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# Strategic Potential of the Vermicompost Agribusiness in Iran: A SWOT Analysis

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## ABSTRACT

**Vermicomposting, or using worms along with bacteria and fungi to recycle agricultural and organic wastes into nutrient-rich bio-fertilizer, has a variety of uses including protecting plants from disease. Through semi-structured in-person interviews, vermicompost practitioners across Kermanshah Province of Iran were surveyed to determine the strengths, weaknesses, opportunities, and threats (SWOT) of this emerging technology. The results provide useful implications for agricultural policymakers in general, and, in particular, for farmers who are seeking diversified sources of income. For both vermicompost practitioners and academicians alike, the SWOT analysis methodology combined with Analytic Network Process (ANP) analysis has implications for other types of agribusiness.**

**Keywords:** SWOT analysis, ANP analysis, Income diversification, Vermicompost agribusiness.



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## INTRODUCTION

Vermicompost applications are emerging as important organic manures around the world. Varalakshmi *et al*. (2012) investigated the use of these organic manures produced by earthworms as a potential micro-enterprise for India, particularly as an enterprise to improve the economic status of women. They found the use of vermicompost helps improve and protect top soil and its fertility and also improves productivity of lower nutrient inputs while improving the end product quality. Their findings noted improved plant resistance to disease and pests while using vermicompost manure as well as sustainability management of biodiversity.

Davies (2014) states that the earthworm has a key ecological role in speeding the decomposition of organic waste and the agribusiness of vermiculture is a growing one for gardeners, farmers, and those who desire a supplemental income source. Edwards *et al*. (2010) agree that vermiculture technology turns waste into value-added, environmentally friendly products. The products not only improve soil fertility but also can improve productivity on a large scale. The authors cite a growing vermiculture technology since 1988 and cite US and UK government-funded projects as the reason. The low labor demanding, fully automated, continuous flow vermicomposting reactor systems can process up to 1,000 tons of organic wastes per reactor each year. According to Edwards *et al*. (2010), vermiculture can be developed into commercial and industrial applications in a variety of countries, applications, and integrated waste management systems.

Vermicompost is composting using different types of earthworms to create a mix of decomposing food waste and vermicast, or worm castings. Ndegwa *et al*. (2000) found that these worm castings contain reduced

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levels of contaminants and a higher saturation of nutrients than organic materials before vermicomposting. Coyne and Knutzen (2008) state that vermicompost is an excellent, nutrient-rich organic fertilizer and soil conditioner. Large-scale vermicomposting is in operation in Canada, Italy, Japan, Malaysia, the Philippines, and the United States (Aalok *et al*., 2008).

Some studies have examined sustainable agricultural practice needs in Iran (Sadighi and Roosta, 2002) and even iron-enriched vermicompost on growth and nutrition of crops has been studied in some areas (Hashemimajd and Golchin, 2009), but studies have not examined the vermicomposting's viability as a new venture creation. The emerging agribusiness seems to hold promise for diffusion, but in-depth analysis is needed for further decision making on expansion. Findings from vermicompost farmers can help define this as a potentially sustainable agribusiness for the country. The purpose of this study was to gather information from vermicompost practitioners for agribusiness development in Kermanshah Province and for the whole country of Iran. The paper presents an overview of the vermicomposting agribusiness and uses SWOT analysis and ANP analysis to arrive at its findings. Discussion for academicians using this method of analysis is included along with suggestions for agribusiness practitioners and, finally, areas for future research.

## MATERIALS AND METHODS

The methodology for gathering vermicompost agribusiness data was to survey agribusiness practitioners and use the popular strategic management tool of SWOT analysis. Categorizing issues into "Strengths, Weaknesses, Opportunities, and Threats", is a widely used strategic planning tool (Glaister and Falshaw, 1999), assisting in the identification of environmental relationships as well as the development of suitable paths for countries, organizations, or entities (Proctor, 1992).

As in the case of agriculture, Valentin (2001) suggests SWOT analysis be used to search for insights into ways of crafting and maintaining a profitable fit between a commercial venture and its environment. Other researchers (Ansoff, 1965; Andrews, 1987; Porter, 1991; Mintzberg *et al.,* 1998) support the use of SWOT methodologies to identify an alignment of variables or issues.

SWOT analysis lists favorable and unfavorable internal and external issues in four quadrants. Users of the information can better understand how strengths can be leveraged to realize new opportunities and understand how weaknesses can slow progress or magnify threats. Hofer and Schendel (1978), Schnaars (1998), McDonald (1999) and Kotler (2000) agree that it is possible to identify ways to overcome threats and weaknesses.

SWOT has been used in the analysis of a number of developed and developing economies and has contributed to an understanding of manufacturing location decisions, regional economic development and performance and behavior of new micro-firms (Helms, 1999; Roberts and Stimson, 1998; Smith, 1999).

