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Exploring Profitability of Compost Micro-Enterprises in Chimaltenango, Guatemala: A Case Study of Business Sustainability for International Development

Timothy Silberg
Texas A&M University
Department of Agricultural Leadership, Education & Communications
#1 Tabora Avenue
Makiso Community, Kisangani (DRC)
243-990-139-570
tsilberg@borlaug.us

Theresa Pesl Murphrey
Texas A&M University
Department of Agricultural Leadership, Education & Communications 2116 TAMU
College Station, TX 77843-2116
1-979-458-2749
t-murphrey@tamu.edu

Gary Wingenbach
Texas A&M University
Department of Agricultural Leadership, Education & Communications
2116 TAMU
College Station, TX 77843-2116
1-979-862-1507
g-wingenbach@tamu.edu

Leonardo Lombardini
Texas A&M University
Department of Horticultural Sciences
2133 TAMU
College Station, TX 77843-2133
1-979-458-8079
l-lombardini@tamu.edu

Abstract

The economic sustainability of innovations disseminated to rural communities is an important issue in agricultural development. However, individuals working in international development often do not fully employ monitoring systems to analyze the long-term profit of an innovation prior to diffusion. This multi-case study used qualitative methods, including individual/group interviews and observations, to gather data to analyze all necessary inputs of compost micro-enterprises in Chimaltenango, Guatemala. Each micro-enterprise's relative output was examined to determine how agricultural extension efforts could modify its operations to produce profits. The results revealed entrepreneurs lacked an awareness of total inputs used/needed for a compost operation and lacked effective financial record keeping practices. Net profit fell when inexpensive unskilled labor was used, when the operation's infrastructure deterred access to transport or deterred vision of the operation and when entrepreneurs used greater quantities of free raw material to produce equivalent amounts of compost. All micro-enterprises were cognizant of their compost ingredient ratios, but none had quantified total materials used to produce given amounts for specific periods. Findings from this study provide insights into factors that impact profitability related to compost micro-enterprises in developing countries.

Keywords: Compost, Micro-Enterprise, Sustainability, Profit, Inputs, Guatemala

Introduction

The majority of diffusion–adoption research has focused on the process of initial adoption or rejection of a particular innovation as opposed to long-term impact on livelihood (Miller & Mariola, 2009). Micro-entrepreneurship has been used by international organizations as an extension tool to provide alternative incomes for poor and economically vulnerable populations (Vargas, 2000). When a practice such as composting is used as a micro-enterprise's main business undertaking, the financial success and longstanding use of that enterprise largely lie in accounting for various inputs needed for production.

Birks, Fluitman, Oudin, and Sinclair (1994) explained the complexity of micro-enterprise cost calculation. When an enterprise has failed to account for its inputs and consequent outputs, it becomes unsustainable because it has not satisfied present and future basic economic, social and security needs (Environmental Protection Agency, 2011). The capability of a micro-enterprise to obtain profit depends on the pivotal step of understanding its necessary inputs. As change agents, a discussion of these principles, especially with opinion leaders, may be effective as an innovation is diffused (Oleas, Dooley, Shinn, & Giusti, 2010). Accounting for these costs allows entrepreneurs to realize whether or not they possess sufficient funds to operate their enterprises.

Compost micro-enterprises are unique businesses because their final product's formulas (Vukobratović, Lončarić, Vukobratović, Lončarić, & Čivić, 2008), material quality and operational grounds (Zurbrugg, Drescher, Patel, & Sharatchandra, 2004) influence profitability. The ability to forecast costs and profits may assist international organizations in determining specific investments needed to initiate such projects and potential profits that such innovations could produce for communities.

Study Background

Sixty percent of Latin American rural households rely upon agriculture as their main source of income (Zezza, Carletto, Davis, Kostas, & Winters, 2008). Sadly, soil degradation "...is common in developing countries. A history of Mayan agricultural practices has led to ...rapid soil nutrient depletion and declining crop yields" (Deevey et al., 1979, p. 298). It is estimated that up to 40% of Guatemala's agricultural land has lost its productive capacity (O'Kane, 2006).

