GeoJournal
https://doi.org/10.1007/s10708-019-10063-9

Model-based strategic planning for strengthening mushroom entrepreneurship: insights from a sub-Himalayan Region of West Bengal, India

Pritha Datta · Soumik Das

Abstract Mushrooms are not only beneficial for health but also its production procedure makes it environment-friendly and at the same time can be an adaptation strategy for building climate resilient livelihoods. The present study explores the potentiality of mushroom cultivation in poverty-prone sub-Himalayan Cooch Behar district of West Bengal, India and also develops strategies to address the existing constraints using SWOT, TOWS, and QSPM models. SWOT analysis provides a comprehensive view of twelve internal and nine external factors present in the mushroom cultivation and marketing system. The results of Internal Factor Evaluation Matrix (2.88) and External Factor Evaluation Matrix (2.63) show, strengths and opportunities overweight weaknesses and threats; therefore, the district is well suited for mushroom cultivation. As it is a new venture, producers face difficulties mainly in terms of marketing and pest management. To enhance the current competitiveness, ten strategies are suggested. Moreover, the QSPM analysis reveals that development of strong marketing linkages, ensuring local market demand, implementation of integrated pest and disease management, and construction of scientific mushroom houses are the top four prioritized strategies. With careful management, mushroom production can become a vibrant way towards sustainable livelihood in the near future.

Keywords Mushroom cultivation and marketing · SWOT · TOWS · QSPM

Electronic supplementary material The online version of this article (https://doi.org/10.1007/s10708-019-10063-9) contains supplementary material, which is available to authorized users.

P. Datta (✉)
Department of Geography, Aryabhatta School of Earth Sciences, Assam University, Diphu Campus, Diphu, India
e-mail: dattapritha3@gmail.com

S. Das
Department of Geography, School of Human and Environmental Sciences, North-Eastern Hill University, Shillong, India

Present Address:
S. Das
Department of Humanities and Social Sciences, Indian Institute of Technology Kharagpur, Kharagpur, India

Published online: 12 August 2019

Introduction

The practice of consuming mushroom has a long history in humankind, although confined within a limited spatial extent. However, with the advancement and diffusion of technologies, mushroom farming has expanded globally both in terms of production as well as varieties (Dhar 2014). The global mushroom and truffles production as per FAOSTAT (1994–2016), was about 2.68 million tons in 1994, which

increased to 10.79 million tons in 2016. Nowadays, mushrooms are admired in modern dietary regimes, especially for their adequate nutritional values (Goyal et al. 2006). Different studies have revealed that mushrooms can be used in well-balanced diets for their high dietary fibers (Manzi et al. 2001), richness in essential amino acids (Wani et al. 2010), carbohydrate, and variety of minerals and vitamins (Cheung 2010; Olasantan 2001). Apart from this, mounting evidence from different researches indicates that certain mushrooms have anti-oxidant, anti-diabetic, hypocholesterolemic and anti-cancerous properties (Ajith and Janardhanan 2007; Cheung 2010; Lakhanpal and Rana 2005; Patel and Goyal 2012). It can be grown using organic wastes produced from the agricultural sector, and even the spent mushroom substrates (SMS) can be used as organic manures (Zhang et al. 2014). It is an indoor activity using vertical spaces; therefore, it does not create any pressure on the arable lands (Singh and Kamal 2012). Even the fallow lands can be utilized in this regard. There is no seasonality in the production system and one can gain profit throughout the year with proper maintenance of temperature and humidity in the mushroom house (Marshall and Nair 2009). Several studies have pointed out that cultivators have gained profit within a few months due to its short production cycle (Oseni 2007; Alom and Bari 2010; Barmon et al. 2012; Imtiaj and Rahman 2008; Marshall and Nair 2009). Hence, mushroom production can be a crucial part of the agricultural sector, which will assure income, food security, as well as environmental sustainability. However, there are some issues if not managed properly can cause immense trouble to its producers.

Mushrooms are highly perishable. Under usual transportation and marketing conditions (without any refrigeration), the shelf-life of mushroom is less than 3 days (Lee 1999). It has a high respiration rate than other vegetables and there is no barrier to protect itself from water loss (Ares et al. 2007). Thus post-harvesting management of fresh mushroom becomes a major concern to it's producers if marketing linkages are not well established. Apart from this, it is essential to maintain hygienic conditions regularly through sterilization of growing room and preparation areas of spawn in order to protect mushrooms from pests, diseases, and contaminations (Marshall and Nair 2009). However, without proper training, one cannot produce mushrooms profitably as it's production and marketing system is management intensive, which needs a considerable amount of knowledge, research, and planning (Easin et al. 2017; Alom and Bari 2010). Therefore, proper strategic planning is necessary to run it effectively. Strategic planning is nothing but the development of strategies taking insights from the organization as well as its operating environment for profitable growth (Ward 1988; Poister 2010). According to David (2011), 'strategy formulation includes developing a vision and mission, identifying an organization's external opportunities and threats, determining internal strengths and weaknesses, establishing long-term objectives, generating alternative strategies, and choosing particular strategies to pursue.'

Mushroom entrepreneurship as a sustainable agricultural practice in the Indian scenario

The commercial cultivation of mushrooms is not an age-old phenomenon in the Indian scenario. Primarily it was almost confined to some hilly tracts of the country (Netam et al. 2018). However, with the emergence of some tropical and sub-tropical species as well as the development of technologies, mushroom farming started to expand in foothill and plain areas also (Sharma et al. 2017). The suitable agro-climatic conditions, abundance of agro wastes, relatively low-cost labor, offers this new venture a favorable condition to flourish in India (Karthick and Hamsalakshmi 2017). The study of Gupta et al. (2018) reported that India could be the leading mushroom producing country in the world by utilizing only 2% of its total agro-residues. With such scopes, recently mushroom cultivation is promoted by various governmental and non-governmental organizations as a part of sustainable agriculture (Nasib et al. 2008; Singh and Singh 2017; Biswas 2014). However, studies have reported that training is not the only sufficient condition for the adoption of mushroom entrepreneurship (Singh et al. 2008). Even after adopting this venture, people often quit the entrepreneurship due to several constraints associated with the marketing, transportation, technical guidance as well as spawns and subsidies (Pattnaik and Mishra 2008; Singh and Singh 2017). Therefore, the growth of mushroom entrepreneurship is not satisfactory and the total

production in India is approximately 0.13 million tons only (Sharma et al. 2017; Gupta et al. 2018).

