



الجمهورية الجزائرية الديمقراطية الشعبية  
People's Democratic Republic of Algeria  
وزارة التعليم العالي و البحث العلمي  
Ministry of Higher Education and Scientific Research  
جامعة الشهيد - حمه لخضر - الوادي  
University of Echahid Hamma Lakhdar - El Oued



Faculty of Technology

كلية: التكنولوجيا

Direct use of geothermal energy in poultry farming via heat exchanger		عنوان المشروع
الامن الطاقوي		المحور
جامعة الوادي	عطية عبد المالك	رئيس المشروع
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جامعة الشارقة	شوقي غناي	أعضاء المشروع
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مؤسسة عويمر فلاحة	بقاط فاتح	

## 1. State of the art

Recent developments in the field of agriculture have led to a renewed interest for the poultry farming. The national Algerian production of poultry meat has experienced a considerable evolution in recent years according to statistics of the Agriculture and Rural Development Ministry. It was reached 5.6 million quintals (Mqt) in 2019, vs 2.092 Mqt in 2009, which presents an increase of 167%.

With the expansion of the practice of this field and due to poultry farming being located in isolated area, the consumption of different energy sources is increasing because of its importance in the management of the zootechnic indicators, the role of which is to maintain animal health, welfare, and allowing it to perform and grow well. These energy sources are used for heating in winter, cooling in summer, ventilation system lighting and for automatic feeding systems in the poultry farming.



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One of the greatest challenges faced by many breeders is the increasing use of natural gas or diesel for heating and water for cooling system. The actual used system is too costly due to high energy and water consumption, in which it needs nearly to 6-14 gas bottles of LPG-B13 or 200 L of diesel per day for heating in winter and about 5000 L of water per day for cooling in summer season for one poultry house. The integration of more efficient energy systems and the use of renewable and local energy resources will help to provide the energy demand in the farm for sustainable poultry development.

## 2. Motivation

The ground in the southern regions of Algeria contains very important and easy exploited geothermal energy. In which, the temperature is considered constant in the range of 26-24°C after a depth of 3 m from the surface of the earth meanwhile the ambient temperature drops to 0°C in winter and rises to 50°C in summer. The difference in temperature between the ground and the atmosphere can be exploited in the field of air conditioning in poultry farming via geothermal heat exchangers.

The advantages of geothermal energy systems are: (1) can be used for both heating in winter and cooling in summer; (2) decarbonization of the farm: zero carbon emissions; (3) scalable for large system; and (4) reduce the cost of energy by 50-70% (low capital cost and eliminate the fuel cost). Moreover, the low solidity of El Oued soil (sand) leads to easy exploitation of geothermal energy via vertical heat exchanger, in which we have been realized and experimented it in El Oued climate region through a series of master and doctoral thesis.

Also, our group is formed from Assistant professors and PhD students assisted by veterinary doctor from AOUIMER FILAHA Company that specialized in poultry industrial fattening. This company provided us a standard poultry house (80 m length /8 m width /2.5 m height); to validate its mostly heating and cooling loads required for chicken fattening using geothermal heat exchanger.



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Finally, our group has issued two DZ Patents about geothermal energy use from Algerian National Institute of Industrial Property.

### 3. Methodology

This project aims to utilize the geothermal energy for meeting most of the energy demand in terms of heating and cooling for a standard poultry house located in EL Oued region. With this purpose, the thermal load of the poultry house as well as the maximum supply loads from the geothermal site should be calculated to identify the number of geothermal heat exchangers to be installed.

As horizontal geothermal heat exchangers need a large area around the poultry houses, we designed a geometry that consists of a helicoid shape to reduce the area of installation in one side, and ensures an improvement regarding to system performances. This system contains two main parts: helical ground heat exchanger made from flexible pipe of PVC material and borehole. Due to the poor soil solidity in the region, the borehole was made by reinforced concrete. The geothermal heat exchanger will be inserted into the borehole and embedded after 3 m depth from the surface level. The geothermal energy is directly exploited by pumping ambient air by a solar-powered air pump into the heat exchanger. With the passage of air in the tube, heat exchange takes place between the air and the ground. Then, the air is pumped into the poultry house for indoor conditioning.

Moreover, the electricity need for the ventilation system and lighting of the poultry house should also be estimated and the capacity and number of photovoltaic solar panels to be installed should be determined to meet mostly electricity demand. All these calculations will be done in collaboration with engineers and veterinary doctors of AOUIER FILAHA Company.

There are two types of fuels commonly used in boilers for heating, LPG and diesel. To find the amount saving by the proposed system which happens to suffice all the needs of the poultry house, a detailed calculation on the energy use of the poultry house should be



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done. Within this context, some data has to be gathered about the location and the indoor conditions of the house as well as the specification of the house itself.

As good health and welfare of broiler is depending on excellent management of temperature, ventilation and lighting, an automatic and efficient system in the poultry house should be installed to control and register all the requested parameters. Moreover, the impact of geothermal energy on good health and growing of broiler will be followed continually by the veterinary doctor.