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Development of herbal selection criteria for Malaysian herbal industry

(Pembangunan kriteria pemilihan herba untuk industri herba Malaysia)

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Abstracts

The purpose of this paper is to demonstrate the application of Delphi method and factor analysis (FA) in developing herbal selection criteria that is considered important to help investors or decision makers in deciding which herb types is appropriate to venture in. A total of 226 people from various field in the herbal industry were chosen as the respondents. The Delphi research identified 29 criteria that could influence the choice of herb types in making investment decision. These criteria were analysed using FA to reduce into factor constructs. Finding showed that there were six criteria that influenced decision making toward herbal selections namely incentive, research and development, marketing, community welfare, economics, rules and regulations. The total percentage of variance explained is 58.87% and with 0.904 Cronbach's Alpha reliability test. The outcomes of this study could be considered as accuracy tool for decision makers to identify herbs which are to be addressed by the government in the development of strategies that will give high returns to the national economy.

Introduction

The herbal industry has indeed been long established in the world. The rise of the former, the Malay Peninsular (Tanah Melayu) during the old times was also backed by the trade of herbs and spices. Nowadays, the market of herbal products has grown considerably large due to the multi-purpose nature and usages of herbs and spices. Herb products are being used as medicines and health supplements, cosmetics and beauty products, among others. Nevertheless, most of the herbal products in the domestic markets are imported (MOA 2010). Not with standing, Malaysia has a large variety of herbs which have not been fully exploited in terms of their potentials. Thus, far domestic herbs are used sporadically by small businesses and are traditionally consumed as health supplements (MOA 2010).

Herbs sector is listed in the National Key Economic Area (2010) as high value commodities to be further developed and promoted in terms of production and marketing. A total of five herbs have been identified under NKEA and proposed for investment and commercialisation. These herbs are tongkat ali (*Eurycoma longifolia*), kacip fatimah (*Labisia pumila*), dukung anak (*Phyllanthus niruri*), misai kucing (*Orthosiphon stamineus*) and hempedu bumi (*Andrographis paniculata*) (MOA 2011).

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Currently, the selection of these herbs was made based on their discovery, agronomy, product development and their properties (pre-clinical and clinical tests). However, the selection criteria for investors should comprise of other criteria such as the economic factors, environment, markets and also government policies. A more diversified set of criteria would be a better tool for herb investors to use in their decision making. Since such selection criteria are currently unavailable, they need to be identified and developed. It is also crucial to determine the order of importance of the identified criteria. The ranking of the criteria will provide an important guide in the selection process of the herbs by the investors.

The main objective of this study is to develop the selection criteria for the commercialisation of herbs and investment decision making. This research is complementary to the current criteria already established by policy makers. The criteria model developed will provide a helpful policy making tool which includes research, economic, environmental and other factors. This paper will explore the factors which later classified as the criteria that influence the selection of herb types to be produced or commercialised.

Literature review

Decision making is the study of identifying and choosing alternatives based on the values and preferences of the decision maker. Making a decision implies that there are alternative choices to be considered, and in such a case we not only want to identify as many of these alternatives as possible, but to choose the ones that best fit our goals, criteria, objectives, desires, values, and so on (Harris 2002). When we have alternatives or criteria, it should be related to the selection process to make perfect decisions. Saaty (2006) stated that alternatives and criteria are important elements for the set up of any selection in decision making. There are several scientific methods to develop criteria such as Delphi method and factor analysis (FA).

The Delphi method was used to gather the opinion of experts through a structured questionnaire. It was developed by Dalkey and Helmer (1963) at the Rank Corporation for military decision purposes. It was used to determine the running of the nuclear war in the 1950s (Kahn and Herman 1965). This technique was widely used to generate forecasts in technology, education and other related fields (Cornish 1977). It was designed as a combination of group ideas and it was also a group communication process that was aimed at addressing specific issues or problems. A series of questionnaires were sent to selected respondents (the Delphi group) through a facilitator who oversees the responses of their panel of experts. The group does not meet face-to-face. All communications were done in writing (letters or emails) and surveys. Members of the groups were selected because of their expertise or they have relevant information to be considered (Armstrong 2001).

