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Seasonal Variation on Swine Reproductive Performance:

A Meta-analysis of Selected Farms in Sta. Maria, Bulacan, Philippines

Ningal, NL[1], Aquino, JAB[1], Autriz, ML[2]
[1]Qualipeak Livestock Corporation, Asin East, Malasiqui, Pangasinan, Philippines
[2]Cavite State University, College of Agriculture, Food, Environment and Natural Resources, Indang, Cavite, Philippines

Abstract

The objective of the study it to illustrate the statistical correlation between different reproductive performance (total pigs born [TPB], litter size born alive [LSBA], litter size at weaning [LSW] and percent weaning [PW] based on total pigs born) with the climatic parameters (relative humidity [RH], temperature [T] and rainfall [R]). Secondary data on reproductive performance and egg production were gathered from commercial swine farms and layer chicken farms situated at the Municipality of Sta. Maria, Bulacan. Data on relative humidity, temperature and rainfall were gathered from Department of Science and Technology (DOST) PAGASA, Diliman, Quezon City. The results were analyzed using Pearson Correlation Statistical Technique to illustrate the relationship between the different variables.

During the four quarters of the year, the association between the different reproductive performance (TPB, LSBA, LSW and PW), with the climatic parameters (RH, T and R) presented both positive and negative correlations.

Climatic variation in reproductive performance exists. There is a rise and decline in production during the different quarters of the year. High humidity alone does not have a negative effect in reproduction and production performance. However, high humidity enhances the negative effects of high temperature, promotes discomfort thru heat stress, and lessens the effect of cooling mechanisms. High humidity combined with high temperature causes decline in swine reproductive performance.

Keywords:- *Seasonal variation, meta-analysis, swine, reproduction, Commercial farms, Quarter, Philippines.*

I. INTRODUCTION

Estimating the demand for agricultural commodities has been an interest for many economists to help draw appropriate policies. A study was conducted to determine the demand for pork, beef, and chicken in the Philippines using provincial cross-section data across three time-periods 1995, 2000, and 2009 using the Almost Ideal Demand System. The study determines the market potential of the meat commodities. It was found out that pork is a necessity good with market potential higher compared to chicken and beef but decreases over time. Chicken, on the other hand, has grown to become a necessity, a commodity next to pork, with growing market potential (Apolinares, Digal and Sarmiento, 2010).

The Swine Industry, being one of the leading contributors to Philippine agriculture, was valued at 160 billion pesos in 2007. This tells us that swine production in the Philippines has great value and opportunity to people who want to engage in it (Lapus, 2009).

Due to interminable increase in demands and evident high-income value for swine production, swine raising is now a leading enterprise in the Philippines. Despite the crises facing the industry, still many people are venturing in this enterprise (Bureau of Agricultural Research, 2012).

One of the major predicaments in swine production is seasonal variation. The process of reproduction is extremely complicated and involves many highly specific biological functions. The external environment (temperature, disease, diet, housing, social surroundings, etc.) has a far greater influence on reproductive performance than on any other biological process because the newborn of any species require special protection from environmental extremes. The mammalian mother must maintain herself, as well as provide nutrients, warmth, and protection for her young. She must be sensitive to both the existing and the future environment (Thompson and Johnson 1983).

For these reasons, it is perceived that climate change stimulates seasonal variation in swine production. Changes in climate present both challenges and opportunities for swine. It is therefore vital to carefully deliberate the climate-related effects on the reproductive performance of swine.

II. METHODOLOGY

- *Research Design*

Meta-analysis method was used in this study to classify the association of the effects of quarterly climatic variation on the reproductive performance of swine in the Municipality of Sta. Maria, Bulacan. Relative humidity, temperature and rainfall were gathered from Department of Science and Technology (DOST) PAGASA, Diliman, Quezon City, Philippines from 2011 until 2013. The results

were analyzed using Pearson Correlation Statistical Technique to illustrate the relationship between different variables.