Applications of SWOT have been used as a tool to assess the implementation of an environmental management system, agribusiness global competitiveness, competitive advantages of government, country concentration in a major agribusiness, and for company performance and quality. SWOT analysis is a trusted and respected method of profiling the general environmental position of a country or company (Lozano and Valles, 2007; Shinno *et al*., 2006; Chang and Lin, 2005; Tam *et al*., 2005; and Ahmed *et al*., 2006). Panagiotou (2003) affirms that SWOT analysis is used more than any other strategic planning tool. The SWOT methodology has been used in other studies in Kermanshah. Panahi and Akbari (2013) used SWOT to study the feasibility of rural industries. Falahati and Veisifu (2013) studied the small processing





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industries and used the popular methodology. Finally Safari et *al*., (2013) used SWOT analysis to study entrepreneurship and job creation in the region. Using the popular strategic tool of SWOT analysis, it is possible to apply strategic thinking toward new SME business creation in Iran and examine the internalities and externalities interacting for, and more importantly, against vermicompost farming. By uncovering and reviewing the issues, policy makers can enact changes making the process for expanding agribusiness easier while simultaneously working to change the culture and encourage entrepreneurial growth in this new "green" farming method.

To overcome the weaknesses of SWOT analysis (Drago and Folker, 1999; Haberberg, 2000; Warren, 2002), the authors agreed the framework should be used in combinations with other strategic tools, given the difficulty in interpreting qualitative data in a scientific way (Cornford and Smithson, 1996). Suggestions of tools for expanding and validating SWOT findings range from Porter's (1980) 5-Forces Analysis, Malcolm Baldrige National Quality Award criteria, quality function deployment, balanced scorecard, and Analytic Hierarchy Process (AHP) or Analytic Network Process (ANP) which both rank and prioritize each SWOT element using specialized software (Shinno *et al*., 2006; and for a discussion of methods, see Helms and Nixon, 2010). The analytical network process is a general form of the AHP where multi-criteria decisions are used in a structure. Given the quantitative rigor of ANP, the authors chose this methodology to use in concert with the qualitative SWOT data gathered. The ANP extends the SWOT findings by using pairwise comparisons to measure the weights of the components or variables from SWOT within the structure and the decision criteria finally rank the alternatives. Interestingly, the analytic hierarchy process followed by sensitivity analysis was the methodology used to examine the agricultural environmental effects of forest roads in Iran and the authors recommended the multi-criteria evaluation and decision making be extended (Hayati *et al*., 2013).

This analytic network processing methodology applies a quantitative analysis to the SWOT analysis and the proposed algorithm allows for measurement among the dependent factors in the vermicompost agribusiness (see Yuksel and Dagdeviren, 2007 for a discussion of ANP analysis with SWOT and dependent variables). The ANP methodology (a more robust form of AHP) is widely used in the literature for multi-criteria decision-making and strategy optimization. For example, Baby (2013) used the technique in a study on protecting coastal landscape resources while Palanisamy and Abdul Zubar (2013) used the technique to make a final vendor ranking selection. Saaty (2013) believes that the AHP/ANP approach is useful for measuring tangible and intangible factors as they are applied to decision making. Further studies have used the methods in a variety of industries including Toker *et al*. (2013) in the pharmaceutical agribusiness in Turkey; Viaggi (2013) in analysis of innovations in Bioeconomy, and Tong and Nachtmann (2013) in cargo prioritization with inland waterway transportation.

## The Study Area: The Province of Kermanshah

Kermanshah is the capital city of the province of the same name in western Iran, located less than 350 miles from Tehran, and has a mountainous land and moderate climate and regular seasons. Key agribusiness in the region is the production of cereals (wheat, barley, and corn), oilseeds, vegetables and fruits. Other key industries include textile manufacturing, food processing, sugar refining, cement production, and weaving of Persian carpet. The area is transitioning to an industrial city as it focuses on petrochemical refineries and the production of tools and electrical equipment. The Kermanshah Oil Refining Company is one of the city's major





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industries and the city is important for both import and export for Iran. The city is home to five major universities. Tourism has been studied as growing in importance in the province (Daryaei *et al*., 2012), along with the feasibility of rural industrial development in Kermanshah (Panahi and Akbari, 2013).

### The Vermicompost Agribusiness

During the past three decades, vermicompost production began in Kermanshah Province, initially with research and development, then, training of vermicompost producers. Vermicompost found its way in most higher education establishments due to unsustainability of chemical fertilizers. Some major provinces in Iran such as Khorasan, Fars, Alborz and the capital city of Tehran are primary vermicompost initiators. Kermanshah Province started vermicompost production in 2006 and ranked 5$^{th}$ among major provinces in Iran. Moreover, the Agricultural Organization in Kermanshah Province has recently promoted the Office of Environment and Sustainable Development (OESD) to diffuse vermicompost agribusiness to potential producers. This office has established a link with agricultural faculties to promote research and development in vermicompost technology.

### Sample Demographics

For this study, purposeful sampling was used from a list of all vermicompost producers in the province (52 total producers) obtained from OESD in Agricultural Organization. Data was gathered through semi-structured interview. The questions asked included: If you want to start a new enterprise again, do you repeat your selection? The process of interview was started through phone calling with the subjects.

### Personal Surveys and Focus Groups

The population of producers was narrowed to the final sample. Expert consensus recommended interviewing those with a minimum of two years experience. New and nascent producers lacked sufficient depth of agribusiness knowledge for SWOT analysis leading to strategy development. In addition, some farmers on the original list were no longer in operation. The remaining sample of 21 individuals represented some 40% of local vermicompost producers.