Luzon and El-Sayegh (2016) identified supplier selection criteria for oil and gas projects in UAE using Delphi method. They stated top 10 criteria using this method to two main groups, each consisting of five selection factors. Group one includes technical and commercial aspects, which include delivery, claims, price, service and warranties and quality. Group two is company-related aspects, which include financial position, technical capability, production, facility and capability, performance history and geographical location. Chen et al. (2013) used Delphi method to list down possible criteria to identify the content and priorities of health professional education in child abuse by integrating expert opinions and achieving consensus. A total of three round Delphi study was conducted with 25 multidisciplinary experts in health care, social welfare, psychology and counseling, and law and jurisdiction.

They found that several criteria such as importance of knowledge, subjective norms, attitudes, skills, team collaboration and teaching strategies.

The FA was originally developed in the early 20th century in the psychometric fields by Karl Pearson, Charles Edward Spearman, Thurstone and others in defining and measuring a person's intelligence level (Walker and Maddan 2009). This technique is one of the multivariate analysis procedures that attempt to identify any underlying factors that are correlated among a group of independent variables. However, Conway explained that the FA is not just a tool to develop independent variables, but can also be used to develop a set of criteria or dimensions to support the decision making process. Micheal (1989) defined the FA as a statistical approach in which the main objective was to represent a set of variables in the form of small variable hypothesis. Coakes et al. (2009) defined a reduction FA as a technique used to reduce the number of variables to a smaller set of underlying factors that summarised the important information contained in the variables. A FA is also frequently used as an exploratory technique when researchers want to condense the structure of a set of variables.

Sarang et al. (2016) used exploratory FA to group critical success factors for supplier development and buyer supplier relationship. They obtain the data from 87 respondents working in manufacturing sector. Using the exploratory FA approach, they analysed and group the critical success factors to six factors with their respective items such as drivers for supplier development practices, supplier development practices, buyer supplier relationship practices, buyer supplier relationship improvement, competitive advantages and profitability. Mak and Nebebe (2013) had conducted a study using FA to determine the best of criteria in supplier selection. The FA was used to group overall criteria into three statistically independent factors which can be interpreted as F1: Product/service attributes, F2: Vendor attributes and F3: Economic attributes. The ranking of criteria were ranked by traditionally calculated as eigenvalue divided to sum of eigenvalues.

Methodology

This study involved two phases for its completion. The first phase was to determine the broad categories of the herb selection criteria using Delphi method. The respondents determined and identified the broad categories of the herb selection criteria to make decision and to reach a consensus on the current situation outlook of the herbal industry in Malaysia. Information, data collection and gathering involved experts from different aspects and background of herbal production, marketing, knowledge and experience. All the data were gathered by Delphi method and were used as items of selection criteria for the design of the questionnaire in second phase. The data obtained through the questionnaire were then used to construct the dimensions of selection criteria model using FA.

Sampling and technique

There are several scholars discuss about a number of respondents that are suitable for Delphi method and FA. For Delphi method, Williams and Webb (1994) mentioned that there was no specific mechanism for identifying the number of experts or panel using this technique. Determination of panel size can be made according to the nature of the topic or research such as the availability of time and funds (Van Zolingen and Klaassen 2003). However, Akins et al. (2005) mentioned that the sample size for Delphi studies varies depending on the research topic and on the specific situation. For example, Wang et al. (2003) included two panels based on location. Lam et al. (2000) used three experts involving three panels. In other words, the number of experts used by previous scholars varied depending on the nature and scope of research and the availability of resources.

Skulmoski and Hartman (2007) had listed some literature with an appropriate sample size, and that the minimum number of respondents was three, while the highest was 171. *Table 1* shows several literature sources using the Delphi method with the corresponding number of sample sizes.

