of the NH breeds, only fragmentary empirical studies have been performed. Therefore, in present study we aimed to perform a comparative production performance of these different lines of NH breed available in different geographical locations.

MATERIALS AND METHODS

Duration and site of study
This experiment was conducted in Swine and Avian Research Program under Nepal Agricultural Research Council (NARC) for seven months from March 2019 to July 2020.

Chick selection and management
Fourty chicks (20 males and 20 females) were randomly selected each line: Pokhara, Parwanipur, Khajura and Khumaltar farms. The experiment was conducted in the deep litter system. Brooding was done up to six weeks' age with a definite temperature. The detailed brooder temperature, feed, and water supply are presented in Table 1.

Table 1. Brooder temperature, feed and water supply of chicks up to six weeks

Age of chicks	Temperature of brooder		Feed and water suuplied	
	°F	°C	Feed (g bird^{-1})	Water (mL bird^{-1})
First week (Seven days)	95	35.00	10	20
Second weeks (8-14 days)	90	32.22	15	35
Third weeks (15-21 days)	85	29.44	20	50
Fourth weeks (22-28 days)	80	26.66	25	65
Fifth weeks (29-35 days)	75	23.89	30	80
Sixth weeks (36-42 days)	70	21.11	35	95

Source: SARP (2010)

Feed, and water provided in increasing order up to twenty-four weeks. During this experiment, 5 g of feed and 15 mL of water in every week were increased, but the temperature was not maintained after six weeks. Standard schedule vaccination of SARP was followed for all chicks. The vaccination was done against Marek's disease in day one, Ranikhet at seven and twenty-eight days and Gumboro at twelve and twenty days. Similarly, fowl pox vaccine was provided at forty-two days of age of chicks.

Treatment and experimental design
The experiment was conducted in a Completely Randomized Design with four treatments of different lines of NH breed and eight replications. A pen was used as an experimental unit containing five male or five female birds. The Pokhara, Parwanipur, Khajura and Khumaltar line of NH breed of rural chicken were used as treatments.

Data collection and analysis
The weight of one-day chicks was recorded. Then after, weight measurement was done in weekly intervals for up to four weeks of age. A separate weight measurement of males and females was taken from eight weeks of age onwards up to twenty-four weeks of age. In order to collect an accurate weight, the recording was taken in the morning time before feeding.

Data were analyzed by Statistical Package for Social Science (SPSS) version 26 computer software and means were separated by DMRT.

RESULTS

Weight up to four weeks
The detailed growth performance of day-old to four weeks weight of chicks is presented in Table 2. Among the different lines, the day-old chick's weight was not significantly different (p>0.05), but the first-week weight was significant at 1% level (P<0.01) and the other weeks' weight was significant in 0.1% level of probability. From first to fourth week, the highest weight was attained by Khajura line and lowest by Parwanipur line, which was 23.95% increment.

Table 2. Growth performance of unidentified sex chicks of New Hampshire breed

Lines	Weekly body weight (Mean±S.E.) in g				
	Initial weight	First week	Second week	Third week	Fourth week
Parwanipur	35.40±3.66	65.20^c±5.32	102.35^c±10.11	146.47^c±15.68	191.60^d±26.53
Khajura	35.70±4.39	75.34^a±7.23	119.27^a±12.31	174.23^a±14.89	237.50^a±16.88
Pokhara	34.50±3.44	68.76^b±4.11	109.45^b±11.23	165.17^b±17.34	223.40^b±21.73
Khumaltar	36.00±3.37	73.12^a±8.24	114.45^b±14.22	162.65^b±19.45	212.90^c±25.08
Overall	35.40±3.72	70.61±5.22	111.38±11.45	162.13±18.73	216.35±29.65
F-test	ns	**	***	***	***

NS: non-significant, **: Significant at 1% level, ***: Significant at 0.1% level (P<0.001)

Body weight gain up to four weeks
The weight gain during early ages were found very low in the all lines of NH breed (Table 2). With the age increment, the weight gain also increased in increasing trends. The body weight gain was significantly (high, P<0.001) in the Khajura line (9.04 gd^{-1}) comparing to the lowest in the Parwanipur line (6.45 g d^{-1}). The detailed trend of body weight gain is presented in Figure 1.
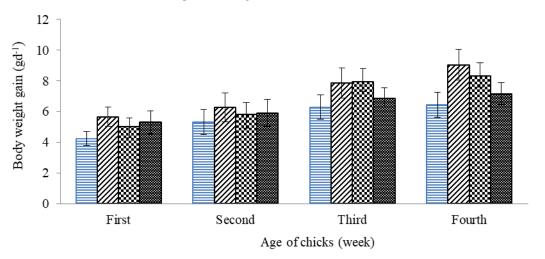
Figure 1. Daily body weight gain of different lines of New Hampshire chicks in different weeks

Body weight after eight weeks

The detailed growth performance of all these lines is presented in Table 3. In the case of sex, the body weight of male chicks was significantly (P<0.001) higher than females. Similarly, within the male, the weight of the Khajura line was significantly (P<0.001) higher from eight to twenty-four weeks, which was up to 23.07% more, but the female weight was significant (p<0.001) at only twenty and twenty-four weeks.