The authors visited the respondent's operations and surveyed them during October 2013. The average time was 45 minutes for the semi-structured, in-person interviews. Respondents were told that their participation was voluntary and confidentiality of individual data was assured, as responses would only be reported in aggregate formats and qualitative comments not identified to respondents. All survey respondents were owners and most operations were small and often had no additional level of management.

After the first round of interviews, the authors drafted a preliminary SWOT list from the qualitative findings and returned the composite list to the original participants and asked them to review the list to determine if additions to the SWOT or changes to the original SWOT classifications were needed (Table 1). Finally, the authors, who had experience in conducing focus groups, held a focus group meeting with five participants from the original sample, to rank the SWOT findings.

## RESULTS

### Initial SWOT Classification

The first step of study grouped the SWOT variables identified by the respondents into the four SWOT categories. The research team classified the factors independently and then jointly to verify and vet the correct





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**Table 1.** Initial SWOT Analysis.

Strengths:

- Abundance of farm manure makes it most appropriate for the production of vermicompost
- Cow manure in the villages which makes it more valuable than chicken and sheep manure
- Suitable climate in the province which helps to produce vermicompost
- Crop and orchard farmers are using vermicompost
- High profit agribusiness - making something from nothing or further processing of a waste product
- Good marketing strategies by producers through Internet websites and pamphlets
- Population of worms doubles every two to three months of production
- Increase in crop performance (alfalfa) and orchard performance (apple)
- Producing vermicompost is easy with limited resources
- Break-even is reached within three months. Needs limited capital investment in small scale production
- Has comparative advantage over farmyard manure (light, lack of acid, no weeds)
- Makes use of existing domestic and agricultural wastes
- Needs limited skills
- Enhances employability skills for rural women and rural youth
- Helps to reduce migration from rural settings to urban settings

It has the potential to be packaged in attractive packaging

Weaknesses:

- Needs larger investments for large scale operations
- Lower reproduction of worms during winter
- Producers do not pay attention to marketing advertisements.
- Farmers feel that vermicompost is expensive to use in their farm.
- Producers do not belong to any union.
- Rural people find it a risky business.
- Farmers are reluctant in adopting vermicompost instead of chemical fertilizer
- Takes time for farm manure (cow manure) to decay so that it can be used for bedding for vermicompost production
- Hard to keep worms from leaving their place when it is raining
- Lack of good technological practice when designing vermicompost site due to lack of knowledge or money.
- Marketing is lacking. Products and by-products are hard to sell

Opportunities:

- Kermanshah Province is known for its agricultural potentials
- Great potential to produce vermin-compost in the province
- Helps in food security of rural population
- Rural officials look at it as a potential micro-enterprise
- Cleaner village – no manure scattered all around the village
- Reducing migration
- Younger villagers show interest in entrepreneurial venture in vermin-compost business
- Vermicompost motivates other farm manure producers to get involved - better than burning or selling cow manure for a very low price
- Crop and orchard farmers get more involved with Ministry of Agriculture in research and development
- Vermicompost can be used as soil coverage Some types of worms can be sold for use in the medicial agribusiness
- Possible soil cover for mushroom production
- It is possible to export vermicompost to other provinces
- It can compete with fertilizers produced from domestic garbage which needs a bigger investment than vermicompost production
- It can be used as a livestock and poultry feed therefore reduces dependence from importing livestock and poultry feed from other countries
- Support from non-agricultural public organizations for those interested to start a venture in vermicompost (NGO support with low interest rate loans)
- Greenhouse nurseries and flower shops can use vermicompost for their operations
- The worms can be used in aquaculture production and in the cosmetic/make up agribusiness
- The vermin--compost can be used as a farmyard manure to make the soil more productive
- Vermicompost can be introduced in exhibitions across town so that citizens are made aware of such technology
- It has a potential to be diffused across rural areas by agricultural extension agents
- It can be exported to neighboring country
- Can be used to engage agricultural graduates in entrepreneurial activity

Threats:

- Marketing vermicompost is a challenge
- Lack of support by Ministry of Agriculture towards potential producers
- Worms are not easily accessible for purchase
- Vermicompost market seems to be a in the hands of certain key producers. Strong competitors make staying in business a challenge.
- Strong competitors from other vermicompost producers in the country
- The market is full of fake or low quality worms
- Large bureaucracy when applying for business license
- Some producers are active without required licensing.
- Imports of worms makes interferes with domestic production
- Lack of manufacture processing facilities to make better use of by-products.
- The role of mediators makes business difficult
- Limited purchasing of vermicompost products by the government
- Difficult to obtain licenses for exporting vermicompost products
- Farmers lack knowledge of the benefits of vermicompost
- Consumers lack knowledge of the benefits of vermicompost
- Government bodies engaged in agricultural sector do not have a thorough knowledge of vermicompost
- Low quality vermicompost imports from inside and outside the country and passive monitoring by government bodies
- Culture among farmers does not promote starting a venture in vermicompost
- Farmers' lack of trust towards vermicompost and risk averse attitudes toward production

classification of factors. These SWOT variables were returned to the initial survey respondents for further agreement on the classifications of the complete list of variables for the vermicomposting agribusiness and its potential in the province of Kermanshah.

