Artificial Intelligence as a Source of Economic Success for Small Broiler Producers

Aloísio Alkmim de Oliveira Filho

Computer Science Department– Universidade de Salvador (UNIFACS)

Salvador, Ba - Brasil - aloisioalkmim@outlook.com

Abstract.*The Brazilian poultry industry is one of the main sectors of agribusiness, being a strong sector in the South and Southeast regions, while in the North and Northeast the sector has not developed as much as the other regions. And one justification for this is the lack of technical assistance for producers in these regions. Thus, this work was justified to offer technical assistance to small poultry producers who carried out artificial incubation, through a chatbot. The result of using the chatbot was positive, since the producers had an increase in their production and a reduction in costs and inputs.*

1. Introduction

The Brazilian poultry industry is one of the main agribusiness sectors in the country, which produces more than 13 million tons of chicken meat per year. It is a sector that has developed more expressively in the South and Southeast regions, while other regions, such as the North and Northeast, despite having development potential, face a lack of rural extension activities to help small producers. We know that in Brazil rural technical assistance is difficult to access in many regions, as is the case in the North and Northeast. As small family farmers are the most affected, unfortunately there is no prospect of change in the short term, because government assistance has been decreasing or no longer exists, as seen in the state of Bahia (Canal Rural, 2015). Since many cannot afford to pay a professional technician to assist them, they are held hostage by the technical assistance offered by the government, which often does not meet the family farmer's needs (IBGE 2017).

Technological advances have allowed the creation of new intelligent and autonomous systems, as is the case of the chatbot, being a software capable of communicating with the user by means of natural language. ELIZA was the first autonomous conversational agent, emulating a psychotherapist (Weizenbaum 1966). The application of a chatbot today is very diverse, being found in e-commerce, educational support, customer service, among other applications. A fact that we must take into account today is the popularization of smartphones, being one of the main means of access to the internet in Brazil and consequently one of the largest sources of

knowledge (IBGE 2017). Making this data more relevant is the democratization of the internet in rural areas, between 2006 and 2017 there was an increase of 1900% of internet points in rural areas (IBGE 2017). This facilitates the adoption of new technologies for this sector.

The Brazilian poultry industry is one of the main agribusiness sectors in the country, growing expressively, generating employment and producing quality protein at low cost to the population. For Brazilians to consume quality chicken, the proper process of artificial incubation is crucial, that is, it is during incubation that embryonic development occurs, and thus failures in this period can cause hatching of low quality chicks, which will have impaired performance when reared. Therefore, this segment of animal production needs specialized professionals to assist the producer in issues such as egg handling, incubator technology, animal welfare, sanity, among others. However, many of the small producers who perform artificial incubation of eggs on their property are unaware of this issue. Thus there is a lower productivity and consequently higher production costs, because the bird will take longer to develop, thus delaying the economic return to the producer and with it a feeling of failure of the poultry activity performed by the family farmer. Thus the family farmer loses his space in local commerce to the large agribusiness industry, causing a very serious social problem.

Given these factors, the objective of this work was to follow the use of an experimental chatbot as a form of technical assistance for artificial egg incubation and to follow the success of production after using it.

2. Theoretical Referential

2.1. Artificial Incubation

Artificial incubation is considered a very old practice, with evidence of its origin in the 4th century B.C. when the Egyptians were incubating eggs on a large scale. Besides the Egyptians, the practice of artificial incubation was also perfected by the Chinese (Sales, 2005). According to Santana et al., (2014), the artificial incubation of fertile eggs is the basis of the entire production chain of poultry, because it conceives the product to be exploited in the field and its results can compromise the entire system and its profitability. As well as the pre-incubation management until the hatching of these eggs interferes with the results of the chick produced. Artificial incubation is the reception of fertile eggs, and these eggs are offered ideal conditions for embryo development, such as ventilation, temperature, turning and humidity.

Eyal-Giladi and Kochav (1976) reported that the development of the embryo begins in the reproductive tract of the chicken, after fertilization of the egg. High cell multiplication and differentiation occurs in the isthmus region, reaching the blastoderm point during the oviposition period, when the embryo is in the pregastrula or early gastrulation stages (Gonzales, 2005). If after laying the egg is stored at low temperatures (below 21ºC), the embryo partially stops its development, remaining in a state of "dormancy" (Schmidt et al., 2002). The embryonic development process continues, if there are the ideal incubation conditions (adequate temperature, humidity, ventilation and turning), and lasts for approximately 21 days (Barbosa, 2011).

