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Solar drying and agribusiness

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ABSTRACT: *Agribusinesses are the livelihoods of rural populations, but when production increase, many products are damaged and lose their commercial value due to lack of conservation treatments at a local level. Agricultural production represents the foundation of economic development of the province of Manabi. A significant level of agricultural products is lost due to lack of conservation technologies. Solar drying is a way of conserving by dehydration of some products such as: vegetables, fruits, aromatic and medicinal plants. This can be achieved by a process of proper conservation that is conducive to reduce losses using technologies easy to build, as are the different types of solar dryers which are already used in different parts of the South American region. This article proposes to introduce solar-drying technology in agricultural areas of the province of Manabi. And thereby achieve the regaining of different products that today are lost, incorporating new and attractive, marketable lines based on agricultural products naturally dehydrated with a high nutritionalvalue, capable of contributing to human health not only in the province but also in the country.*

Keywords : *agribusiness, agricultural products, conservation, solar-drying.*

I. INTRODUCTION

To achieve the sustainable development of productive matrix in Ecuador has worked in pursuit to take advantage and preserve all products of the agricultural sector which are harvested. One of the problems at the field is that a significant level of agricultural products loses their commercial value before reaching the market, as a result bringing economic losses for producers, affecting at the same time the economy of the province and the country. Some losses take place by a defective handling and storage of the product; but others are caused by failing to implement appropriate preservation technologies where the climatic situation plays an important role.
Producers can define the inventory of products that require to be preserved through a process of natural dehydration and determine at what point may be carried to the market for its marketing, Dehydration can be performed manually using ancient techniques or implementing technologies that are easy to apply by means of resources that are next to the harvest areas.The use of modern technologies for drying can reduce the difficulties of the drying of agricultural products with heating systems based on the use of conventional sources or fuelwood dryers which in the end become real predators of wooded areas.

There are proven technologies which have been used for drying since ancient times, as it is the use of the Sun for drying different products by natural means. In Mexico different studies have been developed which shows that the dehydration and preservation of agricultural products help to improve the quality and efficiency of the agribusiness, a practical example is the drying of corn and its seed [1]. In Paraguay, a solar drying guide published in 2005 by developing various models of solar dryers of different sizes and designs which allow processing semi-industrial quantities for primary producers interested in marketing dehydrated products [2].In Ecuador there are different products that have traditionally been sun-dried as cocoa, coffee, cassava flour among others [3]. Currently it is working with the aim of improving product quality obtained.In Ecuador the province of Manabi is a region with the best potential of solar energy. This advantage allows to achieve better energetic qualities, and implement intensive drying of agricultural products in the area promoting agribusiness in the territory by supporting the strategy of improving the productive matrix.

The objective of the research is focused on providing the energy characteristics of solar potential in the province, so that encourages its use as a source of energy in the drying of agricultural products, with the objective of diversifying and increasing production and the quality of the product in the towns of the province of Manabi where currently a great number of products are wasted by not having the technologies for proper conservation and commercialization.

II. MATERIALS AND METHODS

The databases used for the study were drawn from different sources: the mapping of the province of Manabi was obtained from the information published on the website of the Military Geographical Institute (MGI) [4] with free access, the solar radiation information was obtained from the database published by NASA [5], and also the methodology used for predicting energy resources worldwide (POWER) Agroclimatology [6]. A literature search relating to solar dryers that could be used for different agricultural products which improve their conservation, was performed. Also an analysis of the products that can be dehydrated in the territory of the province was conducted.

III. ANALYSIS AND DISCUSSION OF RESULTS

Almost half of the world's population is engaged in some activities linked to agriculture, although its distribution can be very variable. In Africa and Asia over 60% of the population; in the United States and Canada only 5%. In South America the population engaged in these activities is almost a quarter; Western Europe results to be about 7%; and the countries of the Russian Federation and other countries which belong to the former Soviet Union reaches 15%. However, it is clear that resident populations in agricultural areas, are the ones which concentrated most social marginality and the highest rates of poverty, poor health and illiteracy with special emphasis in some countries of South America [7].

