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IMPROVE EFFICIENCY OF BIOGAS FEEDBACK SUPPLY CHAIN IN RURAL CHINA*

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Abstract Feedback supply chain is a key structure in the supply chain system, and the development of feedback supply chain for biogas biomass energy is one of the important ways of the rural ecological civilization construction. Presently, the efficiency problem of biogas supply chain in rural China has been restricting the development of biogas biomass energy business. This article, on the basis of combination of regulation parameters, describes the dynamic changes in the system, using differential equations integrated with simulation to reveal the rules of regulation parameters to investigate the efficiency problem in the biogas supply chain. First of all, on the basis of the actual situation, the flow level and flow rate system structure model and simulation equation set are established for the biogas energy feedback supply chain from a scale livestock farm to peasant households; On the basis of the differentiability of the simulation equation a third order inhomogeneous differential equation with constant coefficients containing regulative parameters is established for the quantity of biogas stored in the feedback supply chain. A theorem and its corollaries are established for the operating efficiency of supply chain to reveal the change law of the quantity of biogas, the quantity of biogas consumed daily by peasant households and its standard-reaching rate as well as other variables.

Key words Biogas biomass energy; feedback supply chain; system dynamics; differential equation; parameter combination method

2010 MR Subject Classification 93A30

1 Introduction

The supply chain is a system structure that combines suppliers, manufacturers, distributors, retailers and end users together as a whole. The feedback supply chain, which is researched in this article, is a dynamic closed feedback system formed by production process, transportation process, and user consumption process. In recent years, in-depth studies on the theoretical application of supply chain have been made and come up with a lot of openly published results,

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but there are few researches on the feedback supply chain, especially on those related to the feedback supply chain about rural biogas energy.

System dynamics is one of the most important tools for the research on a dynamic complex feedback system. It combines the system science theory closely with computer simulation to research the system feedback structure and behavior. In this article, the method of integrating simulation with dynamic variable parameter combination differential is set up to investigate the operation law of the dynamic variable parameter combination of feedback supply chain.

2 Structure Model and Simulation Equation for Flow Level and Flow Rate System of Biogas Energy Feedback Supply Chain in Rural Region

2.1 The background of biogas energy feedback supply chain in rural region

In the tide of ecological agriculture construction, the development and application of biomass energy have become more and more significant. The development of biogas energy in China is progressing rapidly. However, in the process of development, there is a series of problems that needs to be further researched. For example, Debang Scale Cultivation Ecological Economic Zone is located in the Poyang Lake Region in De'An County, Jiujiang City, Jiangxi Province, with a construction area of 666,667m^2. In Debang, the scale cultivation is an important way for increasing the income of the peasant households, but the manure and urine of pigs generated from the scale cultivation have not been fully developed and the directly discharged manure and urine of pigs have polluted the environment. On the other hand, there are more than 350 household biogas digesters in Gaotang Town where Debang Livestock Farm is located but most of the biogas digesters fail to operate normally because of lack of raw materials.

Aiming at the aforementioned problems, the following corresponding management countermeasures were purposed in the early research [4]: making use of the pig manure from the livestock farm as a raw material (the transportation of pig manure is very convenient) to promote the development of household biogas digester in the entire town, with each peasant household engaging in planting on the basis of the biogas slurry and development of household biogas digester development as well as comprehensive utilization of biogas around the entire town.

For implementation of the preceding management countermeasures, the biogas energy feedback supply chain has to be built from livestock farm to peasant households. Therefore, it is necessary to conduct a research on improving the operation efficiency of the feedback supply chain. In this article, combined the differential equation method with the system dynamics, the method of integrating simulation with dynamic parameter combination differential equation is used to investigate the operation efficiency of this feedback supply chain.

2.2 Biogas energy supply chain from the livestock farm to peasant households

Establishment of the biomass energy supply chain system from the livestock farm to peasant households includes Debang Livestock Farm, Gaotang Town Biogas & Slurry Development & Utilization Specialized Cooperative, peasant households within the ecological economic zone, and others nodes, as shown in Figure 1.