For FA, Gorsuch (1983) recommended that sample size (N) should be at least 100 with Kline (1979) supported this recommendation. While Comrey and Lee (1992) offered a rough rating scale for adequate sample sizes in FA: 100 = Poor, 200 = Fair, 300 = Good, 500 = Very good, 1,000 or more = Excellent. In this study a total of 222 respondents were interviewed driven by purposive sampling.

The study was conducted in Klang Valley covered the respondents from multidisciplinary fields such as decision makers, researchers, entrepreneurs and herb cultivators that were considered to represent the population. The survey was carried out during special events such as training or workshop, seminar, conference, exhibition and gathering. Information on the respondents to be contacted were obtained from the Malaysian Agricultural Research and Development Institute (MARDI), Forest Research Institute Malaysia (FRIM) and National Pharmaceutical Control Bureau (NPCB).

Research instruments

A total of two sets of questionnaires for both methods were developed which were used in qualitative and quantitative approaches. The questionnaire for Delphi method was made up of open-ended Delphi questions. This questionnaire had two sections of which the first section was about the demographic profile of the experts and the second was about the criteria used for herb selection. All respondents were given the opportunity to list out the herb selection criteria as much as possible. Whereas the questionnaire for FA included 40 items with 5 point Likert Scale were developed to gather the response of every criteria that listed. Scale 1 = Strongly disagree, 2 = Disagree, 3 = Uncertain, 4 = Agree and 5 = Strongly agree. Some items sentence used reverse meaning for validity checking. The questionnaire was split into two sections, the first section was about demographic question and the second section was about selection criteria items to be rated. At the same time, online questionnaire was developed to be e-mailed to respondents using the same format as conventional questionnaire.

Data collection and analysis

Data collection was started by getting written agreements from potential respondents to participate in the study.

Table 1. Delphi method diversity – Published research

Authors	Research	Rounds	Sample sizes
Gustafson, Shukla, Delbecq and Walster (1973)	Estimate almanac events to investigate Delphi accuracy	2	4
Hartman and Baldwin (1995)	Validate research outcomes	1	62
Czinkota and Ronkainen (1997)	Impact analysis of changes to the international business environment	3	34
Kuo and Yu (1999)	Identify national park selection criteria	1	28
Nambisan, Agarwal and Tanniru (1999)	Develop taxonomy of organisational mechanisms	3	6
Lam, Petri and Smith (2000)	Develop rules for a ceramic casting process	3	3
Roberson, Collins and Oreg (2005)	Examine and explain how recruitment message specificity influences job seeker attraction to organisations	2	171

Source: Skulmoski and Hartman (2007)

Out of ten people, six agreed to give their cooperation in this study. These respondents made up of two experts in each group or panel (decision makers, researchers and entrepreneurs or cultivators). A total of six respondents were deemed to be sufficient to come up with the necessary results as mentioned above. The interviews were conducted personally with the respondents, while phone interviews were carried out with those who were unable to meet the interviewer. The data gathering process were undertaken twice to ensure the validity of the data. In the first round of the Delphi method, the questionnaires were mailed to the experts who had agreed to participate. The inductive approach was used where the experts were invited to generate ideas and were given freedom in their responses driven by questions. All respondents were given the opportunity to list out, as much as possible the herb selection criteria.

All criteria listed by respondents in the first round survey were compiled into a spreadsheet which was then sent back to the same respondents for the validation process of their agreement in the second round survey. Feedbacks from second round were analysed using descriptive analysis to define consensus of criteria and relative importance for each item based on the responses of the participants. All items would be ranked by their percentage score in this round. The survey for the first phase took five weeks, of which the first two weeks were for the first round survey, followed by one week for data compilation, and the last two weeks for the second round survey.