Temperature, relative humidity, ventilation and turning are the physical factors governing artificial egg incubation (Barbosa, 2011). Embryo temperature is considered

the most relevant physical factor for successful incubation, as it dictates the rate of embryo development and proportional organ growth (Hulet, 2007). The embryonic temperature considered optimal is 37.8°C and depends on 14 three main factors: machine temperature, metabolic heat production and heat dissipation by the embryo (Meijerhof, 1999). Thus, Gladys et al. (2000) stressed the need to carefully control the heat production of eggs, since high temperatures can cause low hatchability, problems related to the organs, especially the heart, and poor chick quality.

Another important factor is the control of relative humidity, because values above or below recommended compromise embryo development, prevent the correct formation of the air chamber, and may cause mortality due to lack or excess of egg weight loss, which should be approximately 12% during incubation (Robertson, 1961). According to Boleli (2003), the relative humidity range that should be used during incubation is between 50 and 60%, and these values are recommended for the Cobb® and Aviagen® strains.

Ventilation provides fresh air and controls CO2 levels in incubators and hatchers. Gas exchange also influences embryonic development, since embryo growth is related to obtaining oxygen from the external environment and releasing carbon dioxide from within the egg. This metabolic flow of gases is limited by the diameter and amount of pores in the eggshell, as well as the thickness of the eggshell. If there is not adequate ventilation, the egg atmosphere becomes excessively enveloped by CO2, hindering the passage of oxygen into the egg, and causing a toxic environment for the embryo (Calil. 2007). Thus, inadequate ventilation in the machines can cause less oxygenation and produce an embryo with a deficient cardiopulmonary system (Coleman and Coleman, 1991).

Egg turning is naturally performed by the hen when hatching her eggs and incubation systems attempt to simulate what occurs in nature to obtain better hatching rates (Tona et al., 2003). The main purpose of turning eggs is to prevent the embryo from adhering to the shell membranes, to facilitate the growth of the vascular network, and to prevent malformations and/or malpositions (Wilson 1991). It is indicated to perform 24 turning per day, that is, one turning per hour, at a 45° angle (Neves, 2005). Barbosa et al. (2013) demonstrated that at 15 days turning can be discontinued without harming incubation performance, however, in industrial hatcheries, turning occurs until the eggs are transferred from the setter to the hatcher, between 18 and 19 days of incubation.

2.2. Rural Technical Assistance in Brazil

Historically the term rural extension began in the 19th century, with the extensions practiced by English universities. In the 20th century, the United States created the cooperative rural extension service, bringing together several universities and consolidating the term (Jones and Garfoth, 1997). Rural extension means taking or transmitting knowledge from its generating source to the rural public, having a broader sense as the educational process of communication (PEIXOTO, 2008). This work of taking knowledge to small producers has a very significant role, because it offers to the rural public a perspective of future, both for the producer and his family, and thus, consequently, reduces the rural exodus in search of improvements in the quality of life.

According to Stantill and Paine (2000), rural extension is a service or system that assists rural people with educational procedures to improve farming methods and techniques, increasing efficiency in production and income, improving their living standards, and raising the social and educational standards of rural life. Thus the rural extension agent is a facilitator between the rural producer, and may be the private sector, NGOs, government programs, and other sectors. The federal government suggested, already in the 19th century, some actions related to rural extension, although very simple or included in other policies. As an example, some Sicon records revealed that between 1859 and 1960 four imperial agricultural institutes were conceived, which had their main focus on agricultural research and knowledge dissemination. According to IPEA (2021), rural extension in Brazil was emphatically introduced in the 1970s, the period of the green revolution, and offers conditions for producers to adopt new technologies. However, even being a traditionally agrarian country, only 20.2% of agricultural establishments in the country received some kind of technical guidance in 2017.

The IBGE in its 2017 agricultural census showed that national agricultural establishments received about 37.8% of government technical guidance, 30.9% of the producers' own assistance (when they hire a technician to perform the activity), 24.5% received technical guidance from cooperatives, and 13.2% from integrating companies. IPEA (2021) highlights the cooperatives located in the South region, which represented 37.4% of the technical assistance in this region, showing how the cooperative segment is strong and larger than that provided by public agencies. In the Center-West, the largest type of technical assistance was provided by hiring the technician by the rural establishment itself, showing the greater economic power of the establishments. This characteristic is also seen in the properties in the Southeast, where the assistance hired by the establishment itself represented 41.5%, and the governmental one, 32%.