The cultivation of mushroom has started recently in the sub-Himalayan Cooch Behar district and practiced mainly in small-scale. Generally, the cultivation of field-crops is practiced largely here; albeit the district falls under the low crop productivity regions of the state of West Bengal (Aktar 2015). Such conditions are primarily associated with various physical (soil acidity, porousness) and socio-economic (family and land fragmentation, inadequate irrigational facilities, and lack of modern mechanization processes) elements. Even the highest proportion (51.81%) of Below Poverty Line (BPL) families belong to this district (Department of Panchayat and Rural Development 2005). With these vulnerabilities, climate change is also a reality in this area (Datta and Das 2019). The study of Rudra (2017) reported decreasing rainfall in the monsoon months, which will ultimately impact the conventional agricultural production. Apart from this, the cropping system is mainly paddy and jute centric and to generate viable economy with sustainability especially in this era of changing climate, a shift from the specialization of these two crops towards agricultural diversification is necessary (Das and Datta 2017). In this regard, mushroom entrepreneurship can impart diversification to the agrarian economy and simultaneously capable of addressing the requirements of nutritional foods as well as environmental sustainability (Singh 2011). Currently, mushroom spawn production, mushroom cultivation, and processing training programs are available at the district for three species of oyster mushroom, i.e., *P. flabellatus*, *P. sajor-caju*, and *P. Oestreatus* and one species of milky mushroom, i.e., *Calocybe indica* from different governmental and non-governmental organizations to popularize this alternative form of farming. Therefore, it expands the possibility for the locals (especially small and marginal cultivators, agricultural laborers, women as well as the weaker section of the society) to earn a substantial amount of profits from mushroom entrepreneurship which may reduce the current state of poverty as well as the climatic vulnerabilities. However, the literature shows mushroom entrepreneurship is a management intensive venture which requires adequate strategic planning. Therefore, the presents study intends to find out internal strengths and weaknesses as well as opportunities and threats which are external to the production system in the sub-Himalayan Cooch Behar district of West Bengal using the SWOT analysis. Furthermore, TOWS matrix and QSPM analysis are employed to develop and prioritize the strategies respectively, which will strengthen this new venture of mushroom production.

Description of the study area

The sub-Himalayan Cooch Behar is located in the north-eastern part of the Indian state of West Bengal and shares the boundary with the Indian State of Assam in the east, with other districts of West Bengal in the northwest and an international boundary with Bangladesh in the south (Fig. 1). This region falls under the India Meteorological Department's meteorological sub-division of sub-Himalayan West Bengal. Physiographically, it is situated in the foothills of eastern Himalayas and forms a part of the Terai agro-climatic region of West Bengal. As per Cooch Behar Krishi Vigyan Kendra (2018), the district experiences a sub-tropical climate with high annual rainfall (> 300 cm), high relative humidity (mean maximum and minimum 95% and 65% respectively) and moderate temperature (mean maximum and minimum 38 °C and 5.5 °C respectively).

According to the Census of India (2011), the total population of the district is 2,819,086 persons with a decadal population growth of 13.7% and the density of population is 832 persons/sq.km. The district has larger proportion of population who belongs to backward class communities. As per the Census (2011), it has recorded 50.17 and 0.64% population under the category of Scheduled Caste (SC) (the highest proportion of SC population in India) Scheduled Tribe (ST) respectively. Agriculture being the prime source of economy, the district has a high proportion of area (70.34%) under cultivation (Cooch Behar Krishi Vigyan Kendra 2018) and the workforce is entirely dominated by the cultivators and agricultural laborers, which constitutes 32.3 and 34.7% of the total workers respectively (Census of India 2011). Limited industrial development, lower share (10.28%) of urbanization (Census of India 2011), over-reliance on agriculture and allied activities (85–90%), absence of mineral resources etc. have made Cooch Behar one of the most economically backward districts of West Bengal which was once a princely state of British India ruled by the Koch Dynasty. Therefore, for inclusive

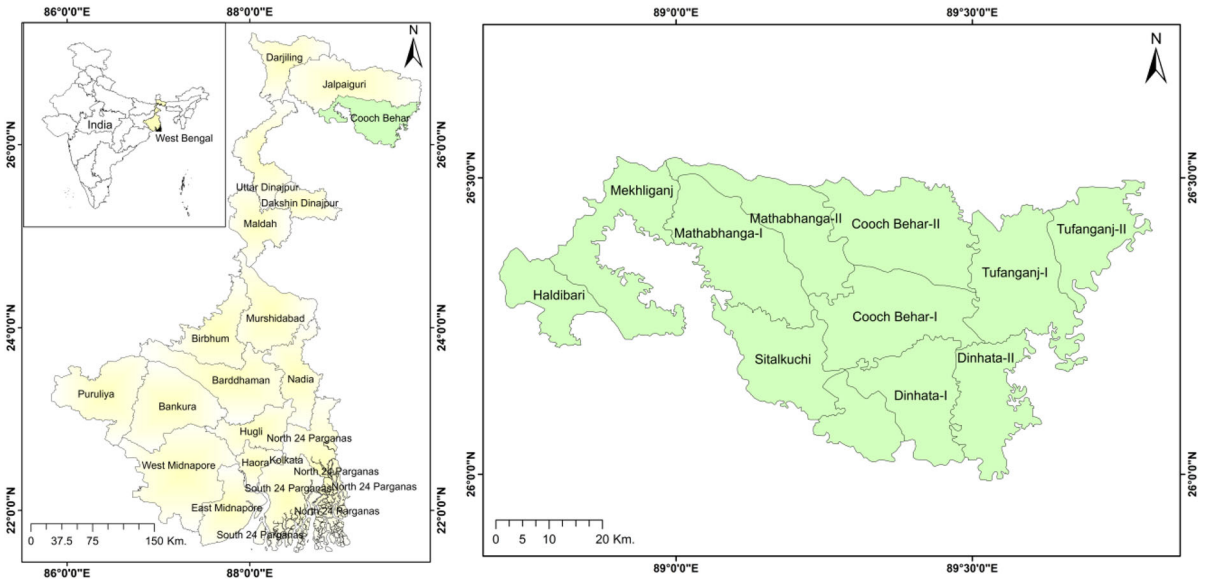

Fig. 1 Geographical location of the study area

development, the main economic reliance of the district, i.e., the agricultural situation needs special attention as well as planning.