➢ *Research Procedure*

Three-year data (2011-2013) on the monthly relative humidity, temperature and rainfall were gathered from DOST-PAGASA. Fifteen commercial swine farms in the Municipality of Sta. Maria, Bulacan were included in the study. Three-year data (2011- 2013) on the monthly reproductive performance were gathered. Using descriptive statistics, data on climatic parameters were correlated with the data on reproductive parameters.

➢ *Statistical Design*

The data gathered are analyzed using correlation coefficient between two variables:

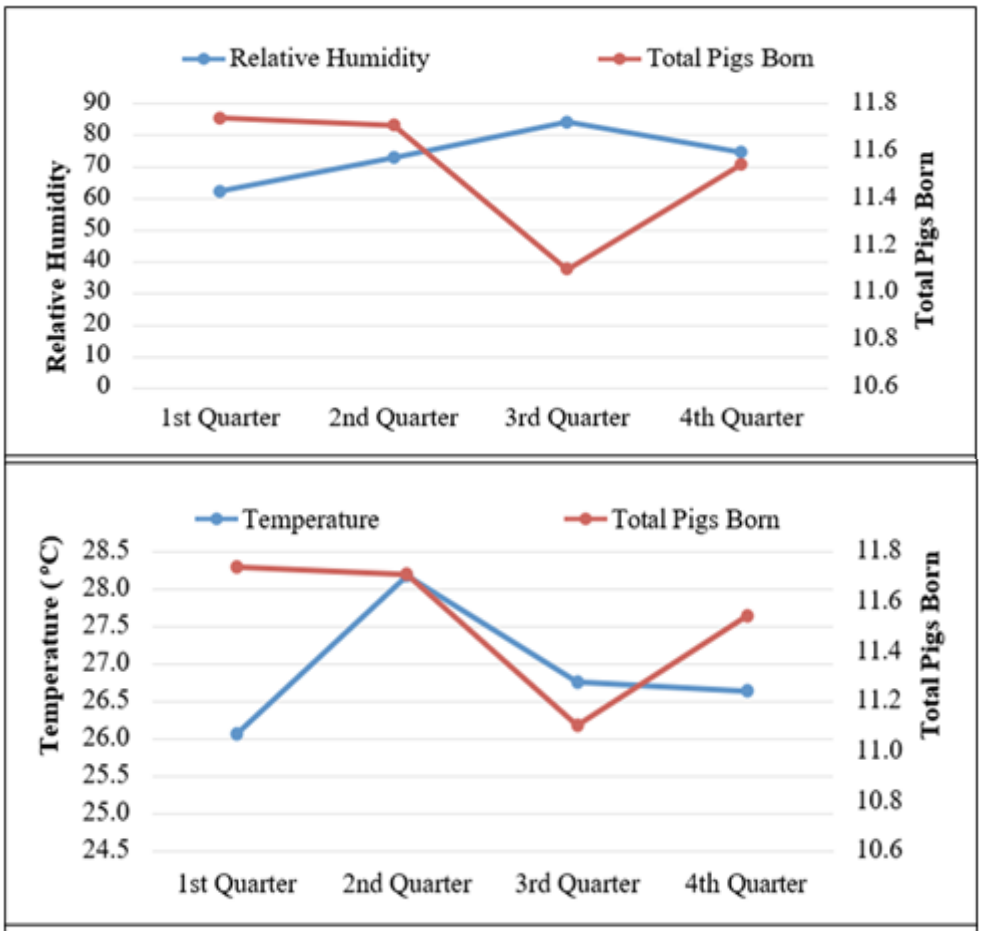
$r = \Sigma (xy) / \text{sqrt} [(\Sigma x^2) * (\Sigma y^2)]$

where: Σ is the summation symbol
$x = x^{i-x}$, xi is the x value for observation i, x is the mean x value
$y = y^{i-y}$, yi is the y value for observation i, y is the mean y value.