## Four Emerging Strategies

As shown in Table 2, four strategies emerged from the classification, ranking, and discussions. The highest ranked internal factors (S and W) on the horizontal axis were combined with the top external factors (O and T) on the vertical axis. Four possible strategies emerged by combining these top factors. For example, SO strategy (Strengths/Opportunities) involves using opportunities by leveraging the existing strengths in the vermicompost technology. The WO (Weaknesses/Opportunities) strategy seeks to gain benefit from the opportunities presented by the external factors by taking into account the weaknesses of the vermicomposting technology. Similarly, the ST (Strengths/Threats) strategy works to leverage the vermicompost technology's strengths in the community that can be used to reduce the effects of potential threats. The final strategy, i.e. WT (Weaknesses/Threats) works to reduce the effects of the agribusiness's potential threats by taking its identified weaknesses into account.

## The Analytic Network Process

Without more analysis, it is unclear which of the four emerging strategies from the SWOT analysis and rankings would be the most appropriate to address the growth of the vermicompost industry.

### Step 1

The vermicompost problem was then converted into a hierarchical structure to transform the sub-factors and alternative strategies from the SWOT analysis into a state in which they could be measured by the ANP technique (see Figure 1).

The final goal is determining the best strategy to place in the first level of the ANP model. The SWOT factors (Strengths, Weaknesses, Opportunities, and Threats) are in the second level of the figure. The top ranked SWOT sub-factors from Table 2 are in the third level and include: three sub-factors for the Strengths factor, four sub-factors for the Weaknesses, four sub-factors for the Opportunities, and three sub-factors for the Threats. The four alternative strategies developed for this study (Table 2) were placed in the last level of the model.

### Step 2

Assuming that there is no dependence among the SWOT factors, pair-wise comparison of the SWOT factors using a 1–9 scale was used. The comparison results are shown in Table 3. All pair-wise comparisons in the application are performed by the expert team. The pair-wise comparison matrix was analyzed using Expert Choice (http://expertchoice.com/) software, and the -eigenvector was obtained. In addition, the Consistency Ratio (CR) was placed in the last row of the matrix.

$$W1 = \begin{pmatrix} 0.083 \\ 0.057 \\ 0.596 \\ 0.264 \end{pmatrix} \quad (1)$$

### Step 3

Using a 1 to 9 scale, we determined the inner dependence matrix of each SWOT factor with respect to the other factors by using the schematic representation of inner dependence among the SWOT factors to calculate *W2*. See Tables 4, 5, and 6 for the calculations with respect to "weaknesses," "strengths," and "threats."

$$W2 = \begin{pmatrix} 1 & 0.873 & 1 & 0.778 \\ 0.077 & 1 & 0 & 0.222 \\ 0.566 & 0 & 1 & 0 \\ 0.357 & 0.127 & 0 & 1 \end{pmatrix} \quad (2)$$





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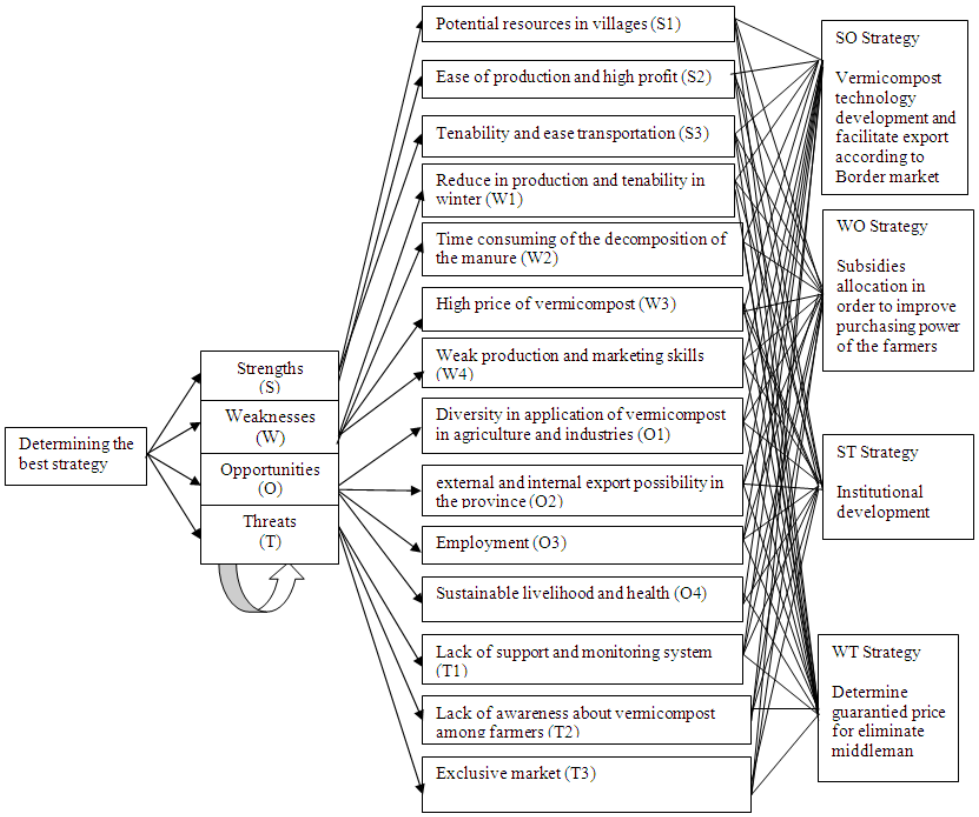