Materials and methods

Data collection

The study is based on both the primary and secondary data. Primary data were collected using a semi-structured interview method and field observations from each respondent from October 2017 to July 2018. Whereas, secondary data were collected from District Horticulture Office (DHO), Cooch Behar Krishi Vigyan Kendra (KVK), Uttar Banga Krishi Viswavidyalaya (UBKV), and the website of DIVA–GIS (https://www.diva-gis.org/gdata). Forty-eight producers, who applied for the subsidies in 2016–2017 were traced out from DHO for personal interview. Secondly, using the snowball sampling technique, more cultivators, wholesalers, and spawn producers were identified and interviewed. This is due to the fact that the cultivation of mushroom is scattered throughout the district and mainly concentrated in some pockets of Cooch Behar-I and II, Mathabhanga-I and II, Haldibari, Tufanganj-I, and Dinhata-II Community Development (CD) blocks. The schedule contains four major themes focussed on (1) identification of the advantages and disadvantages of mushroom cultivation (2) finding the institutional supports provided by different governmental and non-governmental organizations to promote mushroom cultivation, (3) required initial average capital investments to start a small-scale production and average returns from it (4) producers' willingness for the continuation of the mushroom farming. Apart from it, we also interviewed agricultural experts to gain a better understanding of the above mentioned themes. Four agricultural experts, ninety mushroom cultivators, seven wholesalers, and three spawn producers, in total, 104 respondents were interviewed. These qualitative information were then analyzed using SWOT, TOWS, and QSPM model to develop strategic planning for the mushroom production and marketing in the study area (Fig. 2).

SWOT analysis

The SWOT analysis is a useful foundation for developing strategies by assisting an enterprise to estimate their position in the competition (Lee et al. 2009). It investigates internal strengths and weaknesses as well as external opportunities and threats that affect organizational performance. Internal strengths and weaknesses are those well or poor performances

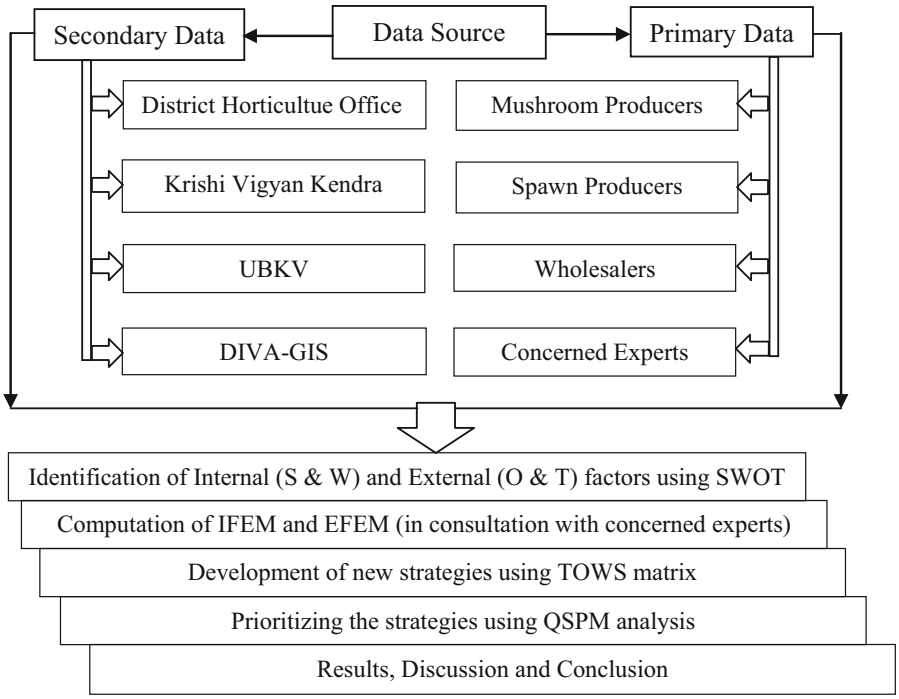

Fig. 2 Flow chart of the present study

which can be manageable by the organisation itself whereas external opportunities and threats such as demographic, socio-economic, cultural, environmental, political, legal, governmental, technological as well as competitive trends and events could remarkably benefit or harm as those are beyond the control of the organization (David 2011). Numerous instances of the application of SWOT analysis to formulate agricultural development strategies can be outlined from the literature (Dayakar Rao et al. 2004; Garnevska et al. 2007; Celik and Peker 2009; Ommani 2011; Akhtar and Prizada 2014; Rosmiza et al. 2016). The identified internal (strengths and weaknesses) and external (opportunities and threats) factors were tabulated in internal factor evaluation matrix (IFEM) and external factor evaluation matrix (EFEM) respectively.

1. In IFEM, each factor was given a weight between 0 (not significant) to 1 (very significant) and the total weight of these factors was assumed to be equal to 1. Then each factor was ranked between 1 and 4, based on the current response of production and marketing system towards identified strengths and weaknesses. Where 1 stand for poor response, 2 for the average response, 3 for the above-average response, and 4 for the excellent response.
2. The weight was multiplied by its score to determine each factors' weighted score. The total weighted score (TWS) of IFEM was calculated by summing up each factors' weighted score.
3. The TWS of IFEM must range between 1 (low) and 4 (high) where the mean score is 2.5. If it was less than 2.5, the response of production and marketing system was below average which means weaknesses eclipse the strengths and vice versa (Monavari et al. 2007; Ghorbani et al. 2015; Pazouki et al. 2017). These steps were followed for EFEM as well.

TOWS matrix

Weihrich developed the TOWS matrix in 1982 for systematically connecting internal and external factors to stimulate new strategic options (Lu 2010). It identifies four conceptually unique strategic groups viz. Strength-Opportunity (SO), Strength-Threats (ST), Weaknesses-Opportunities (WO), and Weaknesses-Threats (WT) (Ravanavar and Charantimath

2012). SO strategies are proposed to take the advantages of opportunities which are well suited with the strengths; WO strategies to grab the opportunities by minimizing weaknesses; ST strategies to reduce susceptibility to the external threats based on internal strengths, and WT strategies to minimize both weaknesses and threats (Weihrich 1982).