Agricultural production in the province of Manabi is similar to those of countries with a tropical climate; the production of fine cocoa aroma, bananas and cotton are distinguished. Among the rice grains, corn, beans, peanuts and coffee. Among the tubers stands cassava and sweet potato. Among the fruit production stands melon, watermelon, orange, cucumber, pineapple, papaya and mango. Among vegetables stand tomato, cabbage, carrot, cucumber, red peppers and cabbage. Among the species can be pointed onion, garlic, chives and other herbs.The recognized coffee regions are: Jipijapa, Paján, Santa-Ana, 24 de Mayo and Junín. Cocoa growing areas are: Chone, Bolívar, Junín and the mountainous area of Sucre. Cotton is grown in Portoviejo and Rocafuerte. Manabí province distinguishes nationally as the first in coffee production (production and cultivated area), the same happens in banana production and ranks second in the production of dry hard corn [8]. The behavior of solar radiation in the province of Manabi behaves as shown in Fig. 1, their values fluctuate with an annual average between 4.1 and 5.2 kWh/m2day, these are suitable for the introduction of drying technologies for dehydration of products, such as those harvested and marketed in the territory.

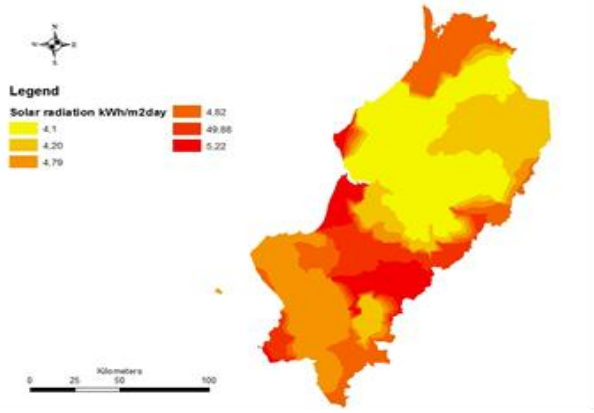

Figure 1. Behavior of the solar radiation

If it is known that the territory corresponds to a region with high production of agriculture, which can assess the performance of different technologies of solar drying, they can be introduced and give producers a viable option of product conservation. At the same time this will allow to diversify marketable supply with a greater use of crops. It must be added that the cost of drying is low because fuel consumption is virtually zero. Costa Rica, where different solar drying technologies are used, has a vast experience in solar drying of different products. [9],This country has achieved the decrease of fossil fuel use in the technological process, besides it has achieved the construction of technologies that are installed in rural sites where the crops are grown and this advantage reduces the need for transportation and handling of products.

Costa Rican farmers have tried different products such as: grains (rice, corn, beans, peanuts, coffee); tubers (potatoes, cassava, yams); vegetables (pea, onion, leaf vegetables, tomato, cabbage, carrot, garlic, chili); fruit (peach, apple, banana, guava, mango, grapes, sugar apple); other products such as fish (unsalted and salted). In all cases they possess the technology for drying by the use of renewable sources, in Fig. 2 is shown a prototype that can be built on the site of the harvest with the advantage of using locally sourced materials in its construction.

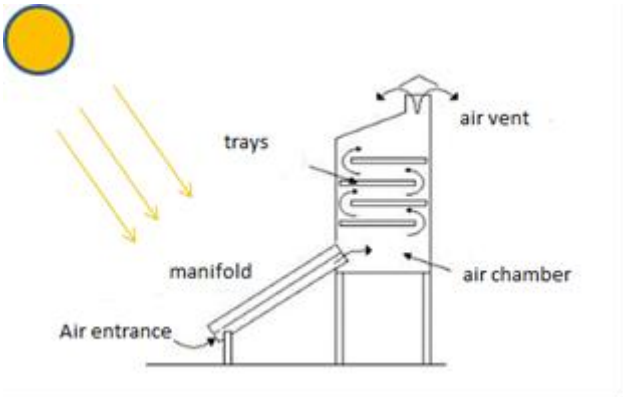

Figure 2. Solar dryer prototype

The technology shown above corresponds to an indirect dryer, because the products are placed on trays and the product is dried with heated air by the collector [10].The advantages of implementing this type of drying are the simple technical process, and the low cost of implementation. This does not require skilled labor; besides it uses an inexhaustible fuel with a virtual cost equal to zero and it is sustainable affordable for rural and low income.There is also the technology of direct solar drying,where products directly receive solar radiation. In this type of dryer the collector and the chamber can be together and the chamber containing the product also serves as the collector.so it receives the solar radiation directly. In direct solar dryers, solar radiation is absorbed by the product itself, resulting in more effective use of energy to produce water evaporation. This happens because the vapor pressure at the surface of the product increases by absorption of solar radiation. This the vapor pressure gradient between product and air is greater and drying is accelerated. Mixed solar dryers are also used which the tasks of the indirect drying chamber and the direct drying joined get together. Each technology has its advantages when weather conditions that get involved in the process are considered. Hence the need to incorporate the analysis of all technologies for being applied in Manabi.