Variables represented were:
X is the value of the climatic parameter
Y is the value of the reproductive parameter

III. RESULTS AND DISCUSSION

➢ *Relationship of Quarterly Climatic Parameters on Total Pigs Born*



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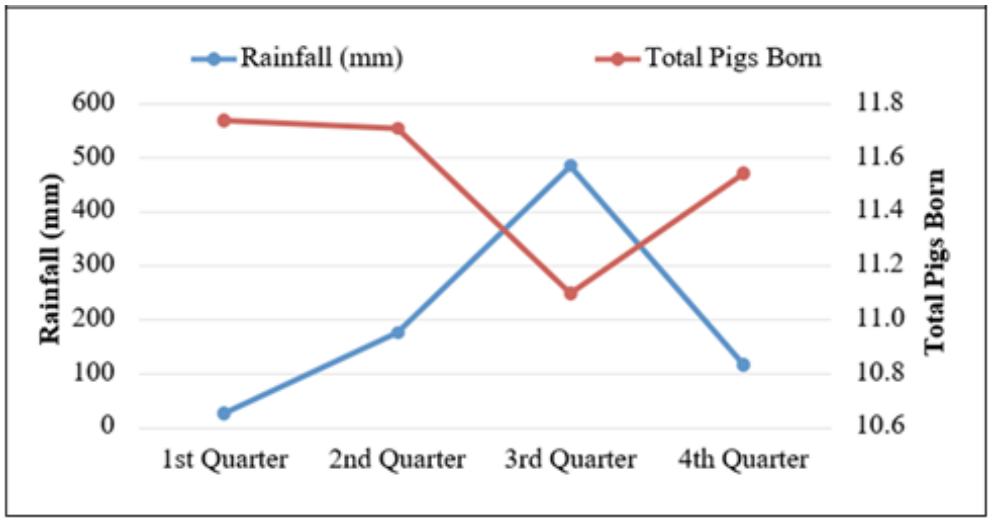

Fig 1:- The relationship of relative humidity, temperature and rainfall with the number of pigs born.

The relationship of relative humidity, temperature and rainfall with the number of pigs born is presented in Table 1.

QUARTER	RH	TEMP	RF
1ST	-0.735	-0.999	-0.986
2ND	-0.985	-0.993	-0.993
3RD	-0.832	-0.988	-0.921
4TH	-0.657	0.029	0.855

Table 1:- Relationship of quarterly climatic parameters on Total Pigs Born

Ambient temperature also affects the reproductive performance of pigs. Sows do well at 15°C but suffer badly at 25°C and above since they do not perspire when the environment is hot. Reproduction rates fall under heat stress due to the discomfort of hot weather (FAO, 2015). Data gathered showed a range of 26°C to 28°C in temperature during the four quarters of the year. Hence, statistical results show that the number of pigs born from sows is negatively correlated with temperature during the 1st, 2nd and 3rd quarter of the year with - 0.999, -0.992 and -0.988, respectively. It is only during the 4th quarter that the correlation value became positive, but still very low. Rainfall also showed negative correlation with total number of piglets born. From first to third quarter, rainfall posted highly negative correlation with number of pigs born. It is because rainfall usually increases humidity and it results to the pig's inability to cool its body because body heat doesn't dissipate quickly during high humidity. This results in discomfort affecting the reproductive performance of pigs. It is only during the 4th quarter, which is usually the coldest, with low humidity and low rainfall that the correlation of rainfall with total number of pigs born is at its highest at 0.855.

- *Relationship of Quarterly Climatic Parameters on Litter Size Born Alive*

All values for climactic factors such as relative humidity, temperature and rainfall showed negative relationships with litter size born alive. For relative humidity, the highest negative correlation was found during the 4th quarter with -0.951. It means that the higher the relative humidity, the lower the average litter size born alive obtained from pigs. It is because high humidity prevents the sows from cooling down their bodies, causing some of the piglets to die *in-utero*, lowering the number of piglets born alive. Various investigators demonstrated that heat stress disrupts implantation and decreases embryo survival in sows. As a result of embryo and early fetal loss during the summer, the subsequent farrowing rates in November to January are decreased dramatically (Almond, 1992).