Quantitative strategic planning matrix (QSPM)

The success or failure of an organization is mostly dependent on its strategies. It is essential to consider both the external and internal factors to the organization to work the strategies effectively (David 2011). Suitable strategies were formulated using the TOWS matrix. However, it cannot claim which strategy will work better. So, amongst different strategies, prioritization is essential in order to determine which strategies should be taken into more serious considerations. The QSPM was used to determine the effectiveness of strategies. This technique indicates the best alternative strategies by determining the relative attractiveness score based on the suitability of strategies with organizations' internal and external environment (Garthinda and Aldianton 2012). Therefore, the implementation of strategies become much more comfortable as well as appropriate. In order to do the QSPM:

1. Each strategy was given a score of 1 to 4 based on specific level attractiveness to the internal and external factors, where, 1 stand for not attractive; 2 for less attractive; 3 for moderately attractive and 4 for highly attractive.
2. These attractiveness scores were multiplied by the respective weights of each internal and external factors to obtain the total attractiveness scores (TAS).
3. Finally, the sum of the TAS was calculated, where higher the score, greater the attractiveness of the strategy.

Results

SWOT, TOWS, and QSPM analyses were performed to obtain strategic planning for mushroom production and marketing in the study area. The identified strengths, weaknesses, opportunities, and threats along with the suitable and prioritized strategies are presented in the following sections.

Internal factor evaluation matrix (IFEM)

There were seven factors pertaining to strengths which had weights between 0.07 and 0.1 and scores between 2 and 4. In strengths, the factors with higher weights were, 'Profit is high as it can return almost double of the investment,' and 'Production is not dependent on the availability of rainfall like other food crops.' While, 'Paddy straw, a medium for growing mushrooms is locally available at a very cheap rate' had the lowest weight. In the case of weaknesses, five factors were recognized, which had weights between 0.06 and 0.1 and scores between 2 and 3. The factors namely, 'Mushrooms are highly perishable and modern technologies to extend shelf-life is absent,' 'Absence of well-insulated and well-ventilated mushroom house,' 'Absence of improved pest management technology creates significant loss to producers' had higher scores. Whereas, 'Deterioration starts with the formation of brown coloration in the absence of careful management of temperature and humidity in the production unit' had the lowest weight. The total value of internal factors (2.88) is more than 2.5, which means that strengths overweight the weaknesses (Table 1).

External factor evaluation matrix (EFEM)

Here, five factors were identified as opportunities. The weights allocated to these factors were ranging from 0.09 to 0.13 and having a score of 3 to 4. Where, 'Availability of training programmes from different governmental (KVK, UBKV, and DHO) and non-governmental (Ramakrishna Math) organisation,' had the highest weight followed by 'Proximity to the mushroom consuming areas (entire North-East India, Darjeeling district and Bhutan) provides assured market,' and 'Presence of wholesalers allows the producer to make profit in absence of well-developed local market'. Whereas, the 'Rapid population growth and high dependency on agriculture' had the lowest weight. While considering threats, four factors were found which had weights between 0.07 and 0.13 and the score ranged between 1 and 4. 'During monsoon, occurrence of natural events at mushroom consuming areas creates transportation problems for marketing,'

Table 1 Internal Factor Evaluation Matrix (IFEM). *Source*: Author's calculation

Particular	Weight	Score	Weighted score
Strengths			
1. Arable land is not required for the production process	0.08	3	0.24
2. All year round production of oyster mushroom and climatic suitability to other mushroom species also	0.08	2	0.16
3. Paddy straw, a medium for growing mushrooms is locally available at very cheap rate	0.07	4	0.28
4. The spent mushroom substrate substrate is an excellent organic fertilizer which enhances soil fertility	0.08	4	0.32
5. Production is not dependent on the availability of rainfall like other food crops	0.09	4	0.36
6. Profit is high as it can return almost double of the investment	0.10	3	0.30
7. Rich source of various nutritional and medicinal properties	0.08	4	0.32
Weaknesses			
1. Mushrooms are highly perishable and modern technologies to extend shelf-life is absent	0.10	2	0.20
2. Absence of well-insulated and well-ventilated mushroom house	0.09	2	0.18
3. Deterioration starts with the formation of brown coloration in the absence of careful management of temperature and humidity in the production unit	0.06	3	0.18
4. Absence of improved pest management technology creates significant loss to producers	0.09	2	0.18
5. Limited number of spawn producers due to technical and economic constraints	0.08	2	0.16
Total	1.00	–	2.88

and 'Maximum local people afraid to consume mushroom due to superstitions thus it has very minimal to no demand in local market' had the highest weight i.e. 0.13. While 'Fluctuations in market price' had the lowest weight i.e., 0.07. The total value of external factors (2.63) was more than 2.5 which means that opportunities overweight the threats (Table 2).

Formulation of strategies

TOWS matrix provided a framework to identify strategies for achieving goals. The total values of internal and external factors were greater than 2.5. Therefore, the district has a significant potentiality for mushroom cultivation. Although the mushroom production and marketing is not well-established in the study area but the following strategies (Table 3) can help the locals to strengthen their livelihood through mushroom production.

Prioritization of strategies

The result of QSPM analysis presented in Table 4. The TAS was 4.64, 4.70, 4.76, 4.87, 4.85, 4.83, 5.12, 5.18, 3.28 and 4.57 for the strategies SO_1, SO_2, WO_1, WO_2, WO_3, ST_1, ST_2, WT_1, WT_2, and WT_3 respectively (additional information are given in online resource-1). According to the QSPM analysis, WT_1 (Establishment of Mushroom Marketing Organisation (MMO) at administrative unit to enhance marketing linkages) had the highest score followed by ST_2 (Organizing campaigns, mushroom food festivals, adding mushrooms to the Mid-Day Meal (MDM)[1] scheme, exhibition at various fairs, distribution of brochures, advertisement in local newspaper, and using social media for mass publicity of multi-facet benefits of mushrooms to capture the local market) and WO_2 (Identification of common diseases and implementation of Integrated Pest & Disease Management (IP&DM) with improved technological aids by governmental organisations). On the other hand, WT_2 (Installation of temperature and humidity measuring devices in mushroom house to maintain the ambience for optimum growth) had the lowest attractiveness score followed by WT_3 (Development of mushroom

[1] It is a scheme launched by the Government of India to serve free lunches to the students studying in classes I to VIII in government, government-aided schools, Special Training Centres (STC), Madarasas, and Maktabs supported under the Sarva Shiksha Abhiyan.

