Analysis of enablers for vertical integration to enhance rural employability

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Abstract

Purpose – The purpose of the paper is to identify, analyze and select the enablers for vertical integration of *Aloe vera* supply chain (AVSC) so that rural employability will be enhanced in the context of Rajasthan, India.

Design/methodology/approach – Interpretive structural modeling (ISM) was proposed to develop a structural model to identify the right enablers for enhancing the rural employability and business prospects. Also, fuzzy-matrix cross-reference multiplication applied to classification (F-MICMAC) was applied to segregate the enablers into four clusters on the basis of their driving and dependence power. Finally, the significant enablers were selected.

Findings – Out of identified 13 enablers, three enablers (i.e. institute for training and research, transportation infrastructure and government incentives for value addition) were appearing at the bottom of the ISM structural model and also in the driving quadrant of driver-dependent diagram. Therefore, they are the significant enablers for vertical integration of AVSC to enhance the rural employability in the context of Rajasthan, India.

Research limitations/implications – The interactions among enablers are not statistically validated. However, the empirical analysis and total interpretive structural modeling may be used for this purpose.

Practical implications – The outcomes of the study will provide the guidelines for implementation of vertical integration at the village level to enhance rural employability in the context of Rajasthan, India in specific.

Originality/value – Although a few studies have been reported in the literature related to value-addition process (vertical integration), but the modeling of enablers to segregate and identify the appropriate enablers for vertical integration of AVSC for enhancing employability at the rural areas is unique.

Keywords Vertical integration, Aloe vera supply chain, Rural employability, Value addition, India

Paper type Research paper

1. Introduction

Aloe vera (AV) is a vital herbal crop proven to be beneficial for the mankind due to its medicinal values. It is cultivated in all soil conditions and considered as a commercial crop. The various AV products having high global demand are AV juices in different flavours, AV extracts in powder form, AV gels and AV-based cosmetics. A *plethora* of studies has been reported in the literature related to the medicinal importance of AV. The various stages of AV supply chain (AVSC) are farmer, consolidator, processing plant, distributor, retailer and customer. All the processes up to retailer stage are push (runs on the basis of anticipated demand) in nature starting from farmer stage whereas the processes between retailer stage and customer stage are pull (runs on the basis of exact demand) in nature. It is observed that downstream supply chain members (i.e. consolidators and processing plant) inflate the selling prices whereas marginal and small farmers are exploited. Due to this, there is an increased price spread (the difference between the selling price of farmer and retailer), which increases the profitability for processing plants and downstream members (distributors and retailers), but the farmers get a marginal benefit. To improve the profit level of farmers, vertical integration should be implemented at farmer stage. The farmer should take the role of a prospective entrepreneur with complete or partial value addition to minimize the price spread and increase the rural employability (Priyadarshi and Routroy, 2018). For AV juice, preparing gel is partial aggregation whereas processing the leaf for AV juice is complete aggregation. Value addition processes at farmer stage can enhance the product quality and shelf-life, guarantee a reasonable price to the farmer (Walters *et al.*, 2002; Eldridge, 2007) and decrease the price spread (the difference between farmer selling price and customer purchase price). However, no scientific study has been carried out along the AVSC focusing on various important aspects such as vertical integration, rural employability, agri-entrepreneurship and supply chain profitability. The proposed study aims to analyze various enablers for vertical integration at farmer stage, which could decrease price spread, develop an agri-entrepreneur for value

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addition process, minimize non-value-added activities to optimize supply chain profitability as a whole and increase farmers' profitability and rural employability in specific.

2. Literature review

During the literature survey, it was observed that a *plethora* of research studies elaborated the medicinal importance of AV and a variety of cultivation techniques are practiced around the world. Das and Chattopadhyay (2004) discussed the botanical characteristics, species and plant population of AV in India. It is based on AV cultivation, internal market and export prospects including importance, utility and benefits. The medicinal varieties of AV have an enormous demand in the global market, and hence, are dealt with in vast quantities (Sachedina and Bodeker, 1999). AV is grown in different parts of the world such as Florida, Southern California, Rio Grande Valley of South Texas and India. It is also sourced from Mexico to meet the demand in the USA and the parts of Southern America (Grace, 2011). Various aspects of AV supply chain including cultivation have been studied and analyzed in the developed nations such as France, UK and the USA (Grace, 2011). One can find the research studies on self-employment and wealth creation (Biswas, 2010; Blanc and Kledal, 2012), sourcing from the wild and commercially cultivated (Ludvig *et al.*, 2016), transportation, market/export prospects (Pangriya, 2015), botanical proceedings (Karkala and Bhushan, 2014) and therapeutic benefits (Ahlawat and Khatkar, 2011). Shahidullah and Haque (2010) proposed a closer linkage between the producers and processors through vertical integration in the value chain for a reasonable price, quality, lead time and overall control of the supply chain. Lamont (1992) discussed the concept of the vertical and horizontal integration for the potato seed industries in The Netherlands and Northern Ireland whereas similar kinds of such studies are reported in the literature such as business relationship improvement (Hadjikhani and Thilenius, 2005; Gebauer *et al.*, 2007), vertical integration (Nugent and Hamblin, 1996; Cook, 1997; Howe, 1998; Jennings, 2001; Leach *et al.*, 2001; Charlebois and Camp, 2007; Gueimonde-Canto *et al.*, 2011; Lamprinopoulou and Tregear, 2011; Dabas *et al.*, 2012; Ding and Mahbubani, 2013), level of vertical integration selection (Priyadarshi and Routroy, 2018), comprising of subtopics such as strategic management (Parker *et al.*, 2015), internationalization of retailing for rural entrepreneurs (Mudambi, 1994; Muñiz-Martínez, 1998; Johansson, 2002; Aygün and Oeser, 2017; Satyam *et al.*, 2017), distribution (Brockman and Morgan, 1999), strategic ties (Orozco Quintero and Berkes, 2010; Dunham *et al.*, 2012; Yi *et al.*, 2012; Mehrotra and Verma, 2015), rural entrepreneurship (Saunders and Bromwich, 2012), economic performance (Peyrefitte *et al.*, 2002), women entrepreneurship (Khera and Nayak, 2009; Yadav and Goyal, 2015; Bhardwaj, 2018) and improved information exchange among the supply chain members (Trim and Lee, 2006; Nandonde and Kuada, 2016). However, the detailed economic analysis with the level of vertical integration of AVSC at the village level to enhance rural employability in developing countries such as India is still missing. Hence, there is an urgent need to increase the level of vertical integration at farmer level to enhance farmers' profit share, to decrease the price spread and to reduce cost along the supply chain on the basis of the field visits, processing and semi-processing unit visits, and discussions held with various stakeholders at various locations in Rajasthan, India (Priyadarshi and Routroy, 2018). A few unique establishments for the value-addition process were also found to be practicing for AV leaf in the above-mentioned locations. Thus, the observational study represents the present profitable prospects in the context of Rajasthan in specific (arid and semi-arid zones) such as Bhilwara, Bikaner, Jhunjhunu, Jaipur, Jaisalmer, Jodhpur, Kota, Nagaur, Pali, Sikar, etc., and various locations across the nation on a wider prospect in general. The AV is such a diverse plant that can grow in any soil with bare/minimum water requirements across the world, except the low-temperature geographical locations. Similar studies such as small firms' attitude and behaviour towards licensing (Atuahene-Gima and Lowe, 1994), entrepreneur opportunism (Ting *et al.*, 2007), innovation and entrepreneurship (Yadav and Goyal, 2015), internationalisation in small economies (Deng *et al.*, 1995), leadership and entrepreneurship (Vallaster, 2001; Lettl and Gemünden, 2005; Rich and Bartholomew, 2010), sales prospects and marketing ethics (Donoho *et al.*, 2001; Piercy, 2010) were discussed in the literature. However, till now, no study has been reported in the literature related to the enablers for vertical integration that will tend to propel rural employability, farmers' profitability, wastage use and design of optimal AV supply chain including agri-entrepreneurship. Therefore, a methodology using interpretive structural modeling (ISM) and fuzzy-matrix cross-reference multiplication applied to a classification (F-MICMAC) had been proposed to identify, analyze and select the enablers for vertical integration of AVSC for enhancing the rural employability. The proposed methodology was applied to AVSC for AV juice to select appropriate enablers for encouraging vertical integration at village level by the farmers, which will enhance rural employability, business prospects and farmer's profit.