FA was used as an analysis tool for the data collected using second questionnaire. The data were gathered from 220 respondents through face to face interviews. Data from 217 respondents were accepted for analysis with data from three respondents being rejected due to their incomplete questionnaires. A reliability test was conducted on listed items to check the consistency and reliability of responses. Lin et al. (2002) stated that a Cronbach's Alpha value exceeding 0.9 was considered to reflect the high internal consistency of the scale. The deletion process of items was applied until the best Cronbanch's Alpha value or the value are fitted in an acceptable range value. A scale value of between 0.7 and 0.8 was considered acceptable with 0.8 to 0.9 assumed good in this respect. Finally, the remaining items were analysed using exploratory FA to identify underlying factors or latent factors. The results of FA will produce the Kaiser-Meyer-Okin value (KMO). According to Walker and Maddan (2009), the best of KMO value is 0.9 and above; 0.5 to 0.9 is acceptable and 0.5 and below is unacceptable for social science studies.

Results

Descriptive analysis was conducted for Delphi method for two rounds. In the first round, data were gathered from all these experts and in the second round these data would be verified. Results from this phase would be used as constructs and dimensions of criteria for FA. A summary of the results is as shown in *Table 2*.

Table 2 shows the response rate of selection criteria by experts on the items in the two-round survey series. The third column of the table indicates the percentage of experts who have listed the items in the first round. The fourth column is the percentage of respondents who agree with the items in the second round of the survey. Phase one results show a total of 12 items adopted unanimously by the experts. There are six items accepted by 83.3% of the experts.

If we look at the criteria listed above, there are several criteria that have almost the same meaning and these can be placed in the same grouping within the criteria part of economy, marketing, social or others. However, this process is not made in this phase but will be conducted in the FA phase. All of these criteria are the result of recommendations by experts who will

Table 2. Response rate of the selection criteria

Criteria and items	1st round: Suggestion (n = 6)	2nd round: Verification (n = 6)
Tax deduction	50.0 (3)	100.0 (6)
Market guaranteed	33.3 (2)	100.0 (6)
Provide incentives to productivity target	33.3 (2)	100.0 (6)
Increase research grant	33.3 (2)	100.0 (6)
Local demand	16.7 (1)	100.0 (6)
International demand	16.7 (1)	100.0 (6)
Stability of price	16.7 (1)	100.0 (6)
Fulfil customer requirements	16.7 (1)	100.0 (6)
Suitable to add value	16.7 (1)	100.0 (6)
Level of R&D	16.7 (1)	100.0 (6)
Provide job opportunity	16.7 (1)	100.0 (6)
Society trust of product (safety)	16.7 (1)	100.0 (6)
Maturity of research	33.3 (2)	83.3 (5)
Preferred by consumers	16.7 (1)	83.3 (5)
Maturity of technology	16.7 (1)	83.3 (5)
Have evidence of the clinical studies	16.7 (1)	83.3 (5)
Higher nett returns	16.7 (1)	83.3 (5)
Proven health benefit claims	16.7 (1)	83.3 (5)
Competitive prices	33.3 (2)	66.7 (4)
Health benefits	33.3 (2)	66.7 (4)
Have evidence on pre-clinical studies	16.7 (1)	66.7 (4)
Avoid chemical fertiliser	16.7 (1)	66.7 (4)
More dissemination of loan availability	16.7 (1)	50.0 (3)
Positive impact on soil structure	16.7 (1)	50.0 (3)
Regulations should be clear	16.7 (1)	50.0 (3)
Multipurpose in terms of usage	16.7 (1)	50.0 (3)
Locally culturally accepted	16.7 (1)	33.3 (2)
Entrepreneur interest	16.7 (1)	33.3 (2)
Convenient to access scientific information	16.7 (1)	16.7 (1)

Table 3. KMO and Bartlett's test

Kaiser-Meyer-Olkin	Measure of sampling adequacy	0.905
Bartlett's test of sphericity	Approx. Chi-Square	2077.460
	df	300.000
	Sig	0.000

later confirm them in the second round of the survey.

For FA, the data were analysed using reliability test first on 40 items (selection criteria) to check the consistency of responses. The best value Cronbanch's Alpha was 0.904 after deletion of 13 of the original 40 items. The process of the deletion of items was carried out by considering the value of an item as it was deleted until Cronbach's Alpha became stagnant (did not increase any more). The remaining 27 items were utilised for a FA with varimax rotation to determine the selection criteria or factors. *Table 3* illustrates the KMO and the Bartlett's test of sphericity test of sampling adequacy which has been initially performed on the data to confirm the appropriateness of conducting the FA (Tabachnick 2001).

