

# IMPLEMENTATION OF A SEMI-ARTESIAN WELL AND OVERHEAD IRRIGATION SYSTEM IN ROTATING PASTURE FOR DAIRY CATTLE BREEDING

**Anderson E. de Almeida**

**Dayanny G. P Medeiros**

[dayannysincaruca@hotmail.com](mailto:dayannysincaruca@hotmail.com)

**Jederson Aleixo**

**Profª Esp. Maria Clara Ferrari**

**Prof. MSc. José Ricardo Favoretto**

Translation:

**Marcos Antonio Duarte**

Fatec Itapetininga – SP

**ABSTRACT:** The present work presents a business plan for implementing a semi-artesian well to make the irrigation system for the rotating dairy cattle breeding pasture feasible, showing the importance and relevance in caring for the pasture, considering it as a perennial culture which needs care. The purpose was evaluating the economic feasibility and the beneficial effects of implementing the well for maintaining the pasture. With the implementation of the semi-artesian well and the overhead irrigation system with spacing pattern it is expected to improve the productivity and nutritional quality of the pasture. The economic feasibility indicators used were: Internal Rate of Return (IRR), Net Present Value (NPV), Effective Payback and Profitability Index (PI). As a result, the producer will still gain time and will save in the use of equipment and labor, besides obtaining a higher quality pasture rich in protein, increasing the level of animals per square meter, total milk production and its income.

**Keywords:** Production. Sustainable Handling. Feasibility.

## 1 INTRODUCTION

The agriculture and cattle breeding segment has a significant importance in the formation of the gross national product (GNP) of Brazil. Data from the Agriculture and Cattle Breeding Confederation of Brazil (CNA) (2014) indicate that the GNP of agribusiness increased 3.5% in 2013, representing 22.8% of all riches produced in Brazil in that year.

The important Brazilian agriculture has a significant participation in family agriculture, as indicated by the Agriculture and Cattle Breeding Census of 2006 developed by the Brazilian Institute of Geography and Statistics (IBGE) of 2006, in the technical notes of family agriculture census. According to such document, there was in Brazil in 2006, 4,366,267 family agriculture establishments, representing 84.36% of the Brazilian establishments. These properties

occupied an area of 80.10 million hectares, i.e., 24% of the total area of the agriculture and cattle breeding enterprises in Brazil.

This data from IBGE still highlights a significant participation of these establishments in the production of certain cultures and in the development of cattle breeding activities in the national territory, as it could be seen in table 1 below.

**Table 1** – Participation of family agriculture in selected cultures.

| Culture / Activity | %     |
|--------------------|-------|
| Cassava            | 83.00 |
| Beans              | 69.60 |
| Corn               | 45.50 |
| Coffee             | 38.00 |
| Rice               | 33.00 |
| Milk               | 58.00 |
| Wheat              | 21.00 |
| Swine herd         | 58.00 |
| Birds herd         | 51.00 |
| Bovine herd        | 30.00 |

**Source: Agriculture and Cattle Breeding Census 2006 (IBGE, 2006)**

The term “family” makes such properties, according to common sense, to be seen as little significant, apparently reducing its degree of importance, situation which is not supported by the data presented by the IBGE. Finally, the characteristics indicated by the technical notes of IBGE should be stressed as defining a family agriculture property. According to IBGE (2006), among other observations, family agriculture needs to present some requirements, such as:

- The farmer should not hold, in any capacity, an area greater than 4 (four) fiscal modules.
- Use, predominantly, labor from their own family in the economic activities of their establishment or enterprise.
- Have, predominantly, family income with origin in economic activities connected to the establishment or enterprise itself.
- Runs their establishment or enterprise with their family.

The rural company chosen for the development of this project, characterized as a family agriculture enterprise, presents as management characteristics of high professional level and integration of the cattle breeding activities with agriculture, where waste is reused and serves as inputs for other property activities.

Wise operation, in the rotation pasture system, the areas are divided into lots, which are submitted to alternated periods of pasture and rest, ensuring an appropriate volume of food for the animals along the year. In this method, after occupation of a lot for a few days, for a period of time which is variable, the animals graze and are removed when the vegetation is fully or partially defoliated. The lot remains in rest, without the presence of the animals, for recovery of the leaves, completing the pasture cycle (SANTOS, CORRÊA and BALSALOBRE, 2003).