Major food crop yields have fallen in the past decade, including one of the region's largest exports (i.e., sweet peas) (Eitzinger et al., 2011). A contributing factor to this decline was the green revolution's heavy pesticide and fertilizer use; and furthermore users were not well informed of the consequences of their application at the time, and still today (Tetreault, 2012). Consequently, the concept or benefits of high soil-bioactivity through the use of organic material like compost are minimally recognized (Klotz, 2012). Additionally, these benefits are overshadowed by the speedier productive results of synthetic fertilizer (Holt-Gimenez, 2006).

Compost is not a new idea brought to the region, but the concept of producing compost for sale, and marketing it as organic fertilizer, is a relatively new income stream brought to the Chimaltenango region several years ago by international development organizations (Maluccio, Melgar, Méndez, Murphy, & Yount, 2005). Education of the innovation's practice and its business model were assisted through governmental, non-governmental and agricultural extension entities (Klotz, 2012). Information about the innovation and its profitability were mainly diffused through female social networks (Oleas et al., 2010) and later by agricultural and political networks. These types of micro-enterprises were formed in rural villages by independent associations (e.g., occupational housewives) (Carletto, Kilic, & Kirk, 2011) as well as by coffee cooperatives (Angelina, Kiser, & Trevino, 2009). The enterprises received funding and technical assistance once officially established as a micro-enterprise, from governmental and international organizations, to improve their level of production (World Bank, 2008).

Hernandez and Torero (2011) explained that the fertilizer market of regions such as Chimaltenango is very dynamic because of the types of fertilizers sold and the types of farmers purchasing them. International synthetic producers of chemical fertilizers tend to dominate regional markets in Latin America, such as Chimaltenango, where competition is limited and prices are often inflated (Hernandez & Torero, 2011). Locals expressed to international development agencies that erosion caused by consecutive years of hurricanes warrants the application of fertilizers (Carr, 2008). Additionally, Carr (2008) stated the use of synthetic fertilizers is the preferred choice because benefits are promptly visible and primary nutrient composition (i.e., nitrogen, phosphorus, potassium) is denoted, unlike with compost.

Fertilizer is sold by the quintal, where a quintal is the equivalent to 45.45kg or 100lbs (Lewin, Giovannucci, & Varangis, 2004). The increase of prices has led farmers to use organic techniques (i.e., applying organic fertilizer) because of its low cost (Oleas et al., 2010). Synthetic fertilizers are sold in agro-depots, large and small, outnumbering the informal market and production of locally made organic fertilizer (Rios, Shively, & Masters, 2009). Compost, or, as it is called by the population, organic fertilizer, is either sold locally from its operational grounds or at local farmer markets. Compost produced from agro-byproducts made for retail purposes may come from cooperatives formed by small-scale farmers or large mechanized producers such as commercial sugar cane exporters (Rolz, Leon, Cifuentes, & Porres, 2010).

Conceptual Framework

The conceptual framework was based on the physical transformation of raw material to compost and the financial activities occurring during these operations. The literature revealed numerous physical and financial costs, obvious and unseen, faced by compost micro-enterprises. A number of variables were identified as determinants for the economic sustainability of a compost micro-enterprise. Obvious variables included the social climate and agricultural support activities such as access to credit, favorable tenure systems, availability of markets, farmer resource centers and many more production factors that play a vital role in agricultural productivity (Nompozolo & Igodan, 2002, p. 331). Amounts of required raw materials for specific formulas are identified and input costs are then multiplied by quantities needed and finally summed in order to determine total costs spent per micro-enterprise. An integral part of determining an enterprise's profit is to project output (Alam, Hossain, & Zaman, 2010).

Labor and capital cost. Labor costs and capital expenses for a compost micro-enterprise are critical for an entrepreneur to understand. "The level of capital costs required is dependent on the farming system and the climate" (O'Brien, O'Donovan, Gleeson, & Ruane, 2004). Haggblade, Gelson, and Tembo (2004) and O'Brien et al. (2004) explored returns on investment for various agricultural operations when using a large labor force. They found that while augmented manual labor increased output on smallholder agricultural operations, there is a financial threshold where profit begins to fall, regardless of the output made by a large labor force. Neither investigation analyzed small-scale agricultural operations when using laborers without farming experience or investigated how costs were mitigated by using machinery. Nevertheless, further studies were recommended to determine the costs of using manual labor, considering that rural enterprises often cannot afford technologies to replace labor.