3. Demand and supply environment of *Aloe vera* in global market

The global AV sector yielded the revenue of $1.6bn during 2015-2016 and it is expected to cross over $3.3bn by the end of the year 2026 (PRWEB, July 2016). The global export volume of AV was reported to be more than 60,720.4 tonnes annually whereas the massive demand of cosmetics with AV extracts had accounted to cross over 45 per cent of global demand in 2016, with volumes summing-up to 27,458.5 tonnes annually – a 6 per cent increase as compared to 2015's demand (marketwatch.com, 2016). A significant demand volume was recorded in Japan, Australia, Korea, China, the USA and most of the parts of Europe for finished AV products (Blanc, 2009; Grace, 2011; Blanc and Kledal, 2012; Liontakis and Tzouramani, 2016). The net worth of India's herbal industry was around US$400m in 2013, which covers 1,200 single ingredient and 10,500 poly-herbal registered formulations. A total of 65 per cent of the herbal medicines were categorized as timely-tested ayurvedic medicines (Kokate, 2013). AV finds its origin in different countries (i.e. North Africa, Malagasy, Arabia and Spain) and now, it is been cultivated in various parts

of Asia, Europe and America as well (Karkala and Bhushan, 2014). In India, it can be cultivated in all soil conditions, even under constant drought conditions including arid and semi-arid regions of Rajasthan, Uttar Pradesh, Madhya Pradesh, Gujarat, Odisha, West Bengal, Maharashtra and South India because of its low water requirement (Das and Chattopadhyay, 2004; Kokate, 2013). AV has become such a vital part of herbal product consumption among the public that it needs to be cultivated on a much larger scale than existing. In the future, its demand is only supposed to rise. An organic cultivation can raise the market value of the harvest, as "certified organic produces" are preferred by the international buyers. A colossal rise is observed in cultivation and processing of AV in the different states. Owing to raising popularity of AV products due to their herbal properties, the demand is tremendously increasing year by year in India and around the globe. Hence, there are existing and yet a huge scope for exports (Piercy, 2010; Javalgi *et al.*, 2011). AV is majorly cultivated in Bhilwara, Bikaner, Nagaur, Sikar, Jodhpur, Jhunjhunu, Jaipur, Jaisalmer, Kota and Pali districts and nearby places in Rajasthan in specific and at various locations in general across the nation. The current study was carried out for AV juice supply chain in rural Rajasthan, which has a significant market share and also has growing business prospects (Gebauer *et al.*, 2007).

3.1 Types of Aloe vera supply chain for Aloe vera juice

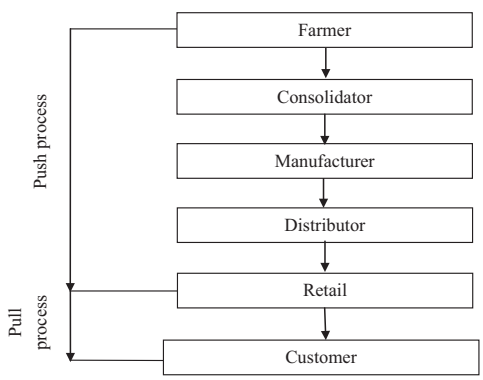
Three different types of AVSC configurations (i.e. non-vertically integrated supply chain, semi-vertically integrated supply chain and vertically integrated supply chain) for AV juice exist in India. The non-vertically integrated supply chain is commonly practiced as shown in Figure 1.

The three types of AVSC configuration are discussed below:

3.1.1 Non-vertically integrated supply chain configuration

In this type of supply chain configuration, the AV leaf is cultivated by the farmer whereas consolidator harvests and transports to the processing plant. It is processed (i.e. pulping, juicing and packaging) at the processing plant and it is used to sell the AV juice generally through traditional distribution system consisting of distributor and retailer stage. This type of supply chain configuration is mostly practiced in India but incurs higher costs than the two mentioned below.

Figure 1 Configuration of non-vertically integrated AVSC for AV juice



3.1.2 Semi-vertically integrated supply chain configuration

In this type of supply chain configuration, the pulp is extracted and stored in drums by the entrepreneur. The entrepreneur collects AV leaves from the farmers and sells the pulp drums to processing plants. The inbound transportation cost decreases in this configuration. It is also an example of business to business transactions where the semi-finished produce is sold from one firm to another.

3.1.3 Vertically integrated supply chain configuration

In this type of supply chain configuration, most of the processes from cultivation to processing (i.e. cultivation, inbound logistics, processing and packaging, outbound logistics and marketing) are owned by one member (i.e. the entrepreneur or manufacturer). The AV juice is sold at different retail outlets through traditional distribution system under the flagship of a promised brand name. This is an example of business to business transactions between the rural stage processing firm and the branding agency where the finished product goes for distribution, retail and exports at a lesser price than earlier.

4. Impact of vertical integration at farmer stage on supply chain performance and farmer's profit

Research needs to be carried out on AVSC from cultivation to finished products as it is at a nascent stage. The present situation of AVSC demands to design its optimal supply chain with vertical integration at farmer level considering various factors such as responsiveness, crop yield, organic cultivation, risks, wastage utilization, price spread, demand, interdependence and impact of enablers and impediments and rural accessibility while optimizing the supply chain cost, price spread and farmer's profit; and enhancing rural employability. The implementation of optimal AVSC in practice is a real challenge. To understand the impact of vertical integration at farmer stage on supply chain performance and farmer's profit, an observational field study was carried out on AVSC for AV juice in rural Rajasthan. It was observed that all the processes from AV cultivation to AV juice do not require high investment and much skill level, but supply chain profitability is quite high in comparison to other agriculture produces. However, the profit of farmer is only around 2-4 per cent of total supply chain profit (TSCP) whereas profit of manufacturer and other downstream members is around 75-85 per cent and 20-25 per cent of TSCP, respectively. This could also be valid for other AV-related products. It was strongly felt that vertical integration at farmer stage will create benefits at village level such as entrepreneur development in rural areas, increased rural employability, enhanced quality of raw material (i.e. AV leaf), minimum risk of raw material availability, elimination of distress sale, reduced inbound logistics cost, low processing cost and expansion of rural market. Therefore, the efforts should be made to develop farmer as an agri-entrepreneur (i.e. vertical integration at farmer stage) for value addition process and waste use to optimize supply chain profitability as a whole and increase farmers' profit share, rural employability in specific and business prospects.

5. Enablers for vertical integration of *Aloe vera supply chain* to enhance the rural employability

Although a few studies have been reported in the literature related to value-addition process (vertical integration), but the modeling of AVSC enablers to segregate and identify the appropriate enablers for vertical integration for enhancing employability at the rural areas is unique. A total of 13 enablers were identified on the basis of available literatures and field visits carried out in rural areas of Rajasthan (Table I). The domain of each enabler is discussed below.

5.1 Awareness of scientific cultivation

The scientific cultivation includes many activities such as choice of crop, crop management including intercropping, scientific irrigation techniques, organic cultivation and certification and quality management during cultivation and post-harvest. The awareness of scientific cultivation (ASC) at farmer level can be achieved, implemented and enhanced in vertical integration at farmer stage. It will be due to the proximity between cultivation and processing, better communication between farmers and the entrepreneur, easy and frequent access to cultivation and post-harvest, real-time information exchange, increased level of belongingness and dependency, similar culture, etc.