The great advantage of this method is to intensify the use of the land, offering the cattle a pasture with greater quality, in the exact point of consumption. Such method allows defining when and for how long the plants will be subject to defoliation. Thus, the pastures tend to be more uniform and the pasture efficiency is higher (FERRAZA, 2007).

Additionally, there are advantages in the preservation of the environment and increase in productivity, as well as the possibility of natural control of tick, which, for having a life cycle varying from 17 to 21 days, does not have contact with animals for 30 days during the rest period of the lot. So, the tick does not resist and dies.

Taking the advantages initially mentioned as a starting point, the present work deals with the preparation of a business plan that aims analyzing the benefits and feasibility of implementing a semi-artesian well, with 10,000 L/h flow capacity, as well as implementing an overhead irrigation system with spacing pattern in the pasture. As additional results, it was sought to identify the impacts generated in the production of milk and production of cheese.

According to decree 717/96 from the Water and Electric Power Department (DAEE), from 12/12/96, a semi-artesian well is a “popular denomination given to deep wells which are not gushing or not artesian”, i.e., it is a well with reduced diameter, drilled with special equipment, which needs the use of a suction pump to make the water available.

The DAEE of the State of São Paulo disciplines the use of surface and underground water resources in the State and, in this sense, the installation of a semi-artesian well like the one in this project could require a permission from this department to be implemented, with this permission known as a grant. The property in question is dismissed from the obligation of a grant because the well to be implemented does not reach the minimum amount of water extraction, which is five cubic meters per day, a capacity which is five times greater than that which should be reached by the well to be implemented. For the property under assessment, there will be advantages in adopting the rotation pasture, due to the possibility of attaining a more uniform pasture, with greater efficiency, as indicated by SANTOS, CORREA and BALSALOBRE (2003).

## 2 METHODOLOGY

The present work is characterized as a rural property case study, whereby a diagnostic was made of the natural, physical, human, financial and social capitals of the rural company, aiming to identify the current situation of the property, creating the baseline for the construction of the most adequate investment plan for the organization's actual situation.

For such, the business plan methodology, validated among other sources of this knowledge by SEBRAE in Rosa's work (2007), was applied as the ideal instrument to paint an accurate picture of the market, of the product and of the entrepreneur, providing greater security in planning the actions and improving the conditions for the success of the business.

The basis for this type of business assessment model is made up by the use of the worldwide validated tools and used by Rosa (2007) in SEBRAE's business plan manual, such as: SWOT analysis, market analysis, risk mapping, strategic planning, scenario analysis, financial investment analysis among others.

By means of semi-structured interview with the owner of the rural company and analysis of data provided by the same, it was sought to identify the constituent factors of the SWOT analysis of his property.

## 3 RESULTS AND DISCUSSION

### 3.1 Description of the property under study

The rural property analyzed is called 'Sítio Boa Vista', and is located in the District of Cocaes, in the city of Sarapuí-SP, 138 km from the State's capital, in the geographical coordinates - latitude 23° 22' and longitude 47° 29'. The property presents rain in the summer and drought in the winter, presenting an average temperature of 20.9°C, with maximum of 29.8°C and minimum of 10.1°C, with the rainy period from December to March.

The soil of the property is classified as a reddish-yellow latosol, with medium sand texture and medium fertility. The vegetation is formed by clean fields and typical plants of the region. In relation to water resources, there is no incidence of springs or creeks in the property, with the property, still, being dependent on the water supplied by Companhia de Saneamento Básico do Estado de São Paulo (SABESP).

The property has a total area of 12.9 hectares, of which, 10 hectares are conventional pasture, with reduced occupation capacity, based on the *Brachiaria decumbens* grass; 1

hectare with sugar cane and 1.9 hectares of rotating pasture covered with *Panicum maximum* cv Tanzania. Table 2 below indicates the percentage distribution of the property area.

**Table 2** – Percentage distribution of the total property area

| Area destination                                       | Area in hectares | %             |
|--------------------------------------------------------|------------------|---------------|
| Conventional pasture ( <i>Brachiaria decumbens</i> )   | 10.0             | 77.52         |
| Sugar cane                                             | 1.0              | 7.75          |
| Rotating pasture ( <i>Panicum maximum</i> cv Tanzania) | 1.9              | 14.73         |
| <b>Total</b>                                           | <b>12.9</b>      | <b>100.00</b> |

**Source: Research data.**

The property area is used so as to support the development of dairy cattle breeding and derivatives activities, such as the production of frescal and semi-cured type cheese. The production process developed could be classified as handicraft. There is also swine breeding in the property intended for marketing.