Operational cost. Research has indicated that capital costs such as labor are heavily affected by the type of tasks conducted. Lapid, Ancheta, and Villareal (1996) organized compost production activities into three processes: sorting, composting, and refining. Labor and time spent to complete each specific task has been minimally explored among small-scale enterprises. Additionally, minimal analysis has been conducted on costs associated with each process, including fuel expenses dedicated to collecting and transporting raw materials to begin composting (i.e., sorting processes), machinery use costs (i.e., composting processes), and product packaging (i.e., refining processes). Accounting for these costs has great importance, especially if this type of entrepreneurship were to be established in areas that lacked sufficient infrastructure to facilitate transport to farmers' markets (Flury & Guiser, 2002).

Raw material cost. The literature illuminated various types of raw material and how they were classified into different genres (e.g., green material, dry material) in order to formulate an appropriate mix to process compost. Vukobratović et al. (2008) conducted a cost-benefit analysis of various raw materials within a compost formula, noting the importance of using effective microorganisms (EMOs). They found that the duration of decomposition, compost quality, and cost-effectiveness of operations, regardless of material type used or the regimen administered, were affected by EMO presence. Raviv (2005) analyzed the quality of compost in terms of "…organic matter (OM) content, nutrient content, potential for disease suppressiveness and other physical, chemical, and biological properties…" when using specific quantities of raw materials (p. 52-53). His findings suggested that compost possessing favorable characteristics (e.g., air porosity, hydraulic conductivity) tends to be produced by raw materials rich in both carbon and nitrogen. Carbon is used as one source of energy to decompose OM. Nitrogen is used for building cell structure. Decomposition requires a high enough carbon to nitrogen ratio (e.g., a favorable ratio is 30:1) to decompose OM; too much carbon can slow the decomposition process. A thorough examination of the physical or biological components of a micro-enterprise's finished product is important when determining the relative advantage of the product; that is, the level of biotic activity within soil that influences crop yields after the application of compost (Raviv, 2005). Consumers' views of compost's relative advantage (Rogers, 1995) may influence sales. Before an evaluation can be conducted about compost's effect upon soil productivity, the output of actual compost produced from a given amount of raw material should be determined. The measurement of specific amounts of output produced from specific amounts of input can enable the determination of the financial efficacy of different compost formulas.

Methods

Case study research was used in this study to identify and quantify variables of input and calculate their resulting output. "The purpose of a case report is not to represent the world, but to represent the case" (Stake, 2005, p. 460). Numerical data was collected via structured oral interviews, individually and in groups, to gather the total cost and amounts of inputs used to produce a reported amount of compost. These costs were monitored within a single six-week period to allow the necessary time for decomposition to occur and to observe all processes conducted. The costs included types and amounts of raw material (i.e., green, dry, manure) and capital (i.e., labor, transport, energy, and packaging) used to produce compost. The group interview protocol was developed from the literature to account for all potential costs that could have incurred during a micro-enterprise's operations.

Individuals and their micro-enterprises included in the case were identified by the Agriculture in Guatemala: Technology, Education, and Commercialization (AGTEC) program, funded by a United States Department of Agriculture grant. Selected participants ($N = 24$) were identified and interviewed because of their continuous participation in each respective micro-enterprise. Among these 24 participants, some held higher position than the general laborer, such as president (three individuals), secretary (two individuals) and treasurer (three individuals). The entrepreneurs holding these positions were critical to interview to collect information about their micro-enterprise's revenue and inventory records. A purposive sample consisting of three micro-enterprises was identified based on the enterprises' participation and funding with AGTEC. Information about laborer positions and operations were collected. Micro-enterprises were randomly assigned a letter: Micro-enterprise A (10 entrepreneurs), Micro-enterprise B (9 entrepreneurs), and Micro-enterprise C (6 entrepreneurs). The principal investigator assigned a random number to each enterprise respondent to ensure confidentiality.

The principal researcher acted as interviewer, gathering information about the enterprises' operations. Data collection occurred during July 2011. Prior to the collection period, instruments were composed by the researcher and translated into Spanish by the Executive Secretary for Trinidad's designated Consulate for Panama. Data were gathered in Spanish and translated into English by the researcher. The principal researcher was an intermediate Spanish speaker and was accompanied by native speakers from the AGTEC staff to ensure reliability of translation.