Table 2 External Factor Evaluation Matrix (EFEM). *Source*: Author's calculation

Particular	Weight	Score	Weighted score
Opportunities			
1. Rapid population growth and high dependency on agriculture	0.09	3	0.27
2. Availability of subsidy (50% of total project cost) from DHO	0.10	3	0.30
3. Availability of training programmes from different governmental (KVK, UBKV, DHO) and non-governmental (Ramakrishna Math) organizations	0.13	4	0.52
4. Proximity to the mushroom consuming areas (entire North-East India, Darjeeling district and Bhutan) provides assured market	0.13	3	0.39
5. Presence of wholesalers allows the producer to make profit in absence of well-developed local market	0.12	4	0.48
Threats			
1. During Monsoon, occurrence of natural events at mushroom consuming areas creates transportation problems for marketing	0.13	1	0.13
2. Maximum local people afraid to consume mushroom due to superstitions thus it has very minimal to no demand in local market	0.13	1	0.13
3. Absence of Minimum Support Price (MSP) and crop insurance for mushroom	0.10	2	0.20
4. Fluctuations in market price	0.07	3	0.21
Total	1.00	–	2.63

Table 3 Formulated strategies using TOWS matrix

SO strategies

SO_1: Organising hands-on experience and financial assistance (special attention to women and BPL population) for different species (Milky, Paddy straw and Button) of mushrooms as a diversification strategy

SO_2: Strengthening support staff at administrative unit (block) to provide on spot solutions as well as proper execution of subsidies and technologies

WO strategies

WO_1: Development of Mushroom Spawn Research Centre and ensuring cheap supply of quality spawns

WO_2: Identification of common diseases and implementation of Integrated Pest & Disease Management (IP&DM) with improved technological aids by governmental organizations

WO_3: Providing financial assistance from government for constructing mushroom houses with scientific insect screening and ventilation by locally available raw materials

ST strategies

ST_1: Producers may form cooperatives or Self Help Groups (SHGs) (see footnote 2) to avail common facilities of drying machine so that they can get maximum rate of returns during Monsoon

ST_2: Organising campaigns, mushroom food festivals, adding mushrooms to the Mid-Day Meal (MDM) (see footnote 1) scheme, exhibition at various fairs, distribution of brochures, advertisement in local newspaper, and using social media for mass publicity of multi-facet benefits of mushrooms to capture the local market

WT strategies

WT_1: Establishment of Mushroom Marketing Organisation (MMO) at administrative unit to enhance marketing linkages

WT_2: Installation of temperature and humidity measuring devices in mushroom house to maintain the ambience for optimum growth

WT_3: Development of mushroom processing units for making different value added products

processing units for making different value-added products) and SO_1 (Organising hands-on experience and financial assistance giving special attention to women and BPL population for different species like-Milky, Paddy straw, and Button mushrooms as a diversification strategy).

Table 4 Ranking of prioritized strategies. *Source*: Author's calculation

Strategies	Total Attractiveness Score (TAS)	Ranking of Total Attractiveness Score (RTAS)
SO_1	4.64	8
SO_2	4.70	7
WO_1	4.76	6
WO_2	4.87	3
WO_3	4.85	4
ST_1	4.83	5
ST_2	5.12	2
WT_1	5.18	1
WT_2	3.28	10
WT_3	4.57	9

Discussion

Throughout the world, mushroom cultivation is known for its commercial significance. Considering its vast scope, many farmers and entrepreneurs are venturing into mushroom cultivation in India (Shirur et al. 2017). It should be noted that climate change has caused irregularities in rainfall pattern, which is now a major concern of the maximum farmers. In this context, the mushroom is a single food crop which neither depends on the rainfall nor any irrigation and still can bring ample amount of profit to enhance the adaptive capacities of farmers. Due to its various utilities and ability to generate gainful employment opportunity, the recent initiatives of Cooch Behar KVK, UBKV, DHO, and Ramakrishna Math (RKM) regarding the training of mushroom and spawn production are notable. Nevertheless, the initial investments (Table 5) tend to be capital-intensive and also increases with the acceleration of farm size. However, 50% of the project cost is available as a subsidy from DHO in the study area. Still, commercialization of mushroom production has not gained enough popularity in the district. There are numerous difficulties faced by producers in terms of production and marketing, which sometimes force them to quit or switch to other income-generating activities. Some of the glimpses of mushroom entrepreneurial activities are presented in Fig. 3.

The study of Alom and Bari (2010) and Celik and Peker (2009) revealed that the illiteracy and/or the poor educational background is not creating any obstacle for getting higher returns if substantial training and demonstrations received properly. The study area is in an advantageous position as different organizations are actively engaged in the demonstration and training programs. During the survey, it was observed that all the producers took this opportunity irrespective of their poor educational background and started the production process individually. Due to its easy and cheap production procedure, oyster mushrooms are widely cultivated in the study area. Although other tropical varieties viz. paddy straw mushroom (*Volvariella volvacea*) and milky mushroom (*Calocybe indica*) can be grown by utilizing locally available raw-materials to diversify the production system. One of the most critical impediments is the difficulty of marketing fresh mushroom as it has a very short shelf-life which cannot be transported too far without refrigerated transport facilities. Singh et al. (2008) pointed out that mushroom producers often face troubles due to lack of cold storage facilities and unavailability of drying equipment. Even modern technologies to extend shelf-life is completely absent in the study area. As drying machines are costly to afford by the producers, they can form cooperatives or Self-Help Groups (SHGs)[2] to avail such common facilities. Gautam et al. (2014) also found that the lack of proper marketing channels was the major hindrance to adopt mushroom entrepreneurial ventures.

The marketing problem is even more enhanced by the consumers' preference. Therefore, awareness about the nutritional and medicinal properties of mushroom plays a significant role in the purchasing behavior of the consumers. The study of Barmon et al. (2012) revealed that maximum consumers are urban residents who have more awareness about the benefits of mushroom, whereas, people mainly rural residents, who avoid its consumption consider it as poisonous fungus. Here, in the study area, mushrooms have minimal demand and most of the local people irrespective of rural or urban, are afraid to consume mushroom as they still believe that mushrooms are

[2] A bunch of people (usually composed of 10 to 20 members), who have same socio-economical background and having a desire to cooperatively work for common purposes. The Government of India as well as various State Government are operating this scheme for uplifting the rural poor especially women.