Ambient temperature also negatively affects the number born alive in pigs. Sows begin to feel the negative effects of heat stress at about 20°C. If temperatures remain above 27°C for more than a short period of time (2 to 4 days), substantial losses in performance and reproductive efficiency can result unless some type of cooling relief is provided (Myer, R. et al, 2001). The highest negative correlation was observed from the 4th quarter with -0.908 and lowest during the 1st quarter with -0.107 when temperature is the lowest at 26.06°C. From the results we could deduce that the higher the temperature the number of piglets born alive decreases.

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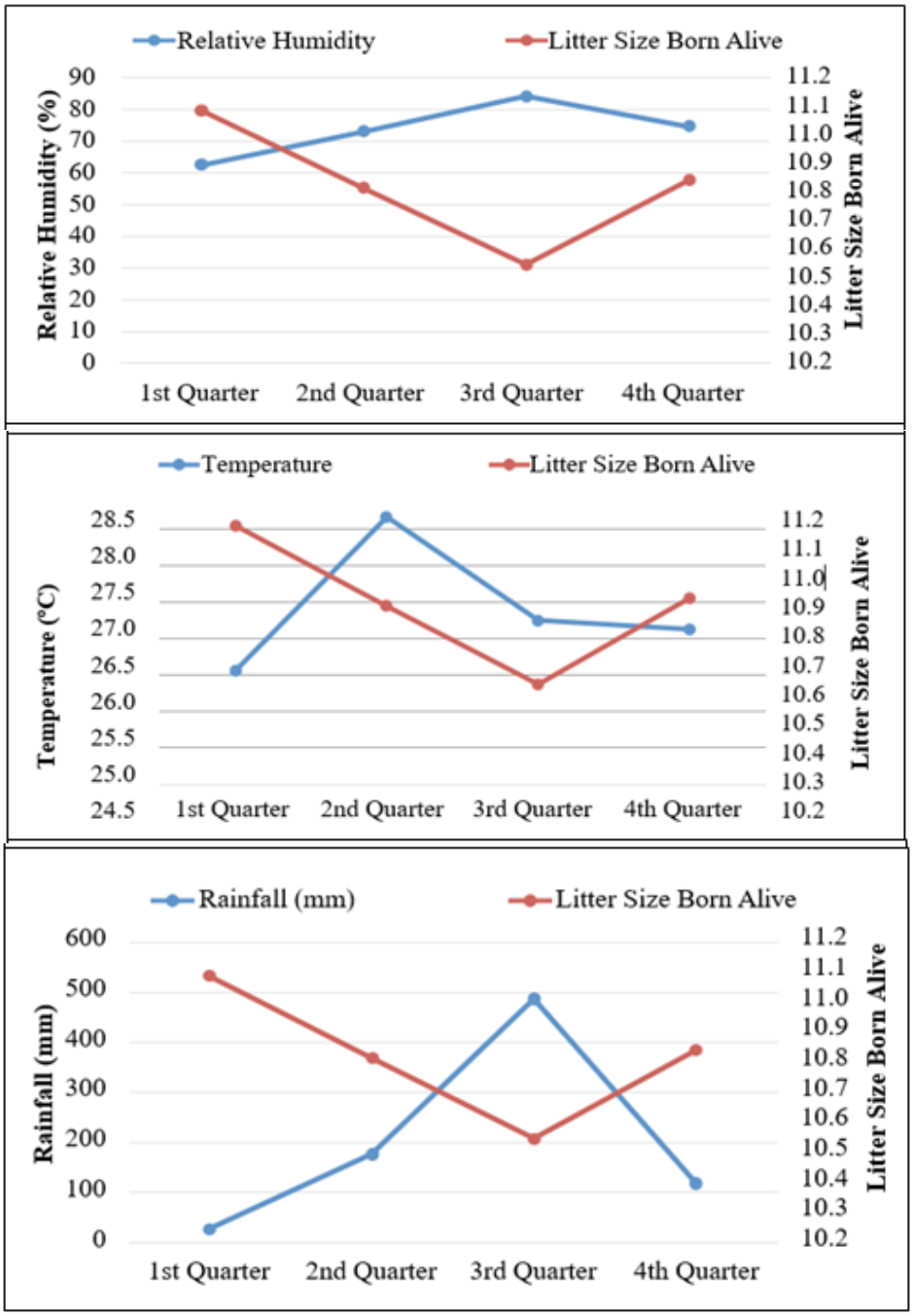

Fig 2:- The relationship of relative humidity, temperature and rainfall with litter size born alive.