**Figure 1.** ANP model for SWOT.

**Table 2.** The SWOT matrix developed from The respondent interviews.

| | Internal Factors | |
|---|---|---|
| | Strengths (S)<br>- Potential resources in villages (S1)<br>- Ease of production and high profit (S2)<br>- Tenability and ease transportation (S3) | Weaknesses (W)<br>- Reduce in production and tenability in winter (W1)<br>- Time consuming of the decomposition of the manure (W2)<br>- High price of vermicompst (W3)<br>- Weak production and marketing skills (W4) |
| External Factors<br>Opportunities (O)<br>- Diversity in application of vermicompost in agriculture and industries (O1)<br>- External and internal export possibility in the province (O2)<br>- Employment (O3)<br>- Sustainable livelihood and health (O4) | 1. SO Strategy<br><br>Vermicompost technology development and facilitate export according to border market | 2. WO Strategy<br><br>Subsidies allocation in order to improve purchasing power of the farmers |
| Threats (T)<br>- Lack of support and monitoring system (T1)<br>- Lack of awareness about vermicompost among farmers (T2)<br>- Exclusive market (T3) | 3. ST Strategy<br><br>Institutional development | 4. WT Strategy<br><br>Determine guaranteed price for elimination of middleman |





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**Table 3.** Pair-wise comparison of SWOT factors by assuming that there is no dependence among them**.**

| SWOT factors | (S) | (W) | (O) | (T) | Importance degrees of SWOT factors |
|---|---|---|---|---|---|
| Strengths(S) | 1 | 1.587 | 6.868 | 3.476 | 0.083 |
| Weaknesses (W) | | 1 | 7.651 | 5.738 | 0.057 |
| Opportunities (O) | | | 1 | 3.107 | 0.596 |
| Threats (T) | | | | 1 | 0.264 |

**Table 4.** The inner dependence matrix of the SWOT factors with respect to ‘‘Weaknesses’’.

| Weaknesses (W) | (S) | (T) | Importance degrees of SWOT factors |
|---|---|---|---|
| Strengths (S) | 1 | 6.900 | 0.873 |
| Threats (T) | | 1 | 0.127 |

CR= 0.00.

**Table 5.** The inner dependence matrix of the SWOT factors with respect to ‘‘Strengths’’.

| Strengths(S) | (W) | (O) | (T) | Importance degrees of SWOT factors |
|---|---|---|---|---|
| Weaknesses (W) | 1 | 6.804 | 5.013 | 0.077 |
| Opportunities (O) | | 1 | 1.709 | 0.566 |
| Threats (T) | | | 1 | 0.357 |

CR= 0.00

**Table 6.** The inner dependence matrix of the SWOT factors with respect to ‘‘Threats’’**.**

| Threats(T) | (S) | (W) | Importance degrees of SWOT factors |
|---|---|---|---|
| Strengths (S) | 1 | 3.49 | 0.778 |
| Weaknesses (W) | | 1 | 0.222 |

CR= 0.00

**Step 4**

The next step was to determine the interdependent priorities of the SWOT factors.
*Calculate* $W_{factors} = W1 \times W2$

$$W_{\mathbf{factors}} = W1 \times W2 = \begin{pmatrix} 0.083 \\ 0.057 \\ 0.596 \\ 0.264 \end{pmatrix} \times \begin{pmatrix} 1 & 0.873 & 1 & 0.778 \\ 0.077 & 1 & 0 & 0.222 \\ 0.566 & 0 & 1 & 0 \\ 0.357 & 0.127 & 0 & 1 \end{pmatrix} = \begin{pmatrix} 0.933 \\ 0.121 \\ 0.642 \\ 0.300 \end{pmatrix} \quad (3)$$

**Step 5**

Next, we determined the local importance degrees of the SWOT sub-factors with a 1–9 scale (calculate $W_{\text{sub-factors (local)}}$). Table 7 shows the pair wise comparison matrices.

$$W_{sub-factor(S)} = \begin{pmatrix} 0.318 \\ 0.575 \\ 0.108 \end{pmatrix} \qquad W_{sub-factor(W)} = \begin{pmatrix} 0.094 \\ 0.123 \\ 0.540 \\ 0.244 \end{pmatrix} \quad (4)$$

$$W_{sub-factor(O)} = \begin{pmatrix} 0.352 \\ 0.448 \\ 0.109 \\ 0.091 \end{pmatrix} \qquad W_{sub-factor(T)} = \begin{pmatrix} 0.740 \\ 0.065 \\ 0.196 \end{pmatrix}$$





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**Step 6**

In this step, the overall priorities of the SWOT sub-factors were calculated by multiplying the interdependent priorities of SWOT factors found in Step 4 with the local priorities of SWOT sub-factors obtained in Step 5. The computations are presented in Table 8. The $W_{sub\text{-}factors\ global}$ vector, obtained by using the overall priority values of the sub-factors in Table 8, is provided equation 5.