Table 5 Initial average capital investments and average returns of oyster mushroom production (500 cylinders). *Source*: Author's calculation

Particulars	Amount in unit	Market price/unit in Rs.	Cost in Rs.	Return in Rs.	
Construction of mushroom house	1 no.	–	10,000	–	
Paddy straw	1500 bundles	1.50	2250	–	
Spawn	500 packets	12	6000	–	
Labour	8 labourers	220	1760	–	
Lime	57 kg.	12	684	–	
Pesticide and fungicide	1 l	500	500	–	
Polythene bags	5 kg	150	750	–	
Motor (1 HP)	1 no.	2500	2500	–	
Spray machine (8 l capacity)	1 no.	1500	1500	–	
Mushroom production	875 kg	55/kg	25,944	GP	48,125
				NP	22,181 (46.09%)

Value within the parenthesis is the percentage of total

GP Gross Profit, *NP* Net Profit

Fig. 3 Mushroom entrepreneurial activities at sub-Himalayan Cooch Behar district: **a** small-scale local spawn production unit; **b** vertically stacked oyester mushroom cylinders; **c** weighing and packing of mushroom before sending into the market; **d** spent mushroom substrates are kept to use as organic manures in agricultural field

harmful. As a consequence, other nutritive vegetables and poultry products are high in demand in the local market. Therefore, producers sell their products through wholesalers in the markets of North-East India (especially to the state of Assam and Arunachal Pradesh), Darjeeling district of West Bengal, and neighboring country Bhutan. In these areas, cultivated mushrooms are adored by many people, perhaps most. In addition, a lot of North-East Indian tribal communities have a culture of consuming edible mushrooms (Kumar et al. 2013). However, the communication system is often hampered by extreme natural events (like landslides in rainy season) and political unrest in those hilly areas. Apart from this, producers face significant loss due to inadequate sunlight in monsoon, the absence of local demand as well as modern technologies of drying facilities. One producer described that "we cannot send our products to Bhutan and North-East India due to lack of communications during the heavy precipitation events and at the same time cannot dry them to store." The development of local market can address the perishability through organizing different campaigns, mushroom food festivals, the exhibition of mushrooms at various fairs, distribution of brochures, advertisement in the local newspaper, and use of social media to aware people about the multi-facet utilities of mushroom. Biswas (2014), in his study, showed that awareness and training programs are effective to change the mindset of locals about the edibility of mushrooms. In such a case, mushrooms can be added to the Mid Day Meals (MDM) (see footnote 1) of local Primary and Secondary schools as an alternative promotional strategy. Although in a few schools of Cooch Behar-II CD block, it is introduced in a pilot mode and is expanding satisfactorily.

Unless the production-related issues are not addressed properly, it will be challenging to increase the yield in a large volume. Recently, the attack of mushroom flies has become a major hurdle in the production process, which needs immediate attention in the study area. The most common pests in this study region belong to the *Order Diptera* (two-winged flies) comprising of three families *Sciaridae, Phoridae, and Cecidomyiidae* (Sarkar et al. 2015). Therefore, the implementation of Integrated Pest & Disease Management (IP&DM) is necessary. During the field visit, it is observed that almost all mushroom houses neither well-ventilated nor well-insulated, which makes the production process even more prone to pests. On the other hand, making scientific mushroom houses can be a challenging task for the producers. Therefore, designing those houses with locally available raw-materials is essential and provision of financial assistance to build those houses can help the producers even more.

The production of spawn is highly technical that maximum cultivators fail to produce. Hence, very few entrepreneurs are producing spawns. The maximum supply of spawn takes place from the entrepreneurs of neighbor district Jalpaiguri. So, either development of mushroom spawn research center as an independent body or tie-up with KVK and/or UBKV will be helpful not only for ensuring a cheap supply of quality spawns but also for the Research and Development (R&D) purpose. The number of mushroom cultivators increases in winter because of higher yields than the summer season and also much more favorable climatic conditions. As a consequence, it leads to a decrease in the market price during wintertime. Usually, in summer, the producers sell their product to the wholesaler at the price of Rs. 60–70 per kg. Whereas in winter the price varies in between Rs. 40–45 per kg. Nevertheless, it is not a massive threat to the producers as the yield per cylinder also increases in winter, as reported by the producers.

So far, it is noticed that fragile marketing linkages and lack of awareness among local people are the most preventive determinants for mushroom producers. One successful entrepreneur reported that "if someone can build strong marketing linkage with effective controls on pests and diseases, he/she will be able to earn double of his/her investments within a shorter period". Hence, there is a need to pay special attention to develop and ensure strong marketing linkages. Apart from these, the inclusion of mushroom processing units for manufacturing different value-added products can extend the shelf-life as well as it may bring a sort of variety in food habits. As per the producers' response, reimbursement of subsidies sometimes takes a longer period (4 to 5 months) due to the poor infrastructural and administrative responsibilities. So, strengthening support staffs at each administrative unit (CD block, i.e., the third tier of Indian administrative system) to provide on-spot solutions, proper execution of subsidies and technologies can be a significant step towards development. Irrespective of different obstacles, all the cultivators

stated that they wish to continue mushroom production in the future as they gained more profit from it than the conventional food crops. The results of this study are entirely based on field observations, interviews, concerned expert advises as well as some suitable modeling approaches like SWOT, TOWS, and QSPM. Therefore, suggested strategies should be taken under considerations to address the existing constraints.

Conclusion

Mushroom entrepreneurial activities offer significant possibilities with an inclusive approach towards the upliftment of unemployed, women, and the weaker section of the society. Besides, the production holds immense prospect to safeguard the additive economic damages occurring from the cultivation of conventional crops. The production process of these crops is generally affected by the climatic extremes and irregularities of rainfall. Being an indoor production system with minimum water requirements, the mushroom is not affected by such climatic adversities. Even the attacks of pest are also controllable in scientific mushroom houses. The present study provides an in-depth insight into the mushroom production and marketing scenarios of the Cooch Behar district by highlighting both qualitative as well as quantitative aspects of internal and external factors (strengths, weaknesses, opportunities, and threats) to attain suitable strategies. Due to the strong influential factors like agro-climatic suitability, non-requirement of irrigational facilities, availability of training programs and subsidies, vicinity of commercial mushroom hubs, this particular cultivation has massive scope to prosper in the study area. Besides, producers are facing quite a few difficulties in terms of production as well as marketing. Especially to the newcomers, marketing is more challenging than production. Through the QSPM analysis, our study has shown some practical yet cost-effective ways where the production management strategies get priority after the marketing enhancement strategies. Therefore, developing and ensuring strong marketing linkages and awareness programs should be the prime focus. With proper implementation of prioritized strategies, mushroom cultivation can boost the rural economy not only in the study area but also in a wide range of areas. Furthermore, this study provides a direction towards the alleviation of poverty as well as sustaining the adversities of climate change.