The property was acquired in 1992 by Mr. Antonio de Oliveira Almeida, starting the milk producing activity with two cows. As of 1997, his son Anderson Eduardo de Almeida, took over the property. In this new cycle, the search for intellectual improvement was intense and compensating, according to the owner's words, but the first steps created lack of trust and low performance in the implementation of changes that already showed to be needed. Increasing the search for knowledge, in 2000, the owner took a pasture course, although never implementing any of the acquired knowledge.

In 2003, the owner started a course in artificial insemination, promoted by a partnership between Fundação Bradesco and PEC PRAN, in the city of Campinas-SP. Already in 2004, he took another insemination course promoted by SENAR, in the city of Sarapuí-SP. This time, believing in the techniques studied, he made an investment and acquired in 2005 his first semen container, aiming at promoting genetic improvement in his herd.

One year later, he acquired his first herd, which counted with twenty head of cattle, made up by cows, calves and heifers. For such, a line of credit was used from the National Program for Family Agriculture (PRONAF), in the amount of BRL 9.000,00. Concomitantly, his portfolio of customers of frescal and semi-cured cheeses was formed.

Finally, in 2008, trying to put into practice the knowledge acquired in the courses taken, he renovated the pasture and implemented the rotating pasture system, based on the *Panicum maximum* cv Tanzania grass, in a 1.9-hectare area. As a result, there was an increase in the

herd productivity, going from 90 liters/14 cows, which represented a productivity of 6.43 liters per animal, to, in the rotating pasture, 150 liters/14 cows, i.e., obtaining productivity per animal of 10.7 liters, representing a gain of 66.56% in productivity.

In 2009, aiming to meet the demand for cheese that was growing, he had to increase the production and, intending to improve the delivery system, he acquired a pick-up truck to transport the products. In 2010, with the increase in revenues, he invested in improvements in the facilities, applying resources in the construction of a shed and increase in the concreted area of the mango tree.

Observing the need to fertilize his rotating pasture system and, having in the property two sources of manure, one bovine, coming from the dairy activity itself, and another swine, coming from the fattening of pigs, he acquired a manure slurry tank with 300-kg capacity, aiming to distribute the excrements in liquid form in the areas that required organic fertilization. In this moment, he also acquired a new cooling tank, with 1000-liter capacity.

Finally, in 2013, his property improvement project involved the study for implementing an overhead irrigation mesh system, supplied by semi-artesian well, with the purpose of extending in three months, at least, the animal pasture period, with this decreasing the cost with complementary treatment and with additional labor that this service currently requires.

### **3.2 Analysis of the dairy market**

The property in question actuates in the bovine dairy production market, where Brazil is in highlight in the world scenario, ranking sixth in milk production with 1.3 million producers and production of 27.5 billion liters per year.