5.2 Effective management of demand and supply risk

The proximity of supply source (cultivation area) and processing unit reduces inbound logistics uncertainty whereas real-time demand requirement and visibility helps the farmer to decide the harvest timings. The visibility of the supply source capacity helps in alternative arrangements in case of high demand situations.

5.3 Profit margin at farmer stage

The elimination of consolidator between farmer and processing plant reduces transportation cost and eliminates consolidator's profit share. The farmer gets different alternative sources to sell his/her AV at the right price; and hence, is able to increase profit. This may not be true for non-vertically integrated supply chains.

5.4 Enhanced farmer satisfaction

The presence of entrepreneurs near to the farmer stage could secure a prompt payment for the farmer's crop and also eliminates the case of distress sale. This process enhances farmer satisfaction and motivates towards farming.

5.5 Availability of workforce

The availability of rural workforce (i.e. unskilled, semi-skilled and skilled) is not an issue with right wages and work continuity. This workforce is essential at farmer stage for cultivation, post-harvest and processing plant. This will restrict the rural population to migrate towards any other place for employment.

5.6 Attitude towards farming and entrepreneurship

The positive attitude towards farming and entrepreneurship (AFE) at rural areas is prerequisite to develop vertical integration of AVSC at the village level. The farming and entrepreneurship should not only be confined to AV but also it should be practiced for different agriculture produces, so that

Table I Literature survey on enablers for vertical integration

Key enablers	Notations	Presence in the literature
Awareness of scientific cultivation	ASC	Blanc, 2009; Blanc and Kledal, 2012; Karkala and Bhushan, 2014; and field visits
Effective management of demand and supply risk	EDS	Piercy, 2010 and field visits
Profit margin at farmer stage	PMF	Shahidullah and Haque, 2010; Karkala and Bhushan, 2014; Pangriya, 2015; and field visits
Enhanced farmer satisfaction	EFS	Blanc, 2009; Shahidullah and Haque, 2010; Karkala and Bhushan, 2014; Pangriya, 2015; and field visits
Availability of workforce	AOW	Blanc, 2009; Shahidullah and Haque, 2010; and field visits
Attitude towards farming and entrepreneurship	AFE	Lettl and Gemünden, 2005; Ting *et al.*, 2007; Blanc, 2009; Rich and Bartholomew, 2010; Blanc and Kledal, 2012; Karkala and Bhushan, 2014; Pangriya, 2015; and field visits
Government incentives for value addition	GIV	Shahidullah and Haque, 2010; Pangriya, 2015; and field visits
Institute for training and research	ITR	Shahidullah and Haque, 2010; Pangriya, 2015; and field visits
Technology availability and adaptability	TAA	Sheth and Sharma, 2006; Shahidullah and Haque, 2010; Blanc and Kledal, 2012; Makkonen and Johnston, 2014; and field visits
Development of rural market	DRM	Blanc, 2009; Piercy, 2010; Blanc and Kledal, 2012; and field visits
Development of vertical integration of other agriculture produces	DVI	Leach *et al.*, 2001; Hadjikhani and Thilenius, 2005; Blanc, 2009; Blanc and Kledal, 2012; Shahidullah and Haque, 2010; Gueimonde-Canto *et al.*, 2011; Lamprinopoulou and Tregear, 2011; Dabas *et al.*, 2012; and field visits
Transportation infrastructure	TAI	Shahidullah and Haque, 2010; Pangriya, 2015; and field visits
Information infrastructure and information visibility	IIV	Trim and Lee, 2006; Shahidullah and Haque, 2010; Pangriya, 2015; Nandonde and Kuada, 2016; and field visits

both farmer and entrepreneur will be able to get work and revenue throughout the year.

5.7 Government incentives for value addition

The incentives/subsidy from the government to both farmer and entrepreneur along different areas such as but not limited to loans for the processing plant, solar power generation, organic cultivation, subsidy, taxes and tariffs will definitely motivate the farmers and entrepreneurs for farming and develop value addition process at village level, respectively. The government should also fix minimum support price for AV to safeguard the farmer on a time to time basis.

5.8 Institute for training and research

The institute for training and research (ITR) should be established in rural areas to create skill and expertise in the different areas such as quality management, logistics management, inventory management, marketing, certification, etc. The educational and government's training institutes such as National Institute for Micro, Small and Medium Enterprises (NI-MSME), National Institute for Entrepreneurship and Small Business Development (NIESBUD), etc., may open centres to provide training, to conduct workshops and to give certification courses. They should also identify and carry out research in different areas of AVSC such as process improvement, value-added products from AV and generated waste, vertical integration, quality and logistics management, inventory management, marketing, entrepreneurship development, women entrepreneurship, etc.

5.9 Technology availability and adaptability

The technology needed for the value addition process in rural areas should be easily available and can be installed with ease. To adopt and operate the technology, appropriate training should be made available. It is essential to use the available modern technologies for achieving better quality and quantity of output from a given input on a continuous basis and reuse of by-products. This will reduce cost and enhance the profitability of entrepreneur in specific and supply chain, in general, leading to enhanced marketing performance.

5.10 Development of rural market

The awareness regarding the use and benefits of AV products and by-products will increase the consumption in rural areas due to value addition at entrepreneur stage. The customer in rural areas will get more confidence, belongingness and satisfaction, which, in turn, will create more demand and expand the rural market.

5.11 Development of vertical integration of other agriculture produces

The value addition processes if carried out for other agriculture produces, the employability at rural areas will increase and will be available throughout the year. This will encourage the entrepreneurs to go for vertical integration of AVSC at village level, and hence, increasing business prospects.

5.12 Transportation infrastructure

The connectivity in general and road connectivity in specific are important for both inbound and outbound logistics as transportation cost will decrease and will enhance the responsiveness by decreasing delivery lead time. The presence of transportation infrastructure (TAI) will help the business to grow and more business will happen in different areas that will have a direct or indirect positive impact on it.

5.13 Information infrastructure and information visibility

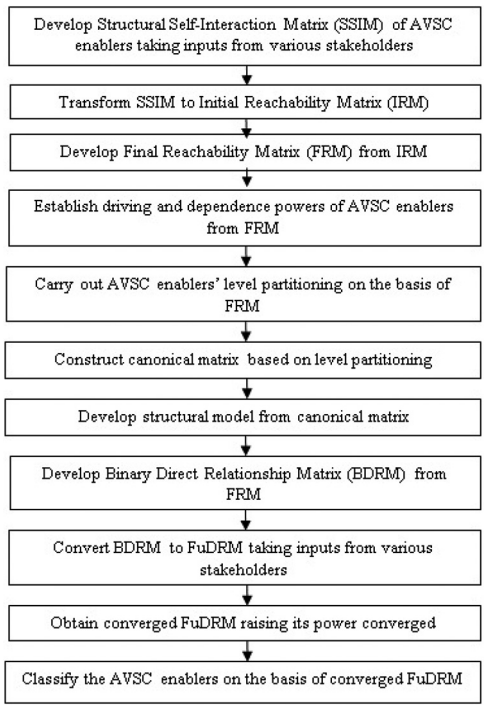
The information infrastructure and information visibility (IIV) is required for effective and efficient management of different activities such as payment system to the farmers and downstream supply chain members, decision-making, demand forecasting, inventory and logistics management, capturing different transactions in the supply chain, etc. The information infrastructure will help in capturing, analyzing and monitoring the relevant information of various operations for their smooth functioning.