There are weather conditions reported by INAMHI [11] on the months of July, August and September when rainfall almost completely disappears in part of the coast and in the inter-Andean corridor. This corresponds to a season where the growing season ends with the harvest, leaving waste to be incorporated into the soil as green manure and where drought for drying grain is used outdoors through traditional methods. At this time of the year only a small area of land of the coastal region is planted with the remaining moisture, including short-cycle crops such as corn and soybeans hard. The research results enhance the idea of using solar dryers in the coastal region of the country where the province of Manabi is located. With the application of solar technologies drying can be increased to twice the volume of agricultural dehydrated products in quantity and variety of these, which can mean the diversification of supply of high quality products on the market, achieving a increased use of crops and achieve better economic results.Manabí represents 15,84% of the agricultural surface in Ecuador. The plantain is the product with most production in this province [12], It strategically could be used not only for drying the fruit, but also its waste that can be used in biotechnological processes and forage for animals. In a survey conducted in small agribusinesses in the city of Portoviejo, the exchange model of farm products was verified. In Fig. 3 is shown the terms of trade of products and goods in Manabí Agrobusinesses.In the current design of Manabi Agrobusinesses, the market, and industry are closely linked in providing benefits to society. But the exchange with products is done in the most basic form without any process that can add value to the productions.The survey confirmed that producers, distributors and sellers do not know the technologies of natural dehydration of products through the use of solar energy. Moreover, it was possible to confirm that in some cases, goods are lost for lack of any conservation treatment, consequently resulting in the lower economic use of crops.

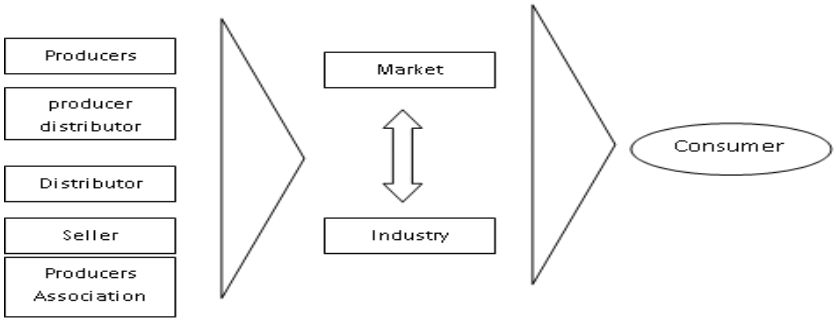

Figure 3. Relationship of the exchange of products and Manabi agribusiness

The dehydration techniques help the agricultural products such as fruits, vegetables, herbs, meats among others, so they can be treated for the purpose of improving their conservation for both sales and expand the lines of supply of goods with high quality. By conducting this survey, another aspect was verified which is linked to the lack of waste collection techniques and its use as animal feed or its use to generate energy through biogas digesters. The conditions of solar potential and the existence of a broad marketing production derived from agribusiness in the province of Manabi show that the conditions are enough for introducing solar drying technologies for different products such as: vegetables, fruits, herbs and medicines, meat, fish; besides the use of residuals for animal feed or energy production. Thereby improving not only agribusiness, but also to change production and energy matrix.

Currently after the earthquake of 7.8 degrees on the Richter scale occurred and affected significantly the provinces of Manabí and Esmeraldas. The activity of marketing of agricultural products has been affected, as some of the traditional sites used for marketing were affected by the occurrence of this natural phenomena. In the new sites chosen for the revival of commercial activity, there is no optimal conditions for the development of the activity, with temperatures ranging from 27 and 37 degrees Celsius, causing that the products get damaged and lose their commercial value, generating significant economic losses. Renewable technologies help to improve technological innovation, the quality and marketing of agricultural products under normal conditions or under any natural disasters.

IV. CONCLUSION

There is a geo-referenced information which shows that the quality of the incident solar potential in the territory of the province of Manabí can be used by solar drying technologies of agricultural products.The introduction of solar drying technologies in the agro-industrial activity in the province of Manabi can create a situation that facilitates getting the most out of the crops and reduce economic losses caused by declines of products. At the same time it will allow diversification and marketable production, offering high quality products with added value and low production costs.

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