In 2017, among the 20% of rural establishments that received some type of technical assistance in Brazil, only 8.2% were located in the Northeast region, while 48% of them were located in the South region. Of the federative units that make up the Northeast region, only two were more expressive, being Paraíba (17.3%) and Rio Grande do Norte (16.1%). The state of Bahia represented 7.7% of rural establishments received some assistance (IPEA, 2021). According to IBGE (2017), Bahia was the only region where technical assistance had a greater government contribution than the others (60%) and 23.5% came from the producer himself. For Santos and Barbosa (2019), the agricultural sector in the country has been following the dynamics that occur in productive sectors. As in other areas, technological innovation has become increasingly relevant. For Peixoto (2008) technical assistance and rural extension have fundamental importance in the process of communicating new technologies, generated by research, and diverse knowledge, essential to rural development in the broad sense and, specifically, to the development of farming, forestry, and fishing activities. However, it should be easily accessible to all regions of the country, including small, medium and large producers.

2.3. Chatbot

In 1965 the first conversational agent was created at MIT (Massachusetts Institute of Technology), called ELIZA, which was part of scientist Joseph Weizenbaum's

DOCTOR project. ELIZA had the objective of stimulating the user to reflect about his life. According to Pimentel (2002) chatbots have existed for a long time, since the 1960's, but they became popular in the 1990's because the internet contributed to a greater interaction, and since then, this system has been used more and more frequently. The term "chatbot" comes from the junction of two English words, Chat (Conversation) Bot (Robot). So the "chatbot" is a system that consists of performing the human / computer interaction through natural language. According to Gomes (2017) the use of this technology represents significant changes in society and, for Carrera & Krüger (2020), the presence of artificial intelligence software such as chatbots, with varying degrees of autonomy and purposes, symbolizes the breakdown of the essentiality of human presence in networks.

As we can see, the chatbot aims to meet a demand for service, through interaction with the user in relation to the questions he has. In the case of the developed chatbot there is no intention of removing the field technician, but to offer support to those who cannot afford to receive a technician to assist them. Knowing that the North and Northeast regions have lower chicken production when compared to the South and Southeast (ABPA 2020), and that in these areas the technical assistance is precarious (IPEA 2021), this tool comes as a promoter of the activity, thus increasing the productive level in these regions.

3. Methodology

A pre-existing chatbot was used, which was developed to clarify the doubts of producers in the area of artificial incubation. It has the characteristic of being simple to understand, so that family farmers can assimilate the treated subject in the best possible way, by sending images and recommending YouTube® videos to facilitate the rural producer's understanding. To assess whether it is possible to perform technical assistance through the chatbot, we sent the access link to the chatbot to a total of 20 family farmers, 10 producers perform the poultry farming activity together with artificial incubation, and 10 family farmers do not perform this activity. All these farmers did not have any kind of rural technical support, however they knew how to use messaging applications, had their own smartphone, and had a 4G internet connection on the property. The system was sent to farmers who did not perform this activity in order to understand if its use allowed the producer self-perception conditions for entering the poultry activity.

It was informed to these producers that any doubt they had about incubation should go directly to the chatbot, and at the end of a 66-day period a form with some questions would be sent. This interval of 66 days refers to the complete cycle of poultry production, being 21 days of incubation and 45 days of fattening. Two types of questionnaires were sent, one to the producers who carry out poultry farming activities together with incubation, and another questionnaire to those who do not carry out poultry farming activities.

4. Results and Discussion

We had 20 producers, 10 male and 10 female, all with high school education and aged between 35 and 50 years old. All had their own smartphone and an average salary of 4

minimum wages per family, and all had a good acceptance when using the chatbot. These small producers reside in the state of Bahia, a growing pole of the activity.

In relation to the first block of questions we had positive data, showing that small rural producers are becoming increasingly familiar with this type of system, not getting big noises. The first question regarding the ease of using the system, 100% of the producers said it was easy, showing that it is an easy system to use. The second question, if the interaction was friendly, 70% said yes, this is due to the bot construction, since we were concerned in leaving the most "human" environment possible, so the system asked the user if he was well and showed happiness to those who said they were well and concern to those who said they were not. Now, if the interaction clarified the doubt of the producer, we had the same percentage of the last question, showing that it has a good database, and in relation to the 30% that answered no, we will investigate what happened and what was asked by the user. If the answers were coherent, 90% of the producers said yes, showing that the bot was well trained. And once again all the producers had interest in passing this technology forward, so we can see that it was something that offered technical support and quality and easy to understand for small producers.