6. Development of interpretive structural modelling–fuzzy-matrix cross-reference multiplication applied to a classification analysis for enablers in Aloe vera supply chain

ISM–MICMAC methodology has the capability to draw the fruitful conclusions in terms of relationships among various relevant enablers/factors/impediments of a system and classify them into different clusters on the basis of driving and dependence power (Sage, 1977). Recently many researchers applied ISM–MICMAC methodology in various areas of the supply chain such as supplier development (Routroy and Pradhan, 2014) and modelling the causal factors of post-harvest losses in vegetable and fruit supply chain (Gardas *et al.*, 2017). In MICMAC analysis, the relationships are captured in binary variables (0 or 1) and the strength of the relationship is not captured accurately. Therefore, many researchers have used FMICMAC analysis in various areas to avoid such shortcomings (Kumar and Routroy, 2014; Kumar *et al.*, 2015; Routroy and Kumar, 2015). Therefore, ISM and FMICMAC are combined to analyze enablers for vertical integration of AVSC to enhance the rural employability. The flow chart used to implement the proposed methodology is shown in Figure 2. The detailed algorithm is mentioned below and it is coded in MATLAB R2015b to reduce the computational burden on the users:

1. *Step 1*: Identify the AVSC enablers (AVSCEs) for vertical integration from the literature survey and the data collected from brainstorming sessions held with various stakeholders such as farmers, practitioners and distributors. Specify the domains for each identified enabler on the basis of expert opinion.
2. *Step 2*: The procedure to develop the structural relationship of enablers for vertical integration using interpretive structural modeling is mentioned below:
3. *Step 2.1*: Develop the structural self-interaction matrix (SSIM) by depicting the relative interactions among the enablers on the basis of the data collected in Step 1. The four symbols, namely, *V* (AVSCE '*i*' leads to AVSCE

Figure 2 Flow chart of ISM–FMICMAC methodology



'*j*'), *A* (AVSCE '*j*' leads to AVSCE '*i*'), *X* (both enablers '*i*' and '*j*' lead to each other) and *O* (neither of '*i*' nor '*j*' leads to each other) are used to denote the direction of relationship between two enablers.

4 *Step 2.2*: Develop initial reachability matrix (IRM) by converting SSIM into a binary matrix as discussed below:

- If (i, j) is *V*, then (i, j) is 1 and (j, i) is 0; if (i, j) is *A*, then (i, j) is 0 and (j, i) is 1; if (i, j) is *X*, then (i, j) is 1 and (j, i) is 1 and if (i, j) is *O*, then (i, j) is 0 and (j, i) is 0 where (i, j) and (j, i) are the cells of SSIM.

5 *Step 2.3*: Develop final reachability matrix (FRM) applying transitivity relationship (when AVSCE '*i*' is related to AVSCE '*j*' and AVSCE '*j*' is related to AVSCE '*k*', then the AVSCE '*i*' is also related to AVSCE '*k*' and (i, k) entry in the FRM becomes 1^*) in IRM. Driving and dependence power of each AVSCE is determined by taking summation of the elements along the rows and columns of FRM, respectively. The AVSCEs are ranked on the basis of driving and dependence powers.

6 *Step 2.4*: Develop a level partition of AVSCEs considering reachability and antecedent set of each AVSCE. The reachability set of an AVSCE is the AVSCE itself and other AVSCEs, which it may reach. While, the antecedent set of an AVSCE contains the AVSCE itself and other AVSCEs, which may reach it. The AVSCEs for which the reachability and intersection sets are same occupy the top-level in the ISM hierarchy. The top-level AVSCEs are separated out from the initial set of AVSCEs and then the process is repeated until all the AVSCEs are assigned to a level.

7 *Step 2.5*: Develop a canonical matrix (also known as lower triangular matrix [LTM]) on the basis of level partitions obtained in the previous step. It is a yet another form of final reachability matrix where the enablers are positioned and clustered according to the level of partitions. Also, develop a structural directed graph (also known as digraph) on the basis of LTM. It indicates the relationships among the enablers (direct or indirect) (i.e. AVSCE '*i*' and AVSCE '*j*' then shall be indicated by an arrow (i.e. link) pointing from AVSCE '*i*' to AVSCE '*j*').

8 *Step 2.6*: The structural model of AVSC enablers is generated by eliminating the transitivity links in the digraph and considering the level partitions and FRM. The developed structural model is reviewed for conceptual accuracy. If it is not conceptually accurate, then go to Step 2.1.

9 *Step 2.7*: Replace all the diagonal elements of IRM with 0's to obtain a binary direct relationship matrix (BDRM). Approach the CFT for their judgements regarding the relationships between AVSCEs in the BDRM using the scale mentioned in Table II to obtain fuzzy Direct Relationship Matrix (FuDRM).

10 *Step 2.8*: The FuDRM's power is raised by fuzzy matrix multiplication (rule: $C = \max k \{\min (a_{ik}, b_{kj})\}$ where $A = [a_{ik}]$, $B = [b_{kj}]$) till it is converged (Kandasamy *et al.*, 2007). The convergence point can be determined where the driving and dependence powers of AVSCEs are stabilized or cyclic in their variation with a certain periodicity.

11 *Step 2.9*: Develop driver dependence diagram on the basis of new driving (along the *X*-axis) and dependence powers (along the *Y*-axis) of the final converged matrix. AVSC enablers are to be classified into four groups (i.e. autonomous having lower dependence and driver power; dependent having higher dependence and lower driver power; linkage having higher dependence and driver power; and independent having lower dependence and higher driving power).

7. Application of proposed model to Aloe vera supply chain for enhancing rural employability

The Indian Government introduced a few "fixed days" employment guarantee schemes such as Mahatma Gandhi National Rural Employment Guarantee Act (MNREGA) also known as National Rural Employment Guarantee Act (NREGA) (Khera and Nayak, 2009). Different states including Rajasthan provide a guaranteed employment of 100 days in a year for the rural population in a year (Khera and Nayak, 2009), but these schemes have never been able to provide a satisfactory source of income to the rural population for their survival. There are two types of population in rural areas, namely, farm holding population and non-farm holding population (Lanjouw and Shariff, 2004). The land-holding populace possesses a certain amount of land and has the capability to cultivate a yield whereas the non-farm holders are mostly employed in agriculture as daily wagers or choose to migrate towards major cities. The attempts have been made to provide the employment to such rural population in rural areas

Table II Possible relationship strength between AVSC enablers

Dominance of interaction	No	Very low	Low	Medium	High	Very high	Full
Grade	N	NL	L	M	H	VH	F
Value on the scale	0	0.1	0.3	0.5	0.7	0.9	1

so that the standard of living of such population will improve and the migration towards urban areas can be minimized. A population of 26.58 million, i.e. 7.32 per cent of labor workforce were found to be unemployed and underemployed during the year 1999-2000 with an increasing rate of unemployment in the state of Rajasthan (Planning Commission Report, 2004). According to a statistical data report by Centre for Monitoring Indian Economy (CMIE) (unemploymentinindia.cmie.com, 2018), a recorded unemployment rate of 6.8 per cent among the urban and, 5.1 per cent among the rural population exist across the nation whereas an unemployment rate of 6.1 per cent in Rajasthan has been recorded. Also, according to CMIE report, 15.33 per cent of rural and 4.15 per cent of the urban population were found unemployed for the year 2017 who may practice cultivation and entrepreneurship for various agriculture, commercial in general and herbal crops in specific (unemploymentinindia.cmie.com, 2018). In India as general and in Rajasthan as specific, a significant percentage among 75 per cent of rural population (villageinfo.in, 2018) is already practicing the concept known as innovation and entrepreneurship (Saunders and Bromwich, 2012) for various agriculture produces, the cultivation of AV leaf and its value addition is one significant illustration (Yadav and Goyal, 2015). According to Rajasthan agricultural statistics report, (2015-2016), the AV cultivation in the districts of Ajmer, Bharatpur, Bhilwara, Bikaner, Churu, Hanumangarh, Jaipur, Jaisalmer, Jhalawar, Pali, Sikar and Tonk are observed in significant volumes, which indicates a wide scope of AV cultivation in other districts as well. The highest yield volume was observed in Churu (550 metric tons) and Sikar (183 metric tons) districts. Therefore, efforts should be made to propagate the knowledge and develop farmer as an agri-entrepreneur for value addition process and use of waste, minimize the non-value-added process, etc., to optimize supply chain profitability as a whole and increase farmers' profit share and rural employability in specific (Piercy, 2010). The value addition processes at farmer stage can also enhance the product quality and shelf-life, guarantee a reasonable price to the farmer and decrease the price spread (difference between farmer selling price and customer purchase price). However, no scientific study has been carried out along the supply chains focusing on various important aspects such as vertical integration, rural employability, agri-entrepreneurship and supply chain profitability. It was found that there is an urgent need to amplify the level of vertical integration at farmer level to enhance farmers' profit share, to decrease the price spread and to reduce cost along the supply chain on the basis of field visits and discussions held with various stakeholders. However, till now, no study has been reported in the literature related to rural employability, farmers' profitability, wastage use and design of optimal AVSC including agri-entrepreneurship. There is a huge scope for the export of herbal produces from India towards the developed nations. This will further enhance the supply and demand situation, which also leads to better business to business transactions (Gebauer *et al.*, 2007; Cortez and Johnston, 2018) and marketing prospects for finished products (Piercy, 2010; Javalgi *et al.*, 2011). This not only accelerates the scope for SME development in India but also improves farmer employability situation at the rural stage because of readily available manpower (Javalgi *et al.*, 2011).