$$W_{Subfactors\,(global)} = \begin{pmatrix} 0.296 \\ 0.536 \\ 0.100 \\ 0.011 \\ 0.014 \\ 0.065 \\ 0.029 \\ 0.225 \\ 0.287 \\ 0.069 \\ 0.058 \\ 0.222 \\ 0.019 \\ 0.058 \end{pmatrix} \quad (5)$$

**Step 7**

In this step, the authors calculated the importance of the alternative strategies with respect to each SWOT sub-factors as shown in Table 9.

$$W4 = \begin{pmatrix} 0.076 & 0.130 & 0.228 & 0.076 & 0.083 & 0.064 & 0.069 & 0.092 & 0.089 & 0.074 & 0.075 & 0.072 & 0.118 & 0.106 \\ 0.101 & 0.224 & 0.226 & 0.190 & 0.162 & 0.115 & 0.137 & 0.191 & 0.147 & 0.177 & 0.192 & 0.164 & 0.180 & 0.218 \\ 0.440 & 0.357 & 0.226 & 0.369 & 0.341 & 0.352 & 0.381 & 0.350 & 0.251 & 0.294 & 0.299 & 0.447 & 0.363 & 0.326 \\ 0.383 & 0.289 & 0.320 & 0.364 & 0.414 & 0.469 & 0.413 & 0.368 & 0.513 & 0.454 & 0.435 & 0.317 & 0.339 & 0.350 \end{pmatrix} \quad (6)$$

**Step 8**

Finally, the overall priorities of the alternative strategies, reflecting the interrelationships within the SWOT factors, were calculated as follows:

$$W_{strategies} = \begin{pmatrix} SO \\ WO \\ ST \\ WT \end{pmatrix} = W_{sub-factor\ global} \times W4 \quad (7)$$

$$\begin{pmatrix} 0.296 \\ 0.536 \\ 0.100 \\ 0.011 \\ 0.014 \\ 0.065 \\ 0.029 \\ 0.225 \\ 0.287 \\ 0.069 \\ 0.058 \\ 0.222 \\ 0.019 \\ 0.058 \end{pmatrix} \times \begin{pmatrix} 0.076 & 0.130 & 0.228 & 0.076 & 0.083 & 0.064 & 0.069 & 0.092 & 0.089 & 0.074 & 0.075 & 0.072 & 0.118 & 0.106 \\ 0.101 & 0.224 & 0.226 & 0.190 & 0.162 & 0.115 & 0.137 & 0.191 & 0.147 & 0.177 & 0.192 & 0.164 & 0.180 & 0.218 \\ 0.440 & 0.357 & 0.226 & 0.369 & 0.341 & 0.352 & 0.381 & 0.350 & 0.251 & 0.294 & 0.299 & 0.447 & 0.363 & 0.326 \\ 0.383 & 0.289 & 0.320 & 0.364 & 0.414 & 0.469 & 0.413 & 0.368 & 0.513 & 0.454 & 0.435 & 0.317 & 0.339 & 0.350 \end{pmatrix}$$

$$\begin{pmatrix} SO \\ WO \\ ST \\ WT \end{pmatrix} = \begin{pmatrix} 0.630 \\ 0.301 \\ 0.694 \\ 0.205 \end{pmatrix}$$





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**Table 7.** Pair wise comparison matrices for SWOT sub-factors local priorities.

| Strengths(S) | S1 | S2 | S3 | Local weights |
|---|---|---|---|---|
| S1 | 1 | 2.320 | 3.77 | 0.318 |
| S2 | | 1 | 4.16 | 0.575 |
| S3 | | | 1 | 0.108 |

CR= 0.06.

| Weaknesses(W) | W1 | W2 | W3 | W4 | Local weights |
|---|---|---|---|---|---|
| W1 | 1 | 1.386 | 5.129 | 2.714 | 0.094 |
| W2 | | 1 | 4.308 | 2.154 | 0.123 |
| W3 | | | 1 | 2.519 | 0.540 |
| W4 | | | | 1 | 0.244 |

CR= 0.003.

| Opportunities(O) | O1 | O2 | O3 | O4 | Local weights |
|---|---|---|---|---|---|
| O1 | 1 | 1.442 | 3.556 | 3.979 | 0.352 |
| O2 | | 1 | 3.914 | 4.578 | 0.448 |
| O3 | | | 1 | 1.259 | 0.109 |
| O4 | | | | 1 | 0.091 |

CR= 0.00.

| Threats (T) | T1 | T2 | T3 | Local weights |
|---|---|---|---|---|
| T1 | 1 | 8.653 | 5 | 0/740 |
| T2 | | 1 | 4 | 0/065 |
| T3 | | | 1 | 0/196 |

CR= 0.07.