Acknowledgements The authors would like to express their sincere gratitude to Dr. Ayon Roy (Asst. Prof. Uttar Banga Krishi Viswavidyalaya), Dr. Khurshid Alam (District Horticulture Officer, Cooch Behar), Dr. Bhaskar Roy, and Dr. Kuhu Roy (Agriculture Officer, Cooch Behar District) for their cooperation and constructive comments in developing the present manuscript. We are also grateful to the Editor-in-Chief, Professor Barney Warf and the anonymous reviewer for their critical comments and constructive suggestions. In addition, we acknowledge the University Grants Commission (Grant No. 3262/NET-JAN 2017), New Delhi, India, for financial support in the form of Junior Research Fellowship Award to carry out the research work.

Compliance with ethical standard

Conflicts of interest The authors declared no potential conflicts of interest concerning the research, authorship, and/or publication of this article.

Informed consent Informed consent was obtained from all individual participants included in the study.

References

Ajith, T. A., & Janardhanan, K. K. (2007). Indian medicinal mushrooms as a source of antioxidant and antitumor agents. *Journal of Clinical Biochemistry and Nutrition, 40*(3), 157–162.

Akhtar, K., & Prizada, S. S. (2014). SWOT analysis of agriculture sector of Pakistan. *Journal of Economics and Sustainable Development, 5*(11), 127–133.

Aktar, N. (2015). Agricultural productivity and productivity regions in West Bengal. *The NEHU Journal, XIII*(2), 49–61.

Alom, M. M., & Bari, M. W. (2010). Investment in mushroom cultivation at Savar Upazilla: A prospective sector for Bangladesh. *ASA University Review, 4*(2), 57–63.

Ares, G., Lareo, C., & Lema, P. (2007). Modified atmosphere packaging for post harvest storage of mushrooms: A review. *Fresh Produce, 1*(1), 32–40.

Barmon, B. K., Sharmin, I., Abbasi, P. K., & Mamun, A. (2012). Economics of mushroom (*Agaricus bisporus*) production in a selected Upazila of Bangladesh. *The Agriculturists, 10*(2), 77–89.

Biswas, M. K. (2014). Oyster mushroom cultivation: A women friendly profession for the development of rural West Bengal. *International Journal of Bio-Resource & Stress Management, 5*(3), 432–435.

Celik, Y., & Peker, K. (2009). Benefit/cost analysis of mushroom production for diversification of income in developing countries. *Bulgarian Journal of Agricultural Science, 15*(3), 228–237.

Census of India. (2011). *District census handbook Cooch Behar*, www.censusindia.gov.in/2011census/dchb/WBA.html. Accessed May 25, 2018.

Cheung, P. C. K. (2010). The nutritional and health benefits of mushrooms. *Nutrition Bulletin, 35*(4), 292–299.

Cooch Behar Krishi Vigyan Kendra. (2018). *District profile of Cooch Behar*, Available at: www.coochbeharkvk.in/. Accessed May 25, 2018.

Das, S., & Datta, P. (2017). Regional character of crop distribution in Cooch Behar district, West Bengal: A critical analysis. *Indian Journal of Spatial Science, 8*(2), 52–58.

Datta, P., & Das, S. (2019). Analysis of long-term seasonal and annual temperature trends in North Bengal, India. *Spatial Information Research*. https://doi.org/10.1007/s41324-019-00250-8.

David, F. R. (2011). *Strategic management: Concepts and cases*. New Jersey: Pearson Education Inc., Prentice Hall Publishers.

Dayakar Rao, B., Ratnavathi, C. V., Karthikeyan, K., Biswas, P. K., Rao, S. S., Kumar, V. B. S., et al. (2004). Sweet sorghum cane for bio-fuel production: A SWOT analysis in Indian context. Report for National Research Centre for Sorghum (NRCS). Report no. 21/2004 21 December. Rajendranagar, Hyderabad, Andhra Pradesh, India.

Department of Panchayat and Rural Development. (2005). *Synopsis of BPL survey,* www.wbprd.nic.in/HtmlPage/bpl.aspx. Accessed May 25, 2018.

Dhar, B. L. (2014). Changing global scenario in mushroom industry. In M. Singh (Ed.), *8th international conference on mushroom biology and mushroom products* (pp. 602–605). New Delhi: ICAR, Directorate of Mushroom Research.

Easin, M. N., Ahmed, R., Alam, M. S., Reza, M. S., & Ahmed, K. U. (2017). Mushroom cultivation as a small-scale family enterprise for the alternative income generation in rural Bangladesh. *International Journal of Agriculture, Forestry and Fisheries, 5*(1), 1–8.

FAOSTAT. (1994–2016). *Production/yield quantities of mushrooms and truffles in World and top ten producing countries,* www.fao.org/faostat/en/#data/QC/visualize. Accessed April 25, 2018.

Garnevska, E., Vaughan, D. R., & Edwards, J. R. (2007). SWOT analysis of the horticultural farms in the Plovdiv region of Bulgaria. *Bulgarian Journal of Agricultural Science, 12*(3), 353–361.

Garthinda, D., & Aldianton, L. (2012). Business strategy recommendation for warung lepak restaurant using quantitative strategic planning matrix (QSPM). *The Indonesian Journal of Business Administration, 1*(3), 137–145.

Gautam, A. K., Singh, P., Mishra, D., Kumar, A., & Singh, A. P. (2014). Constraints in adoption of mushroom production enterprise. *The Indian Society of Extension Education, 50*(1–2), 39–41.

Ghorbani, A., Raufirad, V., Rafiaani, P., & Azadi, H. (2015). Ecotourism sustainable development strategies using SWOT and QSPM model: A case study of KajiNamakzar wetland, South Khorasan Province, Iran. *Tourism Management Perspectives, 16*(4), 290–297.

Goyal, R., Grewal, R. B., & Goyal, R. K. (2006). Nutritional attributes of *Agaricus bisporus* and *Pleurotus sajor caju* mushrooms. *Nutrition and Health, 18*(2), 179–184.

Gupta, S., Summuna, B., Gupta, M., & Annepu, S. K. (2018). Edible mushrooms: Cultivation, bioactive molecules, and health benefits. In J. M. Mérillon & K. Ramawat (Eds.), *Bioactive molecules in food* (pp. 1–33). Berlin: Springer.

Imtiaj, A., & Rahman, A. S. (2008). Economic viability of mushrooms cultivation to poverty reduction in Bangladesh. *Tropical and Subtropical Agroecosystems, 8*(1), 93–99.