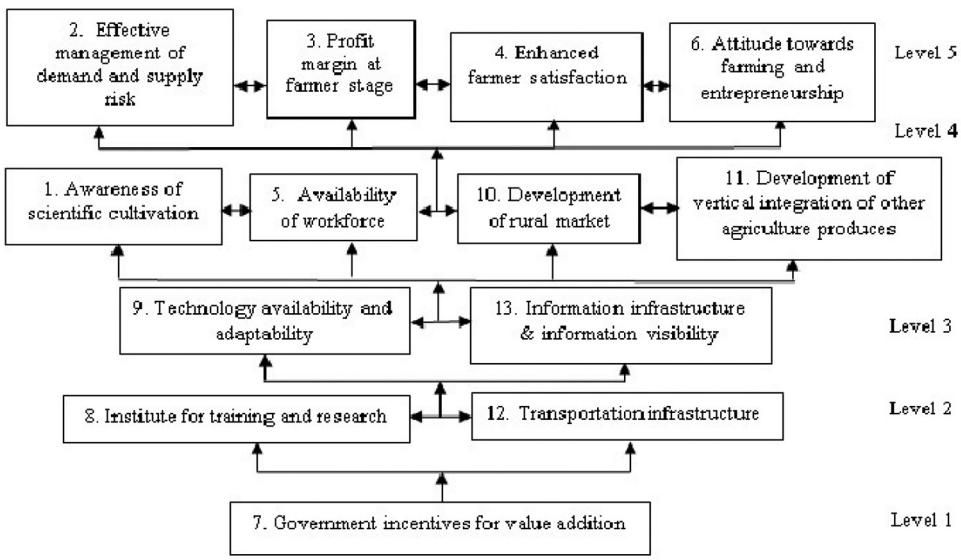
To implement or practice business to business marketing and exports, there are newer online retail hubs, which offer organic certified quality level AV juice and pulp to processing/pharmaceutical firms and food retail firms. Thus, the semi-finished and finished produces, i.e. pulp and juice could be sold online along with government regulations and marketing agencies in the existence such as indiamart.com.

The proposed model was applied to analyze the interactions among enablers to develop a structural model to enhance the rural employability in the context of Rajasthan, India through vertical integration at farmer stage. The 13 AVSCEs as mentioned in Section 7 were discussed with various stakeholders that include farmers and government officials for implementation of vertical integration and its impact on farmer profitability, employability, price-spread, scientific cultivation, farmer satisfaction, development of rural markets (DRMs) and enhanced business prospects. The selected rural areas for study have no major industry around and most of them are far from urban areas. In these rural areas, most of the rural population depends on agriculture in general and on herbal cultivation such as AV in specific. The overview situation was captured from 50 farmers, four consolidators and three processing plant entrepreneurs operating in the state of Rajasthan. AVSCEs as mentioned in Section 7 were found to be relevant for the case environment and relevant information regarding AVSCEs were collected in two phases. The interactions among 13 AVSCEs were investigated with the help of a questionnaire to know the relationships (i.e. V, A, X and O) among AVSCEs (see Step 1 in Section 7). On the basis of the obtained contextual relationships, SSIM was developed and it is mentioned in Table III. The IRM was developed by substituting V, A, X and O by 1 and 0. The transitivity of the contextual relation and IRM were considered to develop FRM. The driving and dependence power of each AVSCE was calculated to develop FRM. The level partition of AVSCEs was performed by developing the reachability and antecedent sets for each AVSCE from the FRM. Five iterations were carried out to assign each AVSCE to a level and by the process, five levels were formed. ISM model of AVSCEs for the case environment was developed and shown in Figure 3. FMICMAC analysis was carried out by revisiting driving and dependence power of each AVSCE and the non-zero cells were replaced by fuzzy numbers depending on the driving and dependence power of the corresponding AVSCEs on the basis of collective

Table III SSIM of AVSCEs

Enablers	ASC	EDS	PMF	EFS	AOW	AFE	GIV	ITR	TAA	DRM	DVI	TAI	IIV
ASC	–	O	V	V	O	X	A	A	X	O	A	O	A
EDS		–	X	V	O	A	O	A	A	O	A	A	A
PMF			–	V	X	X	A	A	A	A	X	A	A
EFS				–	O	V	A	A	A	O	A	A	A
AOW					–	V	A	A	O	O	V	O	O
AFE						–	A	A	A	X	A	O	O
GIV							–	V	V	V	V	V	V
ITR								–	V	V	V	O	V
TAA									–	O	V	O	O
DRM										–	A	A	O
DVI											–	A	V
TAI												–	O
IIV													–

Figure 3 ISM model of AVSCEs for vertical integration



judgments. By the process, FuDRM was formed and its power was raised by fuzzy matrix multiplication to get a converged matrix. Finally, the FMICMAC driver-dependence diagram of AVSCEs was developed and is shown in Figure 4.

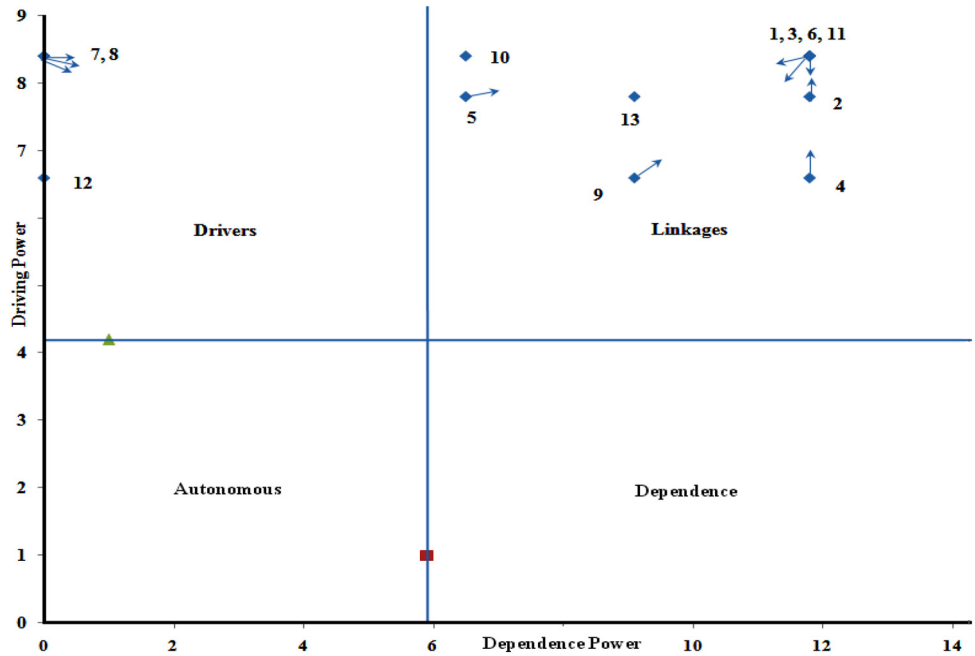
8. Results and discussion

The ISM–FMICMAC analysis was conducted on the vertical integration enablers of AV supply chain for farmer stage following the proposed approach as mentioned in Section 7. The inputs and results for ISM–FMICMAC are discussed in Sections 8.1-8.3.