**Table 8.** Overall priority of the SWOT sub-factors.

| SWOT factors | Priority of the factors | $SWOT_{sub\text{-}factor}$ | Priority of the sub-factors | Overall priority of the sub-factors |
|---|---|---|---|---|
| Strengths | 0.933 | S1 | 0.318 | 0.296 |
| | | S2 | 0.575 | 0.536 |
| | | S3 | 0.108 | 0.108 |
| Weakness | 0.121 | W1 | 0.094 | 0.011 |
| | | W2 | 0.123 | 0.014 |
| | | W3 | 0.540 | 0.065 |
| | | W4 | 0.244 | 0.029 |
| Opportunities | 0.642 | O1 | 0.352 | 0.225 |
| | | O2 | 0.448 | 0.287 |
| | | O3 | 0.109 | 0.069 |
| | | O4 | 0.091 | 0.058 |
| Threats | 0.300 | T1 | 0.740 | 0.222 |
| | | T2 | 0.065 | 0.019 |
| | | T3 | 0.196 | 0.058 |





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**Table 9.** Pair-wise comparison matrices for the priorities of the alternative strategies based on the SWOT sub-factors.

| S1 | WT | WO | ST | SO | Local weights |
|---|---|---|---|---|---|
| WT | 1 | 1.58 | 5.31 | 4.57 | 0.076 |
| WO | | 1 | 4.76 | 4.16 | 0.101 |
| ST | | | 1 | 1.14 | 0.440 |
| SO | | | | 1 | 0.383 |
| CR= 0.006. | | | | | |
| S2 | WT | WO | ST | SO | Local weights |
| WT | 1 | 2.28 | 2.154 | 2.154 | 0.130 |
| WO | | 1 | 1.74 | 1.58 | 0.224 |
| ST | | | 1 | 1.44 | 0.357 |
| SO | | | | 1 | 0.289 |
| CR= 0.02. | | | | | |
| S3 | WT | WO | ST | SO | Local weights |
| WT | 1 | 1.1 | 1.25 | 1.58 | 0.228 |
| WO | | 1 | 1.25 | 1.25 | 0.226 |
| ST | | | 1 | 1.44 | 0.226 |
| SO | | | | 1 | 0.320 |
| CR= 0.01. | | | | | |
| W1 | WT | WO | ST | SO | Local weights |
| WT | 1 | 3.91 | 4.64 | 3.30 | 0.076 |
| WO | | 1 | 2.28 | 2.71 | 0.190 |
| ST | | | 1 | 1 | 0.369 |
| SO | | | | 1 | 0.364 |
| CR= 0.05. | | | | | |
| W2 | WT | WO | ST | SO | Local weights |
| WT | 1 | 3 | 3.30 | 4 | 0.083 |
| WO | | 1 | 3.30 | 2.62 | 0.162 |
| ST | | | 1 | 1.58 | 0.341 |
| SO | | | | 1 | 0.414 |
| CR= 0.05. | | | | | |
| W3 | WT | WO | ST | SO | Local weights |
| WT | 1 | 2.88 | 4.30 | 5.94 | 0.064 |
| WO | | 1 | 4.64 | 4.64 | 0.115 |
| ST | | | 1 | 1.58 | 0.352 |
| SO | | | | 1 | 0.469 |
| CR= 0.05. | | | | | |
| W4 | WT | WO | ST | SO | Local weights |
| WT | 1 | 3.30 | 4.30 | 4.64 | 0.069 |
| WO | | 1 | 4.21 | 3.68 | 0.137 |
| ST | | | 1 | 1.25 | 0.381 |
| SO | | | | 1 | 0.413 |
| CR= 0.06. | | | | | |
| O1 | WT | WO | ST | SO | Local weights |
| WT | 1 | 3.30 | 3.30 | 3 | 0.092 |
| WO | | 1 | 2.6 | 2.28 | 0.191 |
| ST | | | 1 | 1.25 | 0.350 |
| SO | | | | 1 | 0.361 |
| CR= 0.05. | | | | | |
| O2 | WT | WO | ST | SO | Local weights |
| WT | 1 | 2.51 | 2.28 | 4.64 | 0.089 |
| WO | | 1 | 2.62 | 3.63 | 0.147 |
| ST | | | 1 | 2.62 | 0.251 |
| SO | | | | 1 | 0.513 |
| CR= 0.05. | | | | | |

**Table 9.** Continued.





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Continued of **Table 9.**

| O3 | WT | WO | ST | SO | Local weights |
|---|---|---|---|---|---|
| WT | 1 | 3.30 | 2.88 | 6.31 | 0.074 |
| WO | | 1 | 2.28 | 2.62 | 0.177 |
| ST | | | 1 | 1.58 | 0.294 |
| SO | | | | 1 | 0.454 |
| CR= 0.03. | | | | | |
| O4 | WT | WO | ST | SO | Local weights |
| WT | 1 | 3.30 | 3.91 | 4.64 | 0.075 |
| WO | | 1 | 2 | 2.28 | 0.192 |
| ST | | | 1 | 1.81 | 0.299 |
| SO | | | | 1 | 0.435 |
| CR= 0.02. | | | | | |
| T1 | WT | WO | ST | SO | Local weights |
| WT | 1 | 2.92 | 5 | 4.30 | 0.072 |
| WO | | 1 | 3.30 | 2.08 | 0.164 |
| ST | | | 1 | 1.44 | 0.447 |
| SO | | | | 1 | 0.317 |
| CR= 0.01. | | | | | |
| T2 | WT | WO | ST | SO | Local weights |
| WT | 1 | 2.28 | 2.62 | 2.28 | 0.118 |
| WO | | 1 | 2.62 | 2.28 | 0.180 |
| ST | | | 1 | 1 | 0.363 |
| SO | | | | 1 | 0.339 |
| CR= 0.03. | | | | | |
| T3 | WT | WO | ST | SO | Local weights |
| WT | 1 | 3 | 2.62 | 2.62 | 0.106 |
| WO | | 1 | 2.28 | 1.58 | 0.218 |
| ST | | | 1 | 1.44 | 0.326 |
| SO | | | | 1 | 0.350 |
| CR= 0.05. | | | | | |