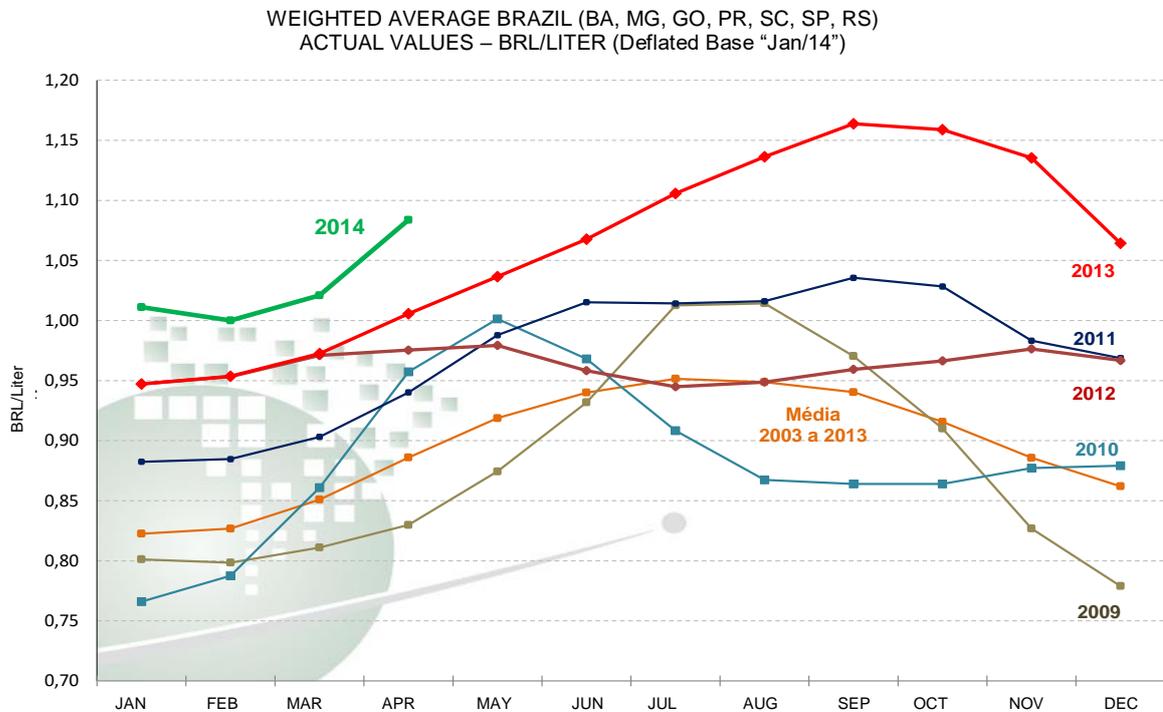
This market moves BRL 64 billion per year, generating employment for 4 million persons. The main producers are the States of Minas Gerais, Rio Grande do Sul, Goiás, São Paulo, Paraná and Santa Catarina, which, in 2008, were responsible for 81.7% of the total produced in the country (BANCO DO BRASIL, 2010).

Still, according to the work developed by Banco do Brasil (2010), the efficiency of the dairy cattle breeding has been improving by means of technologies that proportion an increase in productivity and, as consequence, dilution of fixed costs, indicating that more technical rural companies have greater productivity rates than the national average.

A report from Cepea-Esalq/USP of April 2014 indicates significant improvement in prices paid to the producer, which increased 6.16%, reaching BRL 1.0838/liter (gross price – added by freight and taxes), as a result of the drop in production in March and due to the start of the off season, having this effect been felt more expressively in the South region, where some dairy industries closed due to the lack of milk. The upward movement could also be felt in the dairy products, but there is a tendency to stabilize in the next months, as indicated in said report,

although an inspection in the annual evolution of the price in the last seven years deflated by the IPCA (graph 1) apparently indicates a tendency of increase in milk prices.

**Graph 1 – Series of average prices paid to the producer – deflated by the IPCA**



Source: Adapted from Cepea-Esalq/USP (2014).

If on Brazil level the dairy activity is up, in the region where the property is located good opportunities are rising. Castrolanda group is installing a milk processing manufacturing facility in the region, located in the city of Itapetininga, SP. Aiming to consolidate itself in the milk processing regional market, the group acquired the largest dairy industry in the region, Companhia de Laticínios de Sorocaba (Colaso).

The strategic movement of this player in the region indicates the existence of a future market for the activities of the rural company analyzed and, adding the perspective of, at least, the maintenance of the current prices practiced in the acquisition of the milk by the dairy industry, the main activity of the company presents market feasibility.

### 3.3 Analysis of the Strong and weak points and opportunities and threats of the property (swot analysis)

The SWOT analysis is characterized as an important support tool for decision making, being used as a means of systematizing the internal and external environments of the organization, by means of identifying the strong points, weak points, opportunities and threats.

By making the SWOT analysis the organization could build strategies that favor the use of the strong points, reducing weaknesses, taking advantage of opportunities and defending against threats (KOTLER and KELLER, 2012). The result of this data collection and validation process, referring to the property under study, could be observed in Chart 1.