In the second block, for producers, we had another very positive result, 80% of the producers applied what was said by the chatbot in the incubation, and this result is linked to the seventh question, which was whether the producer realized an increase in the number of hatchlings, and eight out of ten producers realized that there was a higher number of hatchlings in relation to the incubations that were performed before the use of the chatbot. In the eighth question, if there were savings in the production phase, 60% of the producers said yes, and in the last question of this block, the ninth question, if there was a greater profit in relation to production in the past, 70% said yes. Thus, we can see how good incubation favors the entire production system, since this period is essential for the bird's development, especially up to the sixteenth day of incubation, because up to this period the internal organs are being formed. Thus a correct incubation favors the development of the bird in the field, reducing production costs and increasing feed conversion, thus offering a quality product to consumers. Continuing in the second block, more for those who did not perform the activity but had the desire to participate in the poultry production chain, the questions were directed to whether the system had the ability to enlighten the producer in basic aspects of production.

The sixth question asked if they intended to carry out the activity after using the chatbot, 60% said yes, and this data is interesting because 8 out of 10 producers found the activity profitable. In the eighth question, 100% of the producers realized the importance of a good incubation. With these results we can observe that these producers saw that a correct incubation is the key to success in poultry production. As it has a great development this bird will not need many resources in its productive phase, generating economy and not wasting resources in production, also favoring a more environmentally sustainable production. In the last question for non-producers, 7 out of 10 answered yes, so the chatbot once again fulfills its extensionist role, showing that with the monitoring there is profit generation. In the tenth question, if they could choose to have a technical professional or to continue using the system, 65% said they would rather have a professional in person than use an artificial intelligence. However, 7 out of

the 20 producers said that they continued using the system, and 4 out of these 7 were poultry farmers and noticed the difference in the improvement of production.

5. Conclusion and Future Works

Thus, we can see that the chatbot performs its role of quality rural extension in poultry farming, and that its use can generate gains for producers who often do not have access to quality technical assistance. And thus change their relationship with the rural environment, offering them and their families a perspective of a future in the field. But as it was seen by the producers, there is a need for an on-site technician, because for some producers just using the system does not generate a satisfactory trust, especially for those who had the first contact with the system and have not seen the results of its use. Thus, the chatbot is a tool for extension without excluding the technical professional. And as future work we intend to extend this type of system to all poultry production, and other areas of animal production, since we have an audience in rural areas to use new technologies.

References

ABPA. Relatório Anual 2020. São Paulo: 12/05/2020, 159p.

BARBOSA, V. M. Desenvolvimento embrionário. In Barbosa, V. M. Fisiologia da incubação e desenvolvimento embrionário. 1aed., Belo Horizonte: FEP - MVZ, 2011. 124p cap. 5 p. 85-124.

BARBOSA, V. M.; ROCHA, J. S. R.; BAIÃO, N. C.; MENDES, P. M. M.; POMPEU, M. A.; LARA, L. J. C.; MIRANDA, D. J. A.; CARVALHO, G. B.; CARDOSO, D. M.; D. L.; CUNHA, C. E.; MARTINS, N. R. S e LEITE, R. C. Efeitos do momento de transferência dos ovos para o nascedouro e da idade da matriz pesada sobre o rendimento de incubação. Arquivo Brasileiro de Medicina Veterinária e Zootecnia, v.65, n.6, p.1823-1830, 2013.

BOLELI, I.C. Estresse, mortalidade e malformações embrionárias. In: MACARI, M.;GONZALES, E. Manejo da incubação. 3ed. Campinas: FACTA, 2013. Cap. 4.4, p. 394-434.

CALIL, T.A.C. Princípios básicos de incubação. In: CONFERÊNCIA APINCO DE CIÊNCIA E TECNOLOGIA AVÍCOLAS, 2007. Santos, Anais... Santos: FACTA, 2007.

COLEMAN, M.A.; COLEMAN, G.E. Ascites Control Through Proper Hatchery Management. World Poultry Science. v.7, p.33-35, 1991.

Canal Rural: Liminar obriga Bahia a reintegrar demitidos da EBDA. 2015. https://www.canalrural.com.br/noticias/liminar-obriga-bahia-reintegrar-demitidos-ebda-56345/

EYAL-GILADI, H.; KOCHAV, S. From cleavage to primitive streak formation: Acomplementary normal table and a new look at the first stages of the development of the chick. General morphology developmental biology v.49, p.321-337. 1976.