Data were collected through structured oral interviews separately among each enterprise. All 24 participants were interviewed separately in their respective enterprise (Micro-enterprise A: 10 participants, Micro-enterprise B: 9 participants, Micro-enterprise C: 6

participants). These interviews were directed by a set of 13 questions. First, information was collected about the types, quantities, and prices of raw materials used in a six-week cycle (e.g., amounts of manure used). Second, total capital for infrastructure (i.e., building the operational grounds) and overhead (i.e., days of labor, transport cost, energy costs, and packaging costs) required to process raw materials was recorded in one six-week cycle**.**

Interviews sought to determine the unit of cost for each input. For example, payment of labor was distinguished between payment by the hour, task assigned, or by the day. Interviews additionally sought how inputs were affected by variables that did not assume financial overhead. For instance, inquiry was made regarding how transport and sales were affected by visibility and location of operational grounds. Interviews additionally sought to confirm the *Output* (in quintals) produced by an enterprise following a six-week cycle. Apart from interviews, visual representation of production observed during the researcher's six-week study in Chimaltenango reconfirmed verbal responses of the each enterprise's output.

From these interviews, *Total Variable Cost*, *Total Revenue* and *Gross Margin* were calculated. First, by summing the quantity of each input used in a six-week cycle, then multiplying it by the price, and finally summing the totals for each input, Total Variable Cost was determined. Total Revenue was calculated by summing the quintals of compost an enterprise produced after one six-week period and multiplying the total by price sold per quintal. Finally, Gross Margin was calculated by subtracting Total Variable Cost from Total Revenue.

As a final note, all costs were recorded in Guatemalan currency (i.e., Quetzals) during field research. According to SICE Foreign Trade System, an organization of the United States, the 2012 exchange rate was 1 US dollar (USD) to 7.79 Quetzals (Q) (The World Bank, 2012); thus, the findings were presented at this rate of US currency in the tables listed in the findings.

Three composting sites (one for each enterprise) and each of their methods of production were observed for six weeks. Construction receipts provided by the AGTEC program were reviewed to record funds allocated to micro-enterprises for erecting structures, application of microorganisms, and tools/machinery to conduct operations. After data collection, revenue was calculated to determine if economic sustainability was present in the compost micro-enterprises.

Reliability and validity of this study were monitored through member checking, peer reviews, and prolonged engagement in data collection. Reconfirming information with all respondents during in-group interviews, through observations during repeated visits, and in reviewing similar categories within the researcher's documents was completed among all micro-enterprises to ensure triangulation. Raw data of amounts, interpretation of measurements, and categories of compost materials were discussed with respected colleagues to confirm legitimacy.

Purpose and Objectives

The purpose of this case study was to analyze inputs and outputs and determine profitability of compost micro-enterprises in Chimaltenango, Guatemala. Specific objectives were:

1. Identify all types of inputs associated with a compost micro-enterprise and quantify their amounts and costs by summing the amount of compost produced by that enterprise over a six-week production cycle;
2. Calculate amounts of raw materials required to produce one quintal (100 lb. sack) of compost from a micro-enterprise,
3. Evaluate the economic sustainability of micro-enterprises in terms of production costs and outputs.

Findings

The costs presented by each enterprise included types and amounts of raw materials (i.e., green material, dry material, or manure) and capital (i.e., labor, transport, energy, and packaging). These costs were monitored during a single six-week period to allow for necessary time for raw materials to decompose and be processed into the final product of organic fertilizer to be sold. Typically, employees were not aware of the total amount of inputs used and their total costs after six weeks. However, each micro-enterprise was extremely cognizant of the ratio between types of raw material it needed to make compost. Additionally, each was aware of capital it used and its costs during one six-week process but was unaware of how the sum of these operational costs factored into the total overhead cost. Furthermore, each micro-enterprise had an employee who recorded the quantity and cost of inputs used weekly, for example raw material costs (i.e., price of manure, green material, and dry material). Each micro-enterprise had its own regimented formula to make compost; yet, the total raw material used in one six-week cycle was not readily known. The principal researcher deduced the amount of the total raw material used in one six-week cycle by interviewing the secretary and reviewing his or her records of purchases made for raw material over several six-week cycles. Table 1 illustrates Total Variable Costs, Total Revenue and Gross Margin for each micro-enterprise. Raw material cost was a primary component of the Total Variable Cost*s*.