8.1 Development of ISM model for vertical integration

The developed ISM model (Figure 3) was discussed with various stakeholders such as farmers and government officials for its acceptability. It has five levels and it was divided into three groups (i.e. base, middle and top). Government incentives for value addition (GIV), ITR and TAI are at the base of the hierarchy of structural framework (i.e. Levels 1 and 2) (Figure 3). These three enablers have high driving power and play crucial rule for implementation of vertical integration at farmer (village level). The government should provide incentives and subsidies across different areas to the entrepreneur at the farmer stage for value addition so that it will be a motivating factor to the entrepreneur. At the same time, the effort should be put at farmer stage to establish ITR related to agriculture produces and improve the TAI so that the vertical integration will be possible at farmer stage with ease. The TAI at the village is quite essential for enhancing rural accessibility, business sustainability and business growth. The government should accelerate Pradhan Mantri Gram Sadak Yojna, (PMGSY- the Prime Minister's Rural Roads Program) under the Ministry of Rural Development to give a boost to rural connectivity. The AVSCEs (i.e. technology availability and adaptability [TAA]; IIV; ASC; availability of workforce [AOW]; DRM; and development of vertical integration of other agriculture produces [DVI]) are at the middle of ISM

Figure 4 Driver-dependence diagram of AVSCEs



model. The AVSCEs positioned in the middle of the hierarchy should be addressed tactically in the vertical integration implementation process. The AVSCEs (i.e. effective management of demand and supply risk (EDS); profit margin at farmer stage (PMF); enhanced farmer satisfaction (EFS); and AFE) are positioned in the top level of the hierarchy and have high dependence power with different driving powers. The AVSCEs positioned in this level have the long-standing and should be treated strategically to achieve the excellence in vertical integration implementation at the village level. Thus, the ISM model developed presents a directional framework for the vertical integration of AVSC in rural Rajasthan and gives a clear picture about the relationship between AVSCEs.

8.2 Aloe vera supply chains classification and selection for vertical integration

The classification of AVSCEs for the case environment was carried out through FMICMAC analysis. It was carried out on the basis of driving and dependence powers of 13 AVSCEs into four clusters. However, the 13 AVSCEs were grouped into two clusters (i.e. driver and linkage quadrant) as no AVSCEs were appeared in autonomous quadrant and dependent quadrant. It was concluded that all AVSCEs were relevant for the case environment as no AVSCEs were found in the autonomous quadrant (i.e. driving and dependence power). Also, it was observed that no AVSCEs were in dependent quadrant (low driving power, high dependence power as shown in Figure 4). This signifies that it is not easy to enhance directly any AVSCE, but can be enhanced through other AVSCEs. The AVSCEs, i.e. GIV, ITR and TAI were in driver cluster, which means that these three AVSCEs have high influence on rest of the ten other AVSCEs and these were also placed on bottom side of the developed ISM (Section 9.1). Therefore, these three AVSCEs have to be addressed at first and the efforts should be made to establish and enhance them. The rest ten AVSCEs (i.e. ASC, EDS, PMF, EFS, AOW, AFE, TAA, DRM, DVI and IIV) were grouped in this cluster having both high driving and high dependence power. Typically, these can be attributed as unstable because they have feedback effect, i.e. they get affected by their own action and so are difficult to manage. However, these AVSCEs cannot be ignored and have to be closely monitored regarding their status in making decisions. The key enablers for vertical integration in rural Rajasthan are GIV, ITR and TAI as they were in the base of the ISM model and driver quadrant in driver-dependent diagram of AVSCEs. Therefore, these three AVSCEs have to be addressed at first and the effort should be made to enhance them. Moreover, the current study may be used as a basis to investigate more details regarding post-harvest supply chain in general and vertical integration in specific.

8.3 Managerial implications

The existing supply chain of agricultural produces in India is inefficient with unnecessary intervention from different intermediaries such as traders, commission agents, wholesalers and retailers. This results in an enhanced price to the consumer and less profit to the farmers as the risks and wastages increase due to the longer supply chain. At the same time, the present supply chain of agriculture produces in India are isolated, less vertically integrated, weakly connected, poorly coordinated, relatively unproductive and inefficient. The study carried out also revealed the same for AV supply chain in rural Rajasthan. It was strongly felt that vertical integration at the village level is essential for enhancing rural employability, increased farmer profit share and minimizing price spread. However, its implementation and business sustainability is the area of

concern. The study revealed that government support and motivation is a prerequisite for its implementation. For business sustainability, different sets of agriculture produces have to be identified in a particular area for combined vertical integration (complete or partial) of agriculture produces considering harvesting pattern, demand/consumption pattern, quantity of production in the nearby areas, their processing requirements, storage needs, etc. The economic aspects of both partial and complete vertical integration of single and multiple agriculture produces should be carried out to find its feasibility, sustainability and profitability. The business to business transactions and marketing are also suggested to be adopted in various forms in AVSC such as sale of semi-finished (i.e. AV pulp) and finished produces (AV juice, pharmaceutical products and cosmetics, etc.) from potential offline and online platforms in order to enhance sales and export prospects.

9. Conclusions and future scope

The proposed methodology was applied to analyze the enablers of AVSC in context of rural Rajasthan, India for streamlining the efforts so that vertical integration can be implemented at farmer stage effectively for enhancing rural employability, increasing supply chain profit, reducing the price spread and improving farmers' profitability. It was concluded from the ISM model and FMICMAC analysis that the GIV along with the other two enablers (i.e. ITR and TAI) were the most influencing AVSCEs. The enablers ASC, PMF, AFE, DVI, EDS, DRM, AOW, IIV, TAA and EFS fall in second quadrant in FMICMAC analysis signifying that they have excellent linkage properties. If the three enablers in driver quadrant will be improved, the rest of the enablers will also tend to improve consequently for implementation of vertical integration at village level. Therefore, these three enablers were considered as the prerequisite for implementing vertical integration for the case environment. These three enablers are related to government, and therefore, it will be difficult to implement vertical integration without the Government support and motivation. Although this result was for the case environment (i.e. AVSC of rural Rajasthan) but the obtained results cannot be too far from the agriculture produces, which are similar in nature and are grown in others parts of the country. Moreover, the current study may be used as a basis to investigate more details regarding vertical integration at farmer stage in general and enhanced business to business transaction and marketing in many ways. Although the proposed methodology is applied to AVSC for analyzing the enablers to enhance the rural employability but it can be applied to problems in similar nature related to other agriculture produces considering the judgement of various stakeholders.

9.1 Limitations and future research direction

In future, several studies of this nature could be carried out for different parts of the developing countries in general and India in specific. Also, like every study, the present study has some shortcomings. However, these shortcomings are the future research directions and these have outlined further research directions in the field of the supply chain of agriculture produce in general and vertical integration in specific as follows:

- An empirical study on the strength of relationship among AVSCEs and the impact on the implementation of vertical integration and rural employability should be carried out using structural equation modelling. Similar kind of study may be extended to other agriculture produces in different parts of the country. Finally, a theoretical framework may be developed, which will act as a guideline for vertical integration.
- Total interpretive structural modelling should be used to study and analyze the linkage relationship between enablers. The study should be carried out on the quantification of the impact level of each relevant enabler and their combinations on the vertical integration. The impact of the dynamic behavior of enablers on vertical integration should also be studied and analyzed using Bayesian networks.
- Studies should be conducted to identify the different activities (such as cold storage at farmer stage) for various agriculture produces those can be integrated and study its impact on various areas such as farmers' profitability, waste reduction, rural employability, supply chain profit and price spread.