GLADYS, G. E.; HILL, D.; MEIJERHOF, R.; SALEH, T.M.; HULET, R.M. Effect of Embryo Temperature and Age of Breeder Flock on Broiler Post-hatch Performance. Poultry Science. v.79, p.123, 2000.

GONZALES, E. Análise de problemas de eclodibilidade e fertilidade de plantéis avícolas por métodos de embriodiagnóstico. In: X Congresso Nacional de Zootecnia – Zootec. Anais Eletrônicos... [online]. Campo Grande, 2005. Disponível em:<http://www.abz.org.br/files.php?file=documentos/Elisabeth_910013612>

HULET, R.M. Symposium: managinh the embryo for performance. Managing incubation: whereare we and why? Poultry Science. v.86, p.1017–1019, 2007.

IPEA. AGRICULTURA NORDESTINA: ANÁLISE COMPARATIVA ENTRE OS CENSOS AGROPECUÁRIOS DE 2006 E 2017. Texto para discussão. no 2675 Rio de

Janeiro, julho de 2021.

IBGE: Censo Agropecuário 2017. https://sidra.ibge.gov.br. 2017. <https://www.ibge.gov.br/estatisticas/economicas/agricultura-e-pecuaria/2017-np-censo-agropecuario/21814-2017-censo-agropecuario.html>

NEVES, A. C. R. S. Maximização do Fluxo Operacional em Incubatório Comerciais. In: VII Simpósio Goiano de Avicultura e II Simpósio Goiano de 34 Suinocultura - Avesui Centro-Oeste Anais eletrônicos... [online]. Goiânia, 2005. http://www.cnpsa.embrapa.br/downphp?tipo=publicações&cod_ publicacao=497.

PEIXOTO, M. EXTENSÃO RURAL NO BRASIL –UMA ABORDAGEM HISTÓRICA DA LEGISLAÇÃO, Textos para discussão, Brasília, Nº 48, outubro2008.

PIMENTEL, M. G. Hiperdiálogo: Ferramenta de bate-papo para diminuir a perda de contexto. 2002. 192 f. Dissertação (Mestrado em informática), NCE/IM, Universidade Federal do Rio de Janeiro, Rio de Janeiro, 2002.

ROBERTSON, I. S. Studies in the Effect of Humidity on the Hatchability of Hen's Eggs. I. The Determination of Optimum Humidity for Incubation. Journal of Agricultural Science. v.57, p.185-194, 1961.

SALES, M. N. G. Criação de galinhas em sistemas agroecológicos. Vitória: Incaper, p.284, 2005.

SANTANA, M. H. M; GIVISIEZ, P. E. N.; FIGUEIREDO JUNIOR, J. P.; SANTOS, E. G. Incubação: principais parâmetros que interferem no desenvolvimento embrionário de aves. Revista eletrônica nutritime. Artigo 245 - Volume 11 - Número 02 – p. 3387– 3398 – Março/Abril 2014

SCHMIDT, G. S.; FIGUEIREDO, E. A. P.; ÁVILA, V. S. Incubação: Estocagem dos Ovos Férteis. Comunicado Técnico Embrapa, n.303, Embrapa Suínos e Aves, 2002.

STANTIALL, John; PAINE, Mark. Agricultural Extension in New Zealand – Implications for Australia. Australasia Pacific Extension Network – APEN 2000 National Forum, Melbourne, 26th & 27th Oct. 2000, ISBN 1 920842 10 1, 10p

TONA, K.; ONAGBESAN, O.; DE KETELAERE, B.; DECUYPERE, E.; BRUGGEMAN, V. Effects of Turning Duration During Incubation on Corticosterone and Thyroid Hormone Levels, Gas Pressures in Air Cell, Chick Quality and Juvenile Growth. Poultry Science. v.82, p.1974–1979, 2003.

JONES, Gwyn E. & GARFORTH, Chris. “The history, development, and future ofagriculturalextension”, in Swanson, Burton E., Bentz, Robert P. andSofranko, Andrew J. (eds.). Improvingagriculturalextension -A reference manual. Rome: Food andAgricultureOrganizationofthe United Nations, 1997, 316 p.

Gomes, C. (2017). Chatbot: entenda tudo sobre o assunto. Recuperado de http://blog. simply.com.br/chatbot/