The KMO measure verified the sampling adequacy for the analysis with KMO = 0.905 with Bartlett's test (p <0.001) being significant, indicating that the correlations between items were sufficiently large for FA. Bartlett's test for sphericity showed that the correlation matrix was at an appropriate level to perform the FA on the data for each scale, with all scales reaching the significant level of p <0. The KMO measure provided a value between 0 and 1. A smaller value for the KMO would indicate that the FA of the variables might not be appropriate since the correlations between the variables cannot be explained by the other variables (Norušis 1993). *Table 3* shows the KMO and Bartlett's test value.

The eigenvalues showed that the items contained more than one factor. A total of six factors/components had eigenvalues over Kaiser's criterion of more than one and the combination explained 58.87% of the variance. The items on the same components suggested that Component 1 represents incentives and assistance; Component 2 represents research and development; Component 3 represents marketability; Component 4 represents community welfare; Component 5 represents economy and Component 6 represents policies and regulations. *Table 4* showed the result of FA of the herbal selection criteria.

The findings also showed that there were nine items included altogether, included in four components. The factor loading of these items is less than 0.4, so it means that the items should be omitted because they had cross loading problems among two or three dimensions and had a small value of factor loading.

Component 1 – Incentives and assistance is recognised as a first criterion that influences the respondents in herbal selection. This criterion consists of five sub-criteria and has a total percentage of variance of 33.45. Providing incentives to cultivators who achieve the productivity target has the highest factor loading of 0.769 followed by export incentives (0.745) and tax deductions (0.730). The fourth sub-criteria under this component is increased research grant with factor loading 0.698 and the last sub-criteria is loan offered spread-out (0.682). The result of this component shows that incentives or assistance is the most outstanding criterion considered by respondents.

Component 2 – Research and development is the second criterion extracted by EFA with a total percentage of variance 7.442%. This criterion has four sub-criteria comprising convenience to access scientific information with the highest factor loading of 0.736, followed by having evidence of pre-clinical study (0.711), level of R&D (0.642) and maturity of technology processing (0.613). This result suggests that research and development activities must fulfil the needs of respondents for certain herbal crops or products to be commercialised.

Component 3 – The third criterion is marketability, which has a total percentage of variance of 5.326% and consists of two sub-criteria: market guarantee with a factor loading of 0.579 followed by high demand in overseas markets (0.578). This result indicates that the herbal products must have guaranteed markets and a high demand. Thus, marketability is important to an industry player to ensure that the herbal products can be sold.

Component 4 – The fourth criterion is community welfare with a total percentage of variance of 4.495% and comprises three sub-criteria: society's trust toward products, which has a factor loading of 0.616, providing job opportunities (0.611) and locally culturally accepted (0.555). The industry players have a high consideration of the criteria of community welfare to ensure that their efforts can contribute to a positive impact on the local community and society.

Component 5 – The fifth criterion is economics, which has a total variance of 4.118%. Even thought this criterion have low cronbach's alpha at 0.428, this criterion is really important to stand in the model

Table 4. Results of FA of the herbal selection factor

Dimensions	Component					
	1	2	3	4	5	6
Incentives and assistance ($\alpha = 0.865$)						
Provide incentive to cultivators who achieve the productivity target	.769					
Export incentives	.745					
Tax deduction	.730					
Increase research grant	.698					
Loan offered spread out	.682					
Research and development ($\alpha = 0.757$)						
Convenient to access scientific information		.735				
Have evidence of pre-clinical study		.711				
Level of R&D		.642				
Maturity of processing technology		.613				
Marketability ($\alpha = 0.710$)						
Market guarantee			.579			
High demand in overseas			.578			
Community welfare ($\alpha = 0.507$)						
Society trust toward product (safety)				.616		
Provide job opportunity				.611		
Locally culturally accepted				.555		
Economics ($\alpha = 0.428$)						
Increase country income					.658	
Higher net return					.655	
Policies and Regulations ($\alpha = 0.374$)						
Clarity of regulation						.556
Minimum trade barriers						.502
Eigenvalue	8.359	1.861	1.331	1.124	1.030	1.014
Percentage of variance	33.435	7.442	5.326	4.495	4.118	4.054
Cumulative percentages of variance	33.435	40.877	46.203	50.698	54.816	58.870
Total Cronbach's alpha coefficient ($\alpha = 0.850$)						