Karthick, K., & Hamsalakshmi, H. (2017). Current scenario of mushroom industry in India. *International Journal of Commerce and Management Research, 3*(3), 23–26.

Kumar, R., Tapwal, A., Pandey, S., Borah, R. K., Borah, D., & Borgohain, J. (2013). Macro-fungal diversity and nutrient content of some edible mushrooms of Nagaland, India. *Nusantara Bioscience, 5*(1), 1–7.

Lakhanpal, T. N., & Rana, M. (2005). Medicinal and nutraceutical genetic resources of mushrooms. *Plant Genetic Resources, 3*(2), 288–303.

Lee, J. S. (1999). Effects of modified atmosphere packaging on the quality of chitosan and $CaCl_2$ coated mushroom (*Agaricus bisporus*). *Korean Journal of Food Science and Technology, 31*(5), 1308–1314.

Lee, K. L., Huang, W. C., & Teng, J. Y. (2009). Locating the competitive relation of global logistics hub using quantitative SWOT analytical method. *Quality & Quantity, 43*(1), 87–107.

Lu, W. (2010). Improved SWOT approach for conducting strategic planning in the construction industry. *Journal of Construction Engineering and Management, 136*(12), 1317–1328.

Manzi, P., Aguzzi, A., & Pizzoferrato, L. (2001). Nutritional value of mushrooms widely consumed in Italy. *Food Chemistry, 73*(3), 321–325.

Marshall, E., & Nair, N. G. (2009). *Make money by growing mushrooms*. Rome: Food and Agriculture Organization of the United Nations.

Monavari, M., Karbasi, A., & Mogooee, R. (2007). *Environmental strategic management*. Tehran: Kavoush Qalam.

Nasib, S., Mehta, S., Godara, A. K., & Yadav, V. P. (2008). Constraints in mushroom production technology in Haryana. *Agricultural Science Digest, 28*(2), 118–120.

Netam, R. S., Yadav, S. C., Mukherjee, S. C., & Kumari, P. (2018). Cultivation of button mushroom (*Agaricus bisporus*) under controlled condition: An initiative in Bastar Plateau of Chhattisgarh. *International Journal of Current Microbiology and Applied Sciences, 7*(10), 782–787.

Olasantan, F. O. (2001). Tropical vegetables and spices: Potential value and contributions to sustainable agriculture in Nigeria. *Outlook on Agriculture, 30*(1), 55–67.

Ommani, A. R. (2011). Strengths, weaknesses, opportunities and threats (SWOT) analysis for farming system businesses management: Case of wheat farmers of Shadervan District, Shoushtar Township, Iran. *African Journal of Business Management, 5*(22), 9448–9454.

Oseni, J. O. (2007). Economic analysis of mushroom marketing as a copping strategy for poverty reduction in Ondo State, Nigeria. In K. J. Ahmed (Ed.), *8th African crop science society conference on, El-Minia, Egypt, 27–31 October 2007* (pp. 1255–1260).

Patel, S., & Goyal, A. (2012). Recent developments in mushrooms as anti-cancer therapeutics: A review. *3 Biotech, 2*(1), 1–15.

Pattnaik, T., & Mishra, S. (2008). Constraints in adoption of mushroom cultivation technology. *Asian Journal of Home Science, 3*(1), 86–89.

Pazouki, M., Jozi, S. A., & Ziari, Y. A. (2017). Strategic management in urban environment using SWOT and QSPM model. *Global Journal of Environmental Science and Management, 3*(2), 207–216.

Poister, T. H. (2010). The future of strategic planning in the public sector: Linking strategic management and performance. *Public Administration Review, 70*(S1), 246–254.

Ravanavar, G. M., & Charantimath, P. M. (2012). Strategic formulation using tows matrix: A case study. *International Journal of Research and Development, 1*(1), 87–90.

Rosmiza, M. Z., Davies, W. P., Jabil, M. J., & Mazdi, M. (2016). Prospects for increasing commercial mushroom production in Malaysia: Challenges and opportunities. *Mediterranean Journal of Social Sciences, 7*(1), 406–415.

Rudra, K. (2017). Sharing water across Indo-Bangladesh Border. In S. Bandyopadhyay, A. Torre, P. Casaca, & T. Dentinho (Eds.), *Regional cooperation in South Asia. Contemporary South Asian Studies* (pp. 189–207). Cham: Springer.

Sarkar, S., Patra, S., & Samanta, A. (2015). Dipteran enemies of cultivated mushroom. *Rashtriya Krishi, 10*(2), 17–18.

Sharma, V. P., Annepu, S. K., Gautam, Y., Singh, M., & Kamal, S. (2017). Status of mushroom production in India. *Mushroom Research, 26*(2), 111–120.

Shirur, M., Gowda, N. S., & Chandregowda, M. J. (2017). An exemplary story of growing temperate mushroom in tropical climate of rural India: Lessons for other startups. *International Journal of Current Microbiology and Applied Sciences, 6*(9), 2423–2433.

Singh, M. (2011). Mushroom production: An agribusiness activity. In M. Singh, B. Vijay, S. Kamal, G. C. Wakchaure (Eds.), *Mushrooms-cultivation, marketing and consumption*. Chambaghat, Solan: Directorate of Mushroom Research.

Singh, G., & Singh, G. (2017). Constraints in adoption of recommended button mushroom cultivation techniques. *Agriculture Update, 12*(3), 351–356.

Singh, M., & Kamal, S. (2012). Agriculture today. In M. J. Khan (Ed.), *Mushroom scenario in India* (pp. 83–87). New Delhi: Rohit House.

Singh, N., Mehta, S., Godara, A. K., & Yadav, V. P. (2008). Constraints in mushroom production technology in Haryana. *Agricultural Science Digest, 28*(2), 118–120.

Wani, B. A., Bodha, R. H., & Wani, A. H. (2010). Nutritional and medicinal importance of mushrooms. *Journal of Medicinal Plants Research, 4*(24), 2598–2604.

Ward, J. L. (1988). The special role of strategic planning for family businesses. *Family Business Review, 1*(2), 105–117.

Weihrich, H. (1982). The TOWS matrix: A tool for situational analysis. *Long Range Planning, 15*(2), 54–66.

Zhang, Y., Geng, W., Shen, Y., Wang, Y., & Dai, Y. C. (2014). Edible mushroom cultivation for food security and rural development in China: Bio-innovation, technological dissemination and marketing. *Sustainability, 6*(5), 2961–2973.