The relationship of rainfall to number of piglets born alive is negative all year round. The values obtained ranges from lowly negative to moderately negative. The highest was obtained during the third quarter when the rainfall is highest. As explained earlier, rainfall causes high humidity, which in turn, reduces the animal's ability to cool down their bodies, resulting in more stillbirths and mummified fetuses.

The correlation values obtained between climatic factors and litter size born alive is presented in Table 2.

QUARTER	RH	TEMP	RF
1ST	-0.728	-0.107	-0.235
2ND	-0.564	-0.519	-0.520
3RD	-0.799	-0.180	-0.673
4TH	-0.951	-0.908	-0.140

Table 2:- Relationship of quarterly climatic parameters on Litter Size BornAlive

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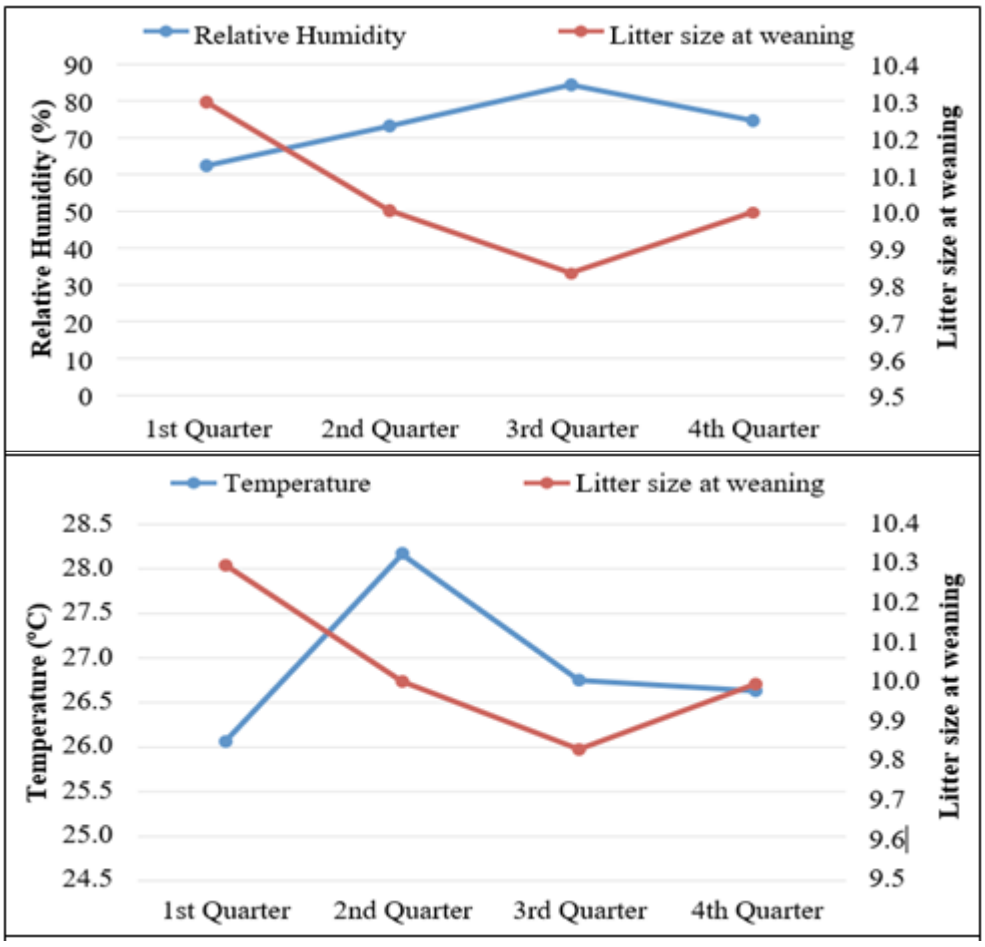
➢ *Relationship of Quarterly Climatic Parameters on Litter Size at Weaning*

Litter size at weaning is the number of piglets weaned after a lactation period. Because eating, digestion, and nutrient absorption all generate heat (the heat increment of feeding), pigs can reduce their metabolic heat production by eating less feed. Thus, voluntary reduction in feed intake by the pig is an effort to lower the heat increment of feeding and thereby decreases the amount of heat that will need to be dissipated into the environment.