Table 1. Gross Margin of Compost Micro-Enterprises A, B, and C

Micro-Enterprise	Total Variable Cost[a]	Total Revenue	Gross Margin
A	186.28	173.30	-12.98
B	381.71	86.70	-295.01
C	269.96	924.26	654.30

[a]Total Variable Cost, Total Revenue, and Gross Margin were originally measured in Quetzals (Guatemalan local currency) and then converted to US dollars.

All micro-enterprises sold their compost directly to customers from the premises of their operations; Enterprise A additionally sold its product in a local farmer's market, requiring local taxis to transport the compost. Thus, the transport cost was included in the Total Variable Cost for Enterprise A. A micro-enterprise's location and security fencing was found to affect how consumers could visibly see operations and inquire about purchasing compost. While the element of *operation-visibility* is not a financial variable, it should be noted that this element affected sales and energy costs to transport compost to farmer's markets for selling. Each micro-enterprise used a Penagos Model TP-24 Grinder to chop raw material during operations. The grinder was powered by standard unleaded gasoline. More fuel was used depending upon type and amount of raw material used. This cost was included in the Total Variable Cost for each enterprise. All micro-enterprises used coffee or fertilizer bags possessing the carrying capacity of one quintal. Depending on the enterprise output, cost of packaging was calculated by the number sacks purchased to bag their final product and this was included in the Total Variable Cost for each enterprise.

The final cost included in the Total Variable Cost was labor. Production schedules were articulated as four tasks: grinding raw material, mixing raw material, aerating piles, and sifting and packaging compost. Each of these tasks required a unique combination of inputs in relation to labor. Characteristics, including the number of employees used, number of days to complete, and the amount of inputs used (e.g., fuel) were recorded for each task. The speed at which a task was completed and the numbers of laborers demanded to complete a task presented a picture of the quality of labor used by each micro-enterprise. Table 1 reveals that Enterprise B incurred the highest Total Variable Cost by assuming the greatest amount of labor while at the same time producing the least amount of compost.

Table 2 presents the individual cost to produce a single quintal of compost for each micro-enterprise (i.e., Expenditure per Quintal). In this table, the Total Variable Cost was divided by Outputs to give a clear representation of how financially aware an enterprise was of its total expenditure used over a six-week period and if the price at which they sold their compost covered that expenditure. Hypothetically, if micro-enterprises were to sell their entire output of compost by the price listed under Expenditure per Quintal, the revenue made from sales would cover all overhead costs. For example, if Enterprise A were to price each quintal of compost for $6.21US, all input costs would be covered, but no profit would be made.

Table 2. Compost Micro-Enterprises A, B, and C: Total Expenditure to Produce One Quintal of Compost

Micro-Enterprise	Total Variable Cost[a]	Output[b]	Expenditure per Quintal[a]
A	186.28	30.00	6.21
B	381.71	15.00	25.45
C	269.96	180.00	1.50

[a]Total Variable Cost and Expenditure per Quintal are figures in US dollars.
[b]Output is in figures of Quintals (100lb sacks)
Note: All data were estimated. Numbers should not be treated as exact figures.

Table 3 reports the Price Sold Per Quintal by an enterprise subtracted by the Total Variable Cost To Produce One Quintal to display the net profit for each sale of one quintal of compost (Gross Margin To Produce One Quintal). Two enterprises did not obtain a net profit (as seen in Table 3) due to selling compost for less than it cost to produce. It should be noted that when revenue from compost sales were received by Enterprise A and B, the entire amount was dedicated to purchasing raw material, fuel, transport and/or packaging. Employees were promised payment of salaries once profits were made; yet, Table 3 illustrates a negative Gross Margin was returned due to high input costs.

Table 3. Gross Margin Received by Micro-Enterprises A, B, and C per Quintal of Compost Sold

Micro-Enterprise	Price Sold Per Quintal[a]	Total Variable Cost to Produce One Quintal[a]	Gross Margin To Produce One Quintal[a]
A	5.78	6.21	-0.43
B	5.78	25.45	-19.67
C	5.13	1.50	3.63

[a] 1 Quintal is equal to a 100lb sack; Figures are in US dollars.
Note: All data were estimated. Numbers should not be treated as exact figures.

Table 4 illustrates the amount of raw material used by each micro-enterprise over one six-week cycle and the amount of resulting compost produced. In this table, Total Input was divided by Output to elucidate how far an enterprise's recipe of raw material exceeded one quintal of compost. Enterprise C made the most profit, as seen in Table 3, but used the largest amount of raw material to produce one quintal of compost. As explained in Table 2, each Total Variable Cost included expenditures spent on labor, energy, packaging and raw material; thus, larger amounts of raw material incurred higher operation expenses.