References

Ahlawat, K.S. and Khatkar, B.S. (2011), "Processing, food applications and safety of aloe vera products: a review", *Journal of Food Science and Technology*, Vol. 48 No. 5, pp. 525-533.

Atuahene-Gima, K. and Lowe, J.F. (1994), "The role of external technology acquisition in product development: attitude-behaviour inconsistency among small firms", *Asia Pacific Journal of Marketing and Logistics*, Vol. 6 No. 3, pp. 26-47.

Aygün, T. and Oeser, G. (2017), "Challenges and opportunities of Turkish food retail in Germany from a value chain perspective", *International Journal of Retail & Distribution Management*, Vol. 45 No. 3, pp. 308-327.

Bhardwaj, B.R. (2018), "Can education empower women through entrepreneurial marketing: a model for upliftment of community services?", *Journal of Enterprising Communities: People and Places in the Global Economy*, Vol. 12 No. 1, pp. 19-31.

Biswas, B.C. (2010), "Cultivation of medicinal plant: success stories of two farmers", *Fertiliser Marketing News*, Vol. 41 No. 3, pp. 1-4.

Blanc, J. (2009), "Family farmers and major retail chains in the Brazilian organic sector: assessing new development pathways, a case study in a peri-urban district of São Paulo", *Journal of Rural Studies*, Vol. 25 No. 3, pp. 322-332.

Blanc, J. and Kledal, P.R. (2012), "The Brazilian organic food sector: prospects and constraints of facilitating the inclusion of smallholders", *Journal of Rural Studies*, Vol. 28 No. 1, pp. 142-154.

Brockman, B.K. and Morgan, R.M. (1999), "The evolution of managerial innovations in distribution: what prospects for ECR?", *International Journal of Retail & Distribution Management*, Vol. 27 No. 10, pp. 397-408.

Charlebois, S. and Camp, R.D. II, (2007), "Environmental uncertainty and vertical integration in a small business network: the case of natural valley farms inc", *Journal of Enterprising Communities: People and Places in the Global Economy*, Vol. 1 No. 3, pp. 252-267.

Cook, G. (1997), "A comparative analysis of vertical integration in the UK brewing and petrol industries", *Journal of Economic Studies*, Vol. 24 No. 3, pp. 152-166.

Cortez, M.R. and Johnston, W.J. (2018), "Marketing role in B2B settings: evidence from advanced, emerging and developing markets", *Journal of Business & Industrial Marketing*, Vol. 34 No. 3, pp. 605-617.

Dabas, C.S., Sternquist, B. and Mahi, H. (2012), "Organized retailing in India: upstream channel structure and management", *Journal of Business & Industrial Marketing*, Vol. 27 No. 3, pp. 176-195.

Das, N. and Chattopadhyay, R.N. (2004), "Commercial cultivation of aloe", *Natural Product Radiance*, Vol. 3 No. 2, pp. 85-87.

Deng, S., Duffy, M.F. and Harrison, G.R. (1995), "Internationalization in small, commodity based economies: the New Zealand example", *Asia Pacific Journal of Marketing and Logistics*, Vol. 7 Nos 1/2, pp. 37-61.

Ding, L. and Mahbubani, J. (2013), "The two-stage decision model of vertical integration", *Management Decision*, Vol. 51 No. 2, pp. 306-320.

Donoho, C.L., Polonsky, M.J., Roberts, S. and Cohen, D.A. (2001), "A cross-cultural examination of the general theory of marketing ethics: does it apply to the next generation of managers?", *Asia Pacific Journal of Marketing and Logistics*, Vol. 13 No. 2, pp. 45-63.

Dunham, L., Ahn, M. and York, A.S. (2012), "Building a bioeconomy in the heartland: bridging the gap between resources and perceptions", *Journal of Enterprising Communities: People and Places in the Global Economy*, Vol. 6 No. 1, pp. 84-100.

Eldridge, D. (2007), "Optimal allocation of decision rights for value-adding in venture capital", *Management Decision*, Vol. 45 No. 5, pp. 897-909.

Gardas, B.B., Raut, R.D. and Narkhede, B. (2017), "Modeling causal factors of post-harvesting losses in vegetable and fruit supply chain: an Indian perspective", *Renewable and Sustainable Energy Reviews*, Vol. 80 No. 1, pp. 1355-1371.

Gebauer, H., Wang, C., Beckenbauer, B. and Krempl, R. (2007), "Business-to-business marketing as a key factor for increasing service revenue in China", *Journal of Business & Industrial Marketing*, Vol. 22 No. 2, pp. 126-137.

Grace, O.M. (2011), "Current perspectives on the economic botany of the genus aloe L. (xanthorrhoeaceae)", *South African Journal of Botany*, Vol. 77 No. 4, pp. 980-987.

Gueimonde-Canto, A., González-Benito, J. and García-Vázquez, J.M. (2011), "Competitive effects of co-operation with suppliers and buyers in the sawmill industry", *Journal of Business & Industrial Marketing*, Vol. 26 No. 1, pp. 58-69.

Hadjikhani, A.a. and Thilenius, P. (2005), "The impact of horizontal and vertical connections on relationships' commitment and trust", *Journal of Business & Industrial Marketing*, Vol. 20 No. 3, pp. 136-147.

Howe, W.S. (1998), "Vertical market relations in the UK grocery trade: analysis and government policy", *International Journal of Retail & Distribution Management*, Vol. 26 No. 6, pp. 212-224.

Javalgi, R.G., Todd, P. and Granot, E. (2011), "The internationalization of Indian SMEs in B-to-B markets", *Journal of Business & Industrial Marketing*, Vol. 26 No. 7, pp. 542-548.

Jennings, D. (2001), "Thorntons: the vertically integrated retailer, questioning the strategy", *International Journal of Retail & Distribution Management*, Vol. 29 No. 4, pp. 176-187.

Johansson, U. (2002), "Food retail buying processes–a study of the UK, Italy and Sweden", *International Journal of Retail & Distribution Management*, Vol. 30 No. 12, pp. 575-585.

Kandasamy, W.B.V., Smarandache, F. and Ilanthenral, K. (2007), "Elementary fuzzy matrix theory and fuzzy models for social scientists", *Automation*, Textbook, Los Angeles.

Karkala, M. and Bhushan, B. (2014), "Aloe vera: a wonder plant its history, cultivation and medicinal uses", *Journal of Pharmacognosy and Phytochemistry*, Vol. 2 No. 5, pp. 85-88.

Khera, R. and Nayak, N. (2009), "Women workers and perceptions of the national rural employment guarantee act", *Economic and Political Weekly*, Vol. 44 No. 43, pp. 49-57.

Kokate (2013), "Human resources, advanced infrastructure can spur Indian herbal industry growth", available at: www.pharmabiz.com/NewsDetails.aspx?aid=73588&sid=1 (accessed 31 August 2017).

Kumar, C.V.S. and Routroy, S. (2014), "Addressing the root cause impediments for supplier development in manufacturing environment", *Procedia Engineering*, Vol. 97 No. 1, pp. 2136-2146.

Kumar, S., Gorane, S. and Kant, R. (2015), "Modelling the supplier selection process enablers using ISM and fuzzy MICMAC approach", *Journal of Business & Industrial Marketing*, Vol. 30 No. 5, pp. 536-551.

Lamont, J.T.J. (1992), "Agricultural marketing systems: horizontal and vertical integration in the seed potato industry", *British Food Journal*, Vol. 94 No. 8, pp. 3-15.