**Chart 1 - SWOT Analysis of Sítio Boa Vista, Sarapuí-SP.**

| <b>Strong points</b>                             | <b>Weak points</b>      |
|--------------------------------------------------|-------------------------|
| Location                                         | Lack of water resources |
| Sexed insemination system                        | Lack of equipment       |
| Rotated pasture lot                              |                         |
| Qualified labor                                  |                         |
| Innovation and technology                        |                         |
| Excellent cow fertility                          |                         |
| Added value to the product                       |                         |
| Large size cooler                                |                         |
| <b>Opportunities</b>                             | <b>Threats</b>          |
| Installation of new dairy industry in the region | Inputs price increase   |
| Availability of animals for acquisition          | Climate                 |
| Marketing of liquid manure                       |                         |
| Good market price for milk and dairy products    |                         |

Source: research data (2013).

The SWOT matrix analysis indicates strategic feasibility for investing in an irrigation system, such as the one under analysis in this project, since the additional production of milk seems to be easily marketed by the increase in demand as of the establishment of the new dairy industry in the region. Besides the milk with very attractive price, the dairy products, are also up indicating good possibilities of increase in the profitability of the property's activities, specifically milk and cheese.

In relation to the rotated pasture, this consists in alternating the use of the pasture by means of division of the total space available for pasture into lots. This way, the animal uses the space of the lot for a certain period, which could vary from 1 to 5 days, followed by a rest period sufficient for full recovery of the pasture, this period varying depending on the grass used, but which, in general, varies from 20 to 36 days.

In the case of the handling adopted in the property analyzed, observing the pasture and herd characteristics, the animals are led so as to graze the forage (*Panicum maximum*) Tanzania grass, daily in the lots, allowing the forage to recover its roots and leaves during a 29-day period.

The irrigation system to be used is overhead with spacing pattern, which uses mechanical devices, the sprinkler, which distributes the water under the form of artificial rain over the plants. The pressure required for fractioning the water is obtained with the use of sets of pumps.

In the overhead system with spacing pattern, the side, derivation and main lines are buried; only the sprinklers are moved. It is observed that in the conventional sprinkler system it is necessary to move both the sprinklers as well as the piping, which compose the side, derivation, main lines and pipeline. Comparing this system with the system with spacing pattern, a significant reduction of required labor is observed.

The system structured for the property at issue will be supplied by the semi-artesian well with an initial capacity determined at 10,000 liters per hour. Ten sprinklers will be used with a space of 30-m between them. The amount of water used will be 1m<sup>3</sup>/h, per sprinkler, totaling 10m<sup>3</sup>/h. With this amount of sprinklers, the area will be irrigated in two stages.

It is expected, with the implementation of the well and irrigation system, that the producer will have a gain of three months of grazing, as indicated previously, going from seven to ten months. Thus, besides obtaining a better quality pasture, rich in proteins ensuring the production of milk, there will be the possibility of reducing costs with complementary food, strengthening the pasture during the winter.

### 3.4 Economic assessment

The operating cost of the project is BRL 41,029.19. The proposed investment value is BRL 22,871.85, of which BRL 7,871.85 is the cost for the overhead irrigation system with spacing pattern and the value of the semi-artesian well is BRL 15,000.00. The income arising from the sale of cattle, swine, milk and cheese added up totals the amount of BRL 89,892.00. Analyzing the cash flow inputs and outputs of the enterprise, there will be a net yearly result of BRL 59,422.81. The NPV, IRR, effective Payback and Profitability Index (PI) showed viability for implementation of the project, and the indicators results are presented in tables 3 and 4.

**Table 3** – Cash flow of the proposed investment BRL/year – NPV and IRR.

| YEAR | INPUT     | OUTPUT    | INVESTMENT | NET CASH FLOW |
|------|-----------|-----------|------------|---------------|
| 0    |           |           | 22,871.85  | -22,871.85    |
| 1    | 89,892.00 | 41,029.19 |            | 48,862.81     |

|              |                   |                   |                  |                   |
|--------------|-------------------|-------------------|------------------|-------------------|
| 2            | 89,892.00         | 41,029.19         |                  | 48,862.81         |
| 3            | 89,892.00         | 41,029.19         |                  | 48,862.81         |
| 4            | 89,892.00         | 41,029.19         |                  | 48,862.81         |
| 5            | 89,892.00         | 41,029.19         |                  | 48,862.81         |
| <b>TOTAL</b> | <b>449,460.00</b> | <b>205,145.95</b> | <b>22,871.85</b> | <b>244,314.05</b> |

Capital cost = 12% interest per year.