Table 4. Amount of Raw Material used by Micro-Enterprise A, B, and C to Produce One Quintal of Compost: An Illustration of Conversion Efficiency

Micro-Enterprise	Total Input[a]	Output Produced After One Six-Week Cycle[a]	Amount of Raw Material to Produce One Quintal of Compost[a]
A	38.33	30.00	1.28
B	18.50	15.00	1.23
C	288.00	180.00	1.60

[a]Total Input, Output and Physical Cost To Produce One Quintal of Compost are figures of Quintals (100lb sack)

Note: All data were estimated. Numbers should not be treated as exact figures.

Conclusions

Based on findings, it was concluded that the construction of a micro-enterprise's operational grounds incurred the greatest cost, and was the most limiting factor for profit. The size and location of operations will inevitably influence all variables. Literature revealed that an enterprise's agroecological location would significantly affect its employee's access to abundant material (Sseguya, Semana, & Bekunda, 1999). Findings from this case study indicated geographic location and its surrounding infrastructure affected access to farming consumers and markets. The physical boundaries where compost is produced will ultimately affect the amount of raw material and working space available to process it. While fencing is necessary for security, if a micro-enterprise's operational unit was constructed in such a way that composting activities were not visible, direct consumers (e.g., farmers) within the enterprise's community inquired less about the product and its price. Enterprise B and C both had open and visible operations resulting in their entire compost being sold at their site of production. Enterprise A, conversely, had walls enclosing its entire property, deterring visibility of operations. Enterprise A was forced to vend its entire compost and explain its comparative advantage at a market. Thus, it was concluded that sales were impacted greatly by operation visibility.

Implications and Recommendations

Training programs for composting micro-enterprise development should include instruction on effective composting practices and measurement of inputs, outputs, quality of compost, and overall good business practices. This study complimented Lapid's et al. (1996) findings in which accounting for all expenditures during the production process was critical. Although, findings from the study revealed that when an enterprise used inexpensive and unskilled labor this in fact compromised the composting process by increasing the amount of time on each task and decreasing the amount of raw material processed. Individuals working in extension and international development should engage adopters in discussions about the consequences of each investment. These types of discussions reiterate Flury and Guiser's (2002) argument that small agro-business should avoid segregating funds to transport products to and from a market without assurance of sales (i.e., Micro-enterprise A) as opposed to creating a market where processing occurs.

Initial costs, especially construction, to establish a compost micro-enterprise should be outlined by those working in international extensions in an understandable format for future entrepreneurs. The pinnacle step of realizing where (e.g., near raw materials, well established infrastructure) and how (i.e., visible or hidden to farming consumers) this operational unit is built can encourage employee awareness of financial variables when managing a compost micro-enterprise. Extension personnel should explain how total variable costs and total revenue can be affected by consumer accessibility. Also, investment decisions should be discussed to determine how they may impact profitability. Use of the most inexpensive raw materials that yield the largest output without jeopardizing the quality of the final product is crucial. Material availability and price will vary depending on the region where a compost micro-enterprise is located. In addition, labor, time and energy costs (e.g., fuel) should be considered before purchasing or spending capital on collecting large amounts of raw material. Each raw material weighs differently, decomposes at different rates, and requires capital to process into compost. This was of particular importance when observing Enterprise C. While the enterprise received the highest gross margin among its counterparts, it consumed the greatest amount of raw material to produce one quintal of compost. These variables should be evaluated prior to the practice of composting.

Efficient agri-business practices by new adopters must not be solely evaluated by output (e.g., the number of bags of compost produced), but also by their ability to continue without outside financial support. Agricultural extension educators who direct newly initiated compost micro-enterprises must not only be capable of instructing the actual practice of composting, but also develop competencies to evaluate financial aspects of these types of businesses. It is critical that adopters be educated in determining the short and long-term profitability of their operations.

Additional areas should be explored within this field, including efficient labor use, raw material formulas that provide ample output and high-quality compost, and other economic aspects that contribute to financial success. If the profitable outcome of an enterprise's practice cannot be predicted by its entrepreneur, its financial outcome may not only be jeopardized, but the economic livelihood of the community it employs.

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