Lamprinopoulou, C. and Tregear, A. (2011), "Inter-firm relations in SME clusters and the link to marketing performance", *Journal of Business & Industrial Marketing*, Vol. 26 No. 6, pp. 421-429.

Lanjouw, P. and Shariff, A. (2004), "Rural Non-Farm employment in India: access, incomes and poverty impact", *Economic and Political Weekly*, Vol. 39 No. 40, pp. 4429-4446.

Leach, M.P., Mesquita, L. and Downey, W.D. (2001), "Case study: partnering strategies in a bio tech. world: the case of dairyland seed company", *Journal of Business & Industrial Marketing*, Vol. 16 No. 3, pp. 219-238.

Lettl, C. and Gemünden, H.G. (2005), "The entrepreneurial role of innovative users", *Journal of Business & Industrial Marketing*, Vol. 20 No. 7, pp. 339-346.

Liontakis, A. and Tzouramani, I. (2016), "Economic sustainability of organic aloe vera farming in Greece under risk and uncertainty", *Sustainability*, Vol. 8 No. 338, pp. 1-13.

Ludvig, A., Tahvanainen, V., Dickson, A., Evard, C., Kurttila, M., Cosovic, M., Chapman, E., Wilding, M. and Weiss, G. (2016), "The practice of entrepreneurship in the non-wood forest products sector: support for innovation on private

forest land", *Forest Policy and Economics*, Vol. 66 No. 1, pp. 31-37.
Makkonen, H.S. and Johnston, W.J. (2014), "Innovation adoption and diffusion in business-to-business marketing", *Journal of Business & Industrial Marketing*, Vol. 29 No. 4, pp. 324-331.
Mehrotra, S. and Verma, S. (2015), "An assessment approach for enhancing the organizational performance of social enterprises in India", *Journal of Entrepreneurship in Emerging Economies*, Vol. 7 No. 1, pp. 35-54.
Mudambi, S.M. (1994), "A topology of strategic choice in retailing", *International Journal of Retail & Distribution Management*, Vol. 22 No. 4, pp. 32-40.
Muñiz-Martínez, N. (1998), "The internationalisation of European retailers in America: the US experience", *International Journal of Retail & Distribution Management*, Vol. 26 No. 1, pp. 29-37.
Nandonde, F.A. and Kuada, J. (2016), "International firms in Africa's food retail business emerging issues and research agenda", *International Journal of Retail & Distribution Management*, Vol. 44 No. 4, pp. 448-464.
Nugent, E.J. and Hamblin, D.J. (1996), "Improved methodologies for vertical integration research", *Integrated Manufacturing Systems*, Vol. 7 No. 1, pp. 16-28.
Orozco Quintero, A. and Berkes, F. (2010), "Role of linkages and diversity of partnerships in a Mexican community-based forest enterprise", *Journal of Enterprising Communities: People and Places in the Global Economy*, Vol. 4 No. 2, pp. 148-161.
Pangriya, R. (2015), "Study of aromatic and medicated plants in Uttarakhand, India: with focus on role in employment generation and supply chain management", *International Journal of Social Sciences and Management*, Vol. 2 No. 2, pp. 148-156.
Parker, D.W., Parsons, N. and Isharyanto, F. (2015), "Inclusion of strategic management theories to project management", *International Journal of Managing Projects in Business*, Vol. 8 No. 3, pp. 552-573.
Peyrefitte, J., Golden, P.A. and Brice Jr, J. (2002), "Vertical integration and economic performance: a managerial capability framework", *Management Decision*, Vol. 40 No. 3, pp. 217-226.
Piercy, N.F. (2010), "Evolution of strategic sales organizations in business-to-business marketing", *Journal of Business & Industrial Marketing*, Vol. 25 No. 5, pp. 349-359.
Priyadarshi, R. and Routroy, S. (2018), "Vertical integration level selection for value addition of herbal products: a farmer's perspective", *Materials Today: Proceeding*, Vol. 5 No. 9, pp. 18354-18361.
Rich, M.K. and Bartholomew, D. (2010), "Undergraduate research centers: simply a source of student employment or a model for supplementing rural university finances?", *Journal of Business & Industrial Marketing*, Vol. 25 No. 3, pp. 172-176.
Routroy, S. and Kumar, C.V.S. (2015), "Strategy for supplier development program implementation: a case study", *International Journal of Services and Operations Management*, Vol. 21 No. 2, pp. 238-264.
Routroy, S. and Pradhan, S.K. (2014), "Benchmarking model of supplier development for an Indian gear manufacturing company", *Benchmarking: An International Journal*, Vol. 21 No. 2, pp. 253-275.
Sachedina, H. and Bodeker, G. (1999), "Wild aloe harvesting in South Africa", *The Journal of Alternative and Complementary Medicine*, Vol. 5 No. 2, pp. 121-123.
Sage, A.P. (1977), "Interpretive structural modeling: methodology for large-scale population density", *Small Business Economics*, Vol. 6 No. 1, pp. 291-297.
Satyam, Aithal, R.K. and Maurya, H. (2017), "Exploring channel conflict in an emerging economy: the small retailer's perspective", *International Journal of Retail & Distribution Management*, Vol. 45 No. 10, pp. 1061-1078.
Saunders, M. and Bromwich, D. (2012), "New model rural cooperatives in Gansu: a case study", *Journal of Enterprising Communities: People and Places in the Global Economy*, Vol. 6 No. 4, pp. 325-338.
Shahidullah, A.K.M. and Haque, C.E. (2010), "Linking medicinal plant production with livelihood enhancement in Bangladesh: implications of a vertically integrated value chain", *The Journal of Transdisciplinary Environmental Studies*, Vol. 9 No. 2, pp. 1-18.
Sheth, J.N. and Sharma, A. (2006), "The surpluses and shortages in business-to-business marketing theory and research", *Journal of Business & Industrial Marketing*, Vol. 21 No. 7, pp. 422-427.
Ting, S.-C., Chen, C.-N. and Bartholomew, D.E. (2007), "An integrated study of entrepreneurs' opportunism", *Journal of Business & Industrial Marketing*, Vol. 22 No. 5, pp. 322-335.
Trim, P.R.J. and Lee, Y.I. (2006), "Vertically integrated organisational marketing systems: a partnership approach for retailing organisations", *Journal of Business & Industrial Marketing*, Vol. 21 No. 3, pp. 151-163.
Vallaster, C. (2001), "Strategy making by multicultural groups–it works if leadership is effective", *Asia Pacific Journal of Marketing and Logistics*, Vol. 13 No. 3, pp. 19-40.
Walters, D., Halliday, M. and Glaser, S. (2002), "Added value, enterprise value and competitive advantage", *Management Decision*, Vol. 40 No. 9, pp. 823-833.
Yadav, V. and Goyal, P. (2015), "User innovation and entrepreneurship: case studies from rural India", *Journal of Innovation and Entrepreneurship*, Vol. 4 No. 5, pp. 1-20.
Yi, J., Zhong, Y. and Zheng, Q. (2012), "An analysis of state-owned and private-owned enterprises' export performance", *Journal of Chinese Entrepreneurship*, Vol. 4 No. 1, pp. 20-34.

Web Cite

https://unemploymentinindia.cmie.com/ (accessed 1 July 2018).
http://planningcommission.gov.in/reports/genrep/bkpap2020/32_bg2020.pdf (accessed 1 July 2018).
www.prweb.com/releases/2016/07/prweb13539970.htm (accessed 1 July 2018).
www.marketwatch.com/story/cosmetics-industrys-love-affair-with-aloe-vera-extracts-continues-study-2016-05-31-13203054 (accessed 1 July 2018).
https://villageinfo.in/rajasthan.html#list-of-districts-in-rajasthan (accessed 1 July 2018).

www.agriculture.rajasthan.gov.in/content/dam/agriculture/Agriculture%20Department/ecitizen/agriculture-statistics/agriculture_statistics_2015-16.pdf (accessed 1 July 2018).

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