Table 3. Body weight of different lines of male and female chicks in different weeks

Sex/Lines		Body weight (Mean±S.E.) (kg)				
		Eighth week	Twelfth week	Sixteenth week	Twentieth week	Twenty-fourth week
Sex						
Male		0.67[a]±0.09	1.35[a]±0.14	1.76[a]±0.21	2.08[a]±0.33	2.40[a]±0.24
Female		0.50[b]±0.06	1.06[b]±0.11	1.28[b]±0.10	1.53[b]±0.13	1.72[b]±0.17
Lines						
Parwanipur	Male	0.62[b]±0.04	1.28[c]±0.15	1.62[c]±0.17	1.91[c]±0.10	2.21[c]±0.11
	Female	0.48±0.06	1.01±0.14	1.26±0.10	1.44[c]±0.17	1.60[c]±0.15
Khajura	Male	0.72[a]±0.12	1.45a±0.18	1.92[a]±0.22	2.25[a]±0.16	2.72[a]±0.16
	Female	0.52±0.07	1.06±0.09	1.30±0.09	1.62[a]±0.09	1.83[a]±0.09
Pokhara	Male	0.67[b]±0.04	1.36[b]±0.04	1.82[b]±0.12	2.10[b]±0.28	2.35[b]±0.13
	Female	0.50±0.05	1.04±0.07	1.29±0.07	1.55[b]±0.09	1.72[b]±0.16
Khumaltar	Male	0.65[b]±0.06	1.32[b]±0.13	1.75[b]±0.12	2.05[b]±0.14	2.31[b]±0.16
	Female	0.51±0.04	1.14±0.11	1.28±0.11	1.51[b]±0.09	1.71[b]±0.11
Overall		0.59±0.08	1.21±0.13	1.52±0.16	1.81±0.23	2.05±0.21
F-test for sex		***	***	***	***	***
F-test for lines		***	***	***	***	***

***: Significant at 0.1% level (P<0.001)

Body weight gain up to twenty-four weeks

The body weight gain of different lines of NH chicks were highest during eight to twelve weeks of age and then gradually declined (Figure 2). Among the lines, the weight gain of both sexes was higher in the Khajura line (16.79 gd^{-1} in male and 11.43 gd^{-1} in female).
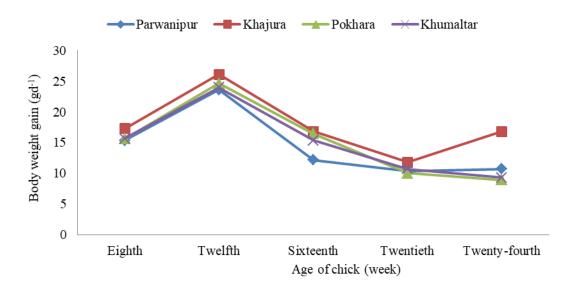
Figure 2. Weight gain of male chicks of different lines from 8-24 weeks
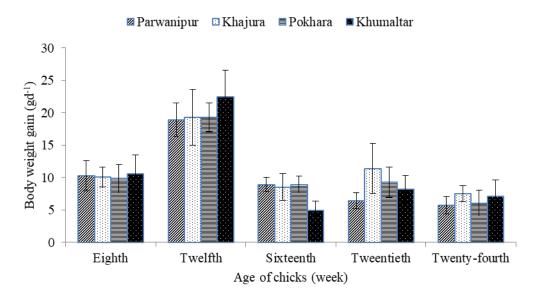

Figure 3. Weight gain of female chicks of different lines from 8 to 24 weeks

DISCUSSION

This study was initiated with the objective to evaluate different lines of New Hampshire poultry breed which are reared in different governmental farms of Nepal. Our results showed that the weight gain of both sexes from the stock taken from Khajura showed significantly higher growth comparing to other lines (Figure 2 and 3). The day-old chick's weight was not significantly different ($p>0.05$), but the first-week weight was significantly different at 1% level ($P<0.01$) and the difference in other week's weight was highly significant ($P<0.001$) among the lines. The body weight gain up to fourth weeks age was the highest in Khajura line and the lowest in Parwanipur line. Similarly, the body weights of male birds of these lines were significantly ($P<0.001$) different from eighth to twenty-fourth weeks, but the body weights of female of these lines were significantly different ($p<0.001$) at only Twentieth and twenty-fourth weeks. The weight gains of both sexes were higher ($p<0.001$) in Khajura line.

Waleed et al (2011) compared the growth performance of New Hampshire and other breeds at different ages showing that the New Hampshire breed had significantly higher day old (34.30±00.23g) than other breeds. Likewise, Ramkrushna (2011) recorded that the body weight at fourth week of age was 422.06±8.29 g in New Hampshire. This study revealed that this line of NH breed differed except at day old to previous studies mentioned by Waleed et al (2011) and Ramkrushna (2011), Gupta et al (1974), Padhi et al (1998).