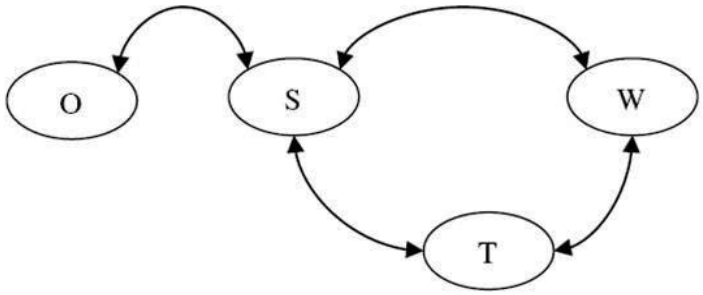


**Figure 2.** Inner dependence among SWOT factors

The ANP analysis results indicated that *ST* was the best strategy of the four initial strategic choices (see Table 2) for the development of vermicompost technology development in Kermanshah Province with an overall priority value of 0.694. For example, if vermicompost enterprises are to develop, more institutional support from the government of Iran is needed.

## DISCUSSION

Based on the ANP analysis, the vermicompost agribusiness does hold much potential for the province and for the country of Iran. However, due to the nascent nature of vermicompost business in Kermanshah





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Province, more institutional support is needed. For example, at present, only the OESD in Agricultural Organization is providing advices and support to potential vermicompost producers. However, other stakeholders need to engage in supporting potential producers. Moreover, agricultural faculties should team with the provincial Agricultural Organization to provide extensive institutional support.

## CONCLUSION

The agribusiness seems to be in a nascent or emerging stage of the lifecycle with little proliferation or acceptance by the wider community. Much remains in marketing the benefits of this agribusiness. Support from the government should offer incentives, grants, and other subsidies to encourage entry in vermicomposting. For the existing agribusiness practitioners, much support is needed to assist them. Most are small operators who have little time to promote the agribusiness and the benefits of vermicompost fertilizer, as they are too engaged with day-to-day operations. As in other countries and other industries, some centralized focus by the government can work to realign the economy to support such new and emerging industries. With much interest in the rural areas of the province to find suitable entrepreneurial activities and many unemployed or underemployed individuals, particularly women, the agribusiness seems a viable choice for the region. The seemingly unlimited supply of manure from farming, plus a focus on vegetable production and expertise, the agribusiness is a way to use a waste product in further processing for organic recycling.

### Areas for Future Research

The data in this exploratory study have identified that even in a small sample in an emerging agribusiness there is potential for growth and possibilities for profitability from this vermicomposting agribusiness. More research is needed to confirm and extend these findings as well as identify specific research and cases on the vermicomposting agribusiness, particularly profiling an operation that has moved from the introductory life cycle stage to a more mature, profitable level to serve as an example. Similarly, additional research should consider how merging SWOT analysis with ANP methodology can overcome some of the weaknesses of the popular SWOT method of analysis.

Additionally, research is needed to more clearly identify other industries operating with a similar structure to benefit the region of Iran without solely concentrating on one agribusiness. An exploration of differences among and between successful vermicomposting operations is also needed. In-depth case studies also may better profile specific small businesses with success in achieving the growth necessary for sustainability.

Finally, future research should study the progression of the agribusiness to assist the Iranian government in marketing the benefits of the agribusiness. Other research on recycling methods in a closed-loop system is needed. The emerging model could offer additional areas of study for other recycling operations and should profile the benefits of this "green" agribusiness from reclamation, reuse, and recycling perspective.

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## پتانسیل‌های راهبردی در راه اندازی کسب و کارهای ورمی کمپوست در ایران: تحلیل سوات (SWOT)

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### چکیده

ورمی کمپوستینگ یا استفاده کرم ها به همراه باکتری ها و قارچ ها از زباله های آلی و کشاورزی و بازیافت آن به یک کود زیستی و غنی از مواد مغذی، یکی از شیوه های متنوع حفاظت از گیاهان در برابر بیماری ها می باشد. در این میان، مصاحبه های انفرادی نیمه ساختاریافته ای از تولیدکنندگان ورمی کمپوست در یکی از استان های ایران (کرمانشاه) جهت شناسایی نقاط قوت، نقاط ضعف، فرصت ها و تهدیدهای این فناوری به عمل آمد. نتایج حاصل از این مطالعه می تواند برای سیاستمداران بخش کشاورزی بطور اعم و برای کشاورزان جهت افزایش تنوع درآمدی خود بطور اخص، مثمر ثمر واقع گردد. برای هردو بخش دانشگاهی و غیر دانشگاهی، ترکیب روش تحلیل SWOT به همراه فرآیند





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تحلیل شبکه (ANP) می تواند دستاوردهایی هم به لحاظ روش شناسی و هم به لحاظ گسترش صنعت ورمی کمپوست به دنبال داشته باشد.



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