Source: Authors (2013)

For calculation of the NPV of BRL 153,267.64 and IRR of 213%, it was considered the initial investment and the sum of the irrigation equipment plus the value of the semi-artesian well. As output, it was considered pasture maintenance cost, animal food cost, herd handling, salaries of the owner and daily worker during four months, besides the fixed costs with water, power, depreciation and maintenance, and as inputs, the income arising from the sales of products.

For the economic analysis of the business plan, it was considered a minimum rate of attractiveness (MRA) of 12% per year, percentage compatible with most financial applications available in the Brazilian market.

Bringing the net cash flow value of the five years to the present value with a rate of discount of 12% per year, a positive balance of BRL 153,267.64 was observed, which means that the investment is economically attractive, since the project is paid for, yields 12% per year and there is still the monetary value left, obtained for the NPV. By means of IRR analysis, an annual income of 213% on the invested capital was observed, thus proportioning a favorable opportunity cost ratio.

Aiming to determine the number of years required for the company to recover the capital invested in the project, the effective payback was calculated. What is sought with the payback is to determine in how long the accumulated balance of the cash flow becomes positive. In the case at issue, the owner obtains the return of his capital in approximately five months after implementation of the well and irrigation system, as it could be seen in the formula below.

The calculation of the effective payback is based on the following structure:

$$\begin{aligned}
 \text{Effective Payback} &= \text{year before recovery} + \frac{\text{Cost not recovered in the start of the year}}{\text{Cash flow during the year}} \\
 \text{Effective Payback} &= 0 + \frac{22,871.85}{48,862.81} = 0.47 \cong 5 \text{ months}
 \end{aligned}$$

The profitability index measures the return in relation to the current value of the cash flow input for each Brazilian Real invested, calculated by the expression:  $PI = PV/I_0$ , where PV is the current sum of the cash flow inputs and  $I_0$  is the net investment value, accepted if greater than or equal to zero. Through the calculation of the present value (PV) of the project's cash flow inputs (Table 4), it was obtained the current sum of the cash flow input.

**Table 4** – Current value of cash flow input in BRL per year.

| Year         | Input values      | Current value of cash flow inputs |
|--------------|-------------------|-----------------------------------|
| 1            | 89,892.00         | 80,260.71                         |
| 2            | 89,892.00         | 71,661.35                         |
| 3            | 89,892.00         | 63,983.35                         |
| 4            | 89,892.00         | 57,127.99                         |
| 5            | 89,892.00         | 51,007.13                         |
| <b>TOTAL</b> | <b>449,460.00</b> | <b>342,040.54</b>                 |

Source: research data (2013).

Calculating the present value and, considering the investment value of BRL 22,871.85, the PI of the project is 14.17, meaning that for each Brazilian Real (BRL) of employed capital, BRL 14.17 of benefit will be generated, i.e., an excellent profitability index. In relation to the economic-financial analyses of the project, it can be stated that the same presented excellent feasibility indices. In table 5, the indicators obtained in this project are presented, summarized.

**Table 5** – Summary of financial indicators of the project.

| Financial indicators          | Indicator obtained |
|-------------------------------|--------------------|
| Net present value (NPV)       | BRL 153,267.64     |
| Internal rate of return (IRR) | 213%               |
| Profitability index (PI)      | 14.17              |
| Effective payback             | 0.47 (5 months)    |

Source: research data (2013).

#### 4 CONCLUSION

The investment should be implemented, considering that the money income exceeds the output in BRL 153,267.64, and the employed capital will be remunerated at 213%, with a

period of return of 5 months after implementation of the project, and for each BRL 1 of invested capital, 14.17 will be generated (PI).

The market, strategic and economic-financial feasibilities of the business plan show that the investment proposal is feasible for implementation of the semi-artesian well and the irrigation system, with the investment being easily absorbed by the financial structure of the enterprise. It should be reminded that the savings the owner will have with the use of water, currently acquired from SABESP will be significant.

The present business plan, by means of the proposed investment, will bring an increase of three months in grazing, besides improvement of the pasture quality, generating savings in inputs, equipment and rationalization of labor. The additional generation of milk and dairy products, taking advantage of the excellent moment of the market, will increase the profitability of the operation and the results of the rural producer. One of the additional effects of the implementation of this system could still generate idle capacity in the pasture and in the use of labor, allowing an increase in the herd. It could be said that the project is fully feasible.

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