Similarly, New Hampshire breed had significantly higher 8th, 12th, and 16th week's body weight then other dual purpose breed which was 536.80±04.42, 984.00±23.20, and 1360.60±49.90 g, respectively (Waleed et al 2011). Ramkrushna (2011) found that the 8th week average body weight recorded was 800.57±10.67 g. Likewise; the mean body weight at 12th week of age was 1141.57±12.73 g, whereas at 16th week, it was 1452.68±17.52 g and at 20th week, it became 1910.60±29.46 g and this result is similar with the finding of this study.

Singh and Chabra (1974) studied the rate of weight gain in New Hampshire breeds. The result showed that the daily weight gain during nine to ten weeks was recorded 11.52±0.90 gd[-1] Whereas; the body weight gain was found 15.57±0.44 gd[-1] in crossbreed of New Hampshire and Australorp during eleven to twelve weeks. Similarly, Ramkrushna (2011) found that the average weight gain during five to eight weeks was 378.51±10.27 g, 311.11±16.11 g in thirteen to sixteen weeks and 457.91±31.47 g in seventeen to twenty week's age.

The growth in poultry is highly dependent to the feed quality, diseases, housing, sanitation, genetics and several other environmental factors. In present study we did not performed feed quality tests, we offered the feed those were directly available to us from contractor in the farm. The routine health checkup including the fecal contents of the chicks taken into the experiment was also not examined. It is likely many internal parasites they often do not exhibit their presence, so often specially nematodes causes poor growth in animals, despite they consume recommended feed (Waleed et al 2011, Ramkushna 2011). So, it is likely that there should be more detailed examination of the different lines available in the country.

CONCLUSION

The New Hampshire breed of poultry is more popular for rural poultry in Nepal. Among the available lines of NH breed in Nepal, the Khajura line performed better and the Parwanipur line became poorer. Therefore the Khajura line should be given emphasis for the promotion of rural poultry in Nepal and the Parwanipur line can be improved by upgrading by Khajura line. In the study, Khajura line showed better performances in meat production, but further research is necessary for egg productivity, fertility, hatchability and to find out the ability about the resistance of disease and pest.

Authors' Contributions
DA: Designed and implemented the experiment, data recording, and data analysis and prepared the manuscript. SP, NB, SS, PBC and NP: Involved in experiment and wrote the manuscript.

Conflicts of Interest
The authors have no relevant financial or non-financial interests to disclose.

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REFERENCES

Bhardwaj RK, S Kumar, D Kumar, A Kumar, RK Sharma and SK Singh. 2005. Study on economic traits of purebred and crossbred chicken. Proceedings of annual conference of Indian Poultry Science Association, 2-4 February, Hyderabad, India; **pp**. 228.

Gupta SC, JN Pandey, KL Arora and MN Razdan. 1974. Studies on growth rate of Australorp and White Leghorn female chicken hatched in December and April. Indian J. of Poultry Sci. **9**(2):108-113.

Kattel P. 2016.Socio-economic importance of indigenous poultry in Nepal. Poultry, Fisheries and Wildlife Sciences **4**(1):9–11. https://doi.org/10.4172/2375-446x.1000153.

Lemlem A and Y Tesfay. 2010. Performance of exotic and indigenous poultry breeds managed by smallholder farmers in northern Ethiopia. Livestock Research for Rural Development **22**(10).

MoALD. 2021. Ministry of Agriculture and Livestock Development. Statistical Information on Nepalese Agriculture. 2020/21.

Padhi MK, RB Rai, S Senanei and SK Sha. 1998. A note on performance of synthetic broiler in hot and humid climate of A and N Island. Indian J. of Poultry Sci. **33**(2):191-193.

Parajuli DP. 2008. Small scale rural poultry production and its contribution to poverty alleviation. Proceedings on 8th National Conference of Nepal Veterinary Association, Kathmandu, Nepal; **pp**. 20- 23

Phiri RM. 2004. A study on productive and economic performances of black Australorps and their crosses with hy-line hens under small holder farming systems in Malawi, http://www.ivs.life.ku.dk/ phiri.pdf.ashx.

Ramkrushna NP. 2011. Evaluation of production potential of three breeds of chicken and growth performance of their crossbred progenies suitable for rural farming. Department of Poultry Science College of Veterinary Science and Animal Husbandry. Anand Agricultural University. Anand-388110. (Gujarat)

SARP. 2010. Annual report of Swine and Avian Research Programme (2009/10), Khumaltar, Kathmandu, Nepal.

Smith AJ. 1990. Poultry-Tropical Agriculture Series. CTA, McMillan Publishers, London; **pp.** 184-185.

Shrestha KB. 2014. Livestock country reviews. 8. Poultry Sector Nepal. 63. Food and Agriculture Organization of the United Nations.

Waleed MR, A Sajida and FA Al-Shaheen. 2011. Use of full diallel cross to estimate crossbreeding effects in laying chickens. International J. of Poultry Sci. **10**(3):197-204.