Unfortunately, a reduction in feed intake results in reduced growth and, in lactating sows, a reduction in milk production (Myer, R. et al, 2001). Hence, highly negative correlation exists between relative humidity and litter size at weaning. The negative relationship is greatest during the 4th quarter with -0.992 and lowest during the first quarter with -0.832. Relative humidity has been shown in this study to consistently affect reproductive performance negatively. It was found in this study that relationship has been highly negative year-round. Weaning litter size is a function of several factors like piglet survival, milking and mothering ability of the sows. All these factors could have been affected by high relative humidity, resulting in low weaning littersize.

Temperature also has a negative relationship with litter size at weaning. The 2nd and 4th quarters had similar correlation (r) values with -0.812. Negative correlation, on the other hand was lowest during the 1st quarter followed by the 3rd quarter with -0.269 and -0.402, respectively. This exemplifies how high temperature affects sow performance.

Rainfall also had negative relationship with litter size at weaning. From the 1st to 3rd quarter, negative correlation exists between rainfall and litter size at weaning. The 2nd and 3rd quarters had almost similar correlation values with litter size at weaning with - 0.812 and -0.826, respectively. Correlation between rainfall and litter size at weaning only became positive but show a very low relationship during the 4th quarter with 0.050.



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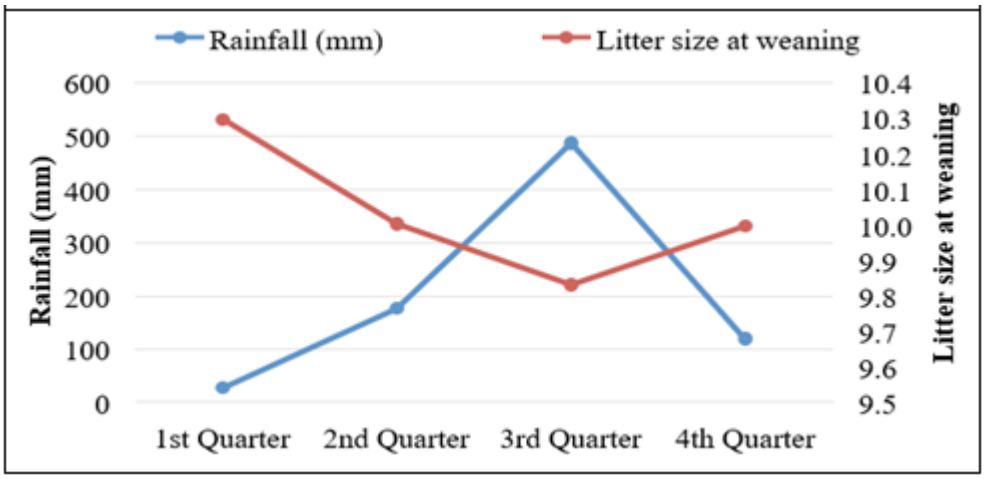


Fig 3:- The relationship of relative humidity, temperature and rainfall with litter size at weaning.