based on literatures by Cobuloglu and Büyüktahtakın (2014), Rezael-Moghaddam and Karami (2007), and Keirungi and Fabricius (2005) that mentioning of economic criteria. This criterion consists of two sub-criteria: increasing country income with a factor loading of 0.658 and higher net returns (0.655). Economic growth is important to any country as it increases aggregate demand for goods and services. Thus, economic growth will increase the potential demand for herbal products. Subsequently, the herbal industry will expand and derive good returns to herbal product manufacturers.

Component 6 – The last criterion is policies and regulations which have a total variance of 4.054%. Despite of this

component have low Cronbach's Alpha at 0.374 but the policy makers especially from Herbal Development Division, Ministry of Agriculture and Agro-based Industry Malaysia suggested this criteria should be retained because the criterion is always considered to make decision in their level. This component contains two sub-criteria: clarity of regulations with a factor loading of 0.556 and minimum trade barrier (0.502). The understanding of policies and regulation is important for herbal producers to ensure that they can prepare their herbal product to perform as per the requirement of regulations in certain countries. In addition, the minimum trade barrier of certain herbs allows the herbal products to penetrate foreign markets more easily.

The environment factor was hypothesised to be an important factor in the current market situation. The experts who were interviewed had the opinion that environmental conservation had to be observed with the production or farming of herbs. However, the expected criteria were not significant in this analysis as it has a low loading factor.

Conclusion

This research provides many good lessons and insights on the herb industry and supports the decision-making process. The decisions made by policy makers, researchers and entrepreneurs (including herbal growers) were to develop the selection criteria. This was because these developments significantly provide an impact on their projects or plans. The research had made use of the Delphi method to identify the selection criteria. The findings had indicated twenty nine sub-criteria which had to be investigated. The FA was conducted which elicited the herbal selection model that contained six groups of criteria. The model that have been developed in this study could be used as a further guideline for decision makers to identify herbs which are to be addressed by the government in the development of strategies to introduce the country's flagship herbs that will give high returns to the national economy. The model developed will provide a useful decision making tool for herbal entrepreneurs in selecting the most suitable herbs to be cultivated or processed.

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Abstrak

Tujuan kertas kerja ini adalah untuk menunjukkan penggunaan kaedah Delphi dan analisis faktor dalam membangunkan kriteria pemilihan herba yang dianggap penting untuk membantu pelabur atau pembuat keputusan bagi memutuskan jenis herba yang sesuai untuk diusahakan. Seramai 226 orang dari pelbagai bidang dalam industri herba telah dipilih sebagai responden. Kajian Delphi telah mengenal pasti 29 kriteria yang boleh mempengaruhi pilihan jenis herba dalam membuat keputusan pelaburan. Kriteria ini kemudiannya dianalisis menggunakan faktor analisis untuk membentuk faktor konstruk. Dapatan kajian menunjukkan terdapat enam kriteria yang mempengaruhi proses membuat keputusan ke arah pemilihan herba iaitu insentif, penyelidikan dan pembangunan, pemasaran, kebajikan masyarakat, ekonomi, dan undang-undang serta peraturan. Jumlah peratusan varians faktor analisis menjelaskan 58.87% dengan 0.904 ujian kebolehpercayaan Alpha Cronbach. Hasil kajian ini boleh digunakan sebagai kaedah yang tepat dalam membuat keputusan untuk mengenal pasti herba yang perlu diberi perhatian oleh kerajaan dalam strategi pembangunan yang akan memberi pulangan yang tinggi kepada ekonomi negara.