QUARTER	RH	TEMP	RF
1ST	-0.832	-0.269	-0.392
2ND	-0.841	-0.812	-0.812
3RD	-0.917	-0.402	-0.826
4TH	-0.993	-0.812	0.050

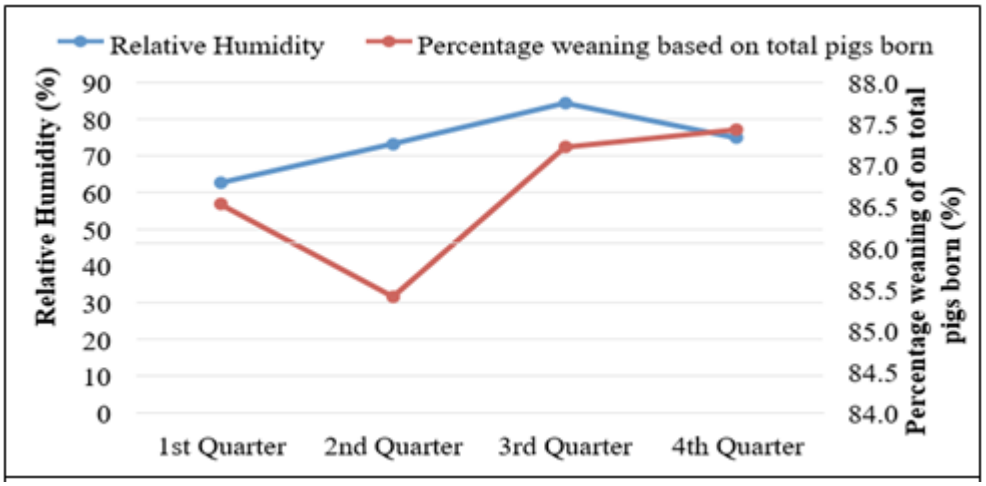
Table 3:- Relationship of quarterly climatic parameters on Litter Size at Weaning

➢ *Relationship of Quarterly Climatic Parameters on Percentage Weaning Based on Total Pigs Born*

Relative humidity posted negative correlation values for the first three quarters, being highest during the 1st quarter with -0.846. The relationship only became moderately to highly positive during the 4th quarter with 0.549.

Temperature also showed the same trend, negative during the first three quarters becoming positive during the 4th quarter. Negative correlation was highest during the second quarter with -0.550 while the highest positive correlation was obtained during the 4th quarter with 0.984.

Rainfall also showed negative correlation for the first 3 quarters, being highest during the 3rd quarter with -0.644. During the 4th quarter, however, an almost perfect positive correlation was obtained with 0.999 between rainfall and percent weaning based on total pigs born.



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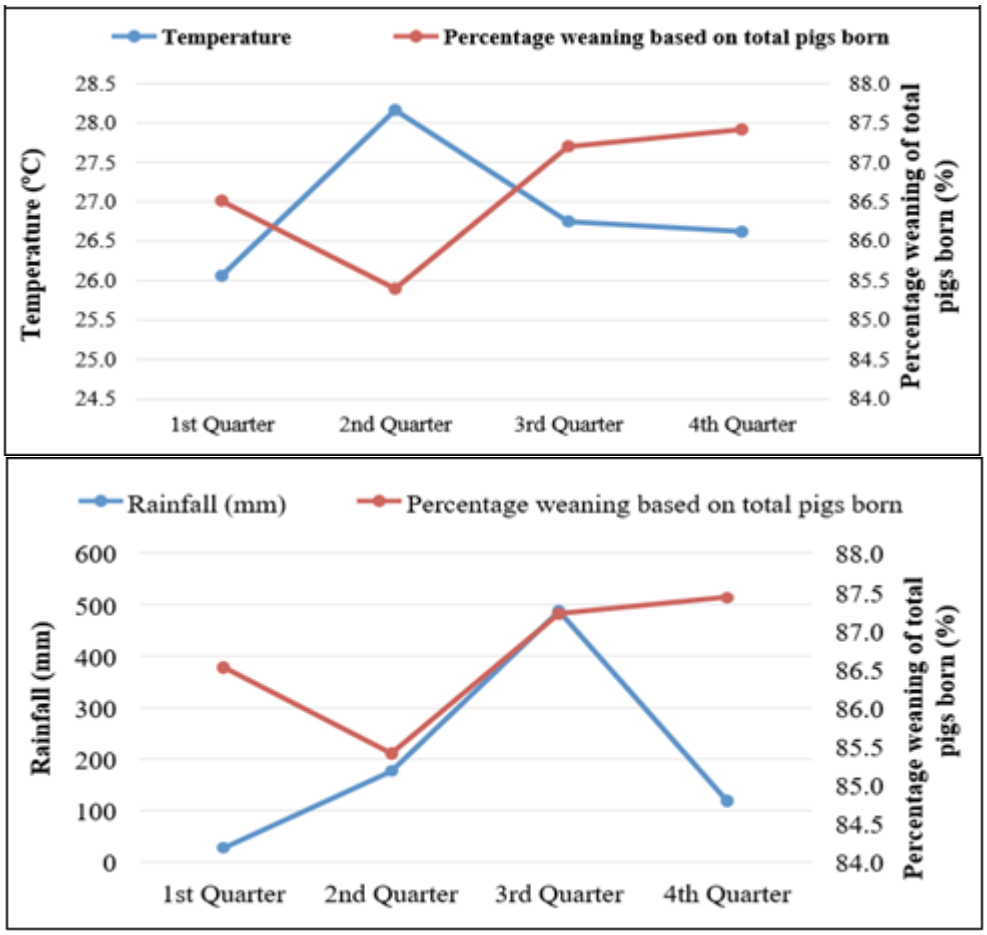

Fig 4:- The relationship of relative humidity, temperature and rainfall with the percentage weaning of total pigs born.

QUARTER	RH	TEMP	RF
1ST	-0.846	-0.296	-0.417
2ND	-0.593	-0.550	-0.551
3RD	-0.776	-0.141	-0.644
4TH	0.549	0.984	0.999

Table 4:- Relationship of quarterly climatic parameters on Percent Weaning Based on Total Pigs Born

IV. CONCLUSION

The correlation between relative humidity with the reproductive performance exists. In terms of swine reproductive performance, high humidity causes the swine's body to become warmer than ideal. Thus, relative humidity showed negative correlations with total pigs born, litter size born alive, litter size at weaning, and percent weaning based on total pigs born in that as relative humidity increases, reproduction parameters decreases.

Likewise, the correlation between temperature with the reproductive parameters of swine is also evident. Temperature showed a highly negative correlation with total pigs born, litter size born alive, litter size at weaning and percent weaning based on total pigs born in that as the temp rises, reproductive performance parameters decreases. High temperature causes heat stress, thus, decreases the reproduction performance.

The results also statistically presented the relationship of rainfall with the reproductive performance of swine. Rainfall showed negative correlation values with Total Pigs Born, Litter Size Born Alive, Litter Size at Weaning and Percent Weaning Based on Total Pigs Born. Rainfall increases humidity and it results to the pig's inability to cool its body because body heat doesn't dissipate quickly during high humidity. This results in discomfort affecting the reproductive performance ofpigs.

Climatic variation on reproductive performance of swine caused by climatic changes exists. There is a rise and decline in production during the different quarters of the year. High humidity alone does not have a direct negative effect in reproduction and production performance. However, high humidity enhances the negative effects of high temperature, promotes discomfort thru heat stress, and lessens the effect of cooling mechanisms. Increase in rainfall affects the increase of relative humidity. High humidity combined with high temperature causes decline in reproduction.

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RECOMMENDATION

Prevention is the most cost-effective approach to seasonal variation caused by climatic changes on swine production. Accurate records are essential to determine the seasonal variations and the severity of the problems caused by changes in climate. Because of evident implications of increase in temperature and relative humidity, cooling techniques will help decrease the negative effects of this climatic variation that could affect the total performance of the animals.

Swine must have access to large quantities of water during periods of high environmental temperatures. Also, water flush waste removal system can be designed so that pigs can wet themselves during warm periods. Water sprinkler systems are also quite effective for wet-skin cooling. Under conditions of heat stress, it is desirable to increase the minimum floor space allowed for pigs, in particular for larger pigs. The number of pigs per pen should also be reduced. More nutrient-dense diet will help to minimize production losses due to the high temperatures since pigs will decrease their feed intake at high environmental temperatures.

For additional recommendations, proper stocking and maintenance of feeds is also important in minimizing decrease in production during climatic change extremes. Heat and moist promotes mold growths in feeds that then lessen its efficacy.

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