International Journal of Business Economics and Management Research
Vol. 8, Issue 12, December 2017 Impact Factor: 4.963 ISSN: (2229-4848)
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A METHODOLOGY FOR DEMAND FORECASTING OF AGRICULTURAL INPUTS IN AGRI-BUSINESS INDUSTRY

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ABSTRACT

INTRODUCTION

Agriculture is one of the most complex and diverse elements of the economic fabric of India. The use of modern farming practices on a wider scale and integrated nutrient management practices are essential if India's farmers wish to produce crops in line with the observed global standards of quantity and quality. The need to be more productive has manifested itself in farmers adopting new methods of agriculture and the latest agricultural technology required to improve the economics of farming.

OBJECTIVES

This Study has the following primary Research objectives:

- ✓ To identify the factors that influence demand for specialty fertilizers in the Indian context
- ✓ To suggest a profile of the typical potential user (farmer) for specialty fertilizers
- ✓ To assess the extent of the relationship between the causal factors and demand for specialty fertilizers

To use above to generate a predictive model to forecast demand for specialty fertilizers applicable to India.

METHODOLOGY

A detailed review of forecasting techniques was undertaken in order to identify those that would be the most appropriate to this study. The various techniques reviewed and the reasons why they were considered appropriate

as part of the methodology for this study are Causal Methods, Surveys Method, Focus Groups & In depth interviews and Segmentation Method.

KEYWORDS: Agronomic requirement, Supply, Demand, Demand Forecasting

INTRODUCTION

Agriculture is one of the most complex and diverse elements of the economic fabric of India. The use of modern farming practices on a wider scale and integrated nutrient management practices are essential if India's farmers wish to produce crops in line with the observed global standards of quantity and quality. If a farmer does not provide balanced 'food' to his crops, he cannot expect optimum levels of farm productivity.

There are a total of *sixteen* elements recognized as essential plant nutrients, each having specific Functions. Neither can a plant complete a healthy life cycle in the absence of even one of the Essential nutrients, nor can they be replaced. The application of nutrients like Nitrogen (through Urea), Phosphorus (through Di-Ammonium Phosphate) and Potassium (through Sulphate of Potash) is commonplace. These are nutrients required in large quantities and they are well recognized as major fertilizers. In fact, there are several instances observed of their rampant overuse, which is a serious cause for concern. Excess nutrients applied tend to reduce the efficiency of uptake of the other nutrients present in the soil, compounding the problems of deficiencies. However Nitrogen, Phosphorus & Potassium are not the only nutrients required by plants. Calcium, Magnesium and Sulphur are considered as secondary nutrients. Several other nutrients called micronutrients; though required in smaller quantities, are equally important for good growth and development of plants. The essential micronutrients are Boron (B), Chlorine (Cl), Copper (Cu), Iron (Fe), Manganese (Mn), Molybdenum (Mo) and Zinc (Zn). Plants take up all these nutrients simultaneously and their requirements vary with type of plants, growth stages, yield potential, etc. **All available sources of micro-nutrients will be classified as Specialty Plant Nutrition Solutions for the purpose of this study.**

NEED FOR THE STUDY

The need to be more productive has manifested itself in farmers adopting new methods of agriculture and the latest agricultural technology required to **improve the economics of farming**.

Integrated Nutrient Management forms an

integral part of this framework. As a result, demand situations for inputs required by the farm sector are no longer certain. Certainty, longer product life cycles and low competitive intensity are things of the past. **The overall environment has become dynamic.** The environment is changing rapidly with the dynamism arising not simply from the interaction of the individual structural components of the industry, but also from the industry "field" itself. New farming methods, increased awareness, understanding and acceptance for modern farming methods, including the application of specialty fertilizers, within the farming community have set **the 'industry's "ground" itself in motion'** creating an environment that can be aptly classified as a turbulent field". **Demand has become uncertain**, product life cycles have shortened, and competition has intensified. In such a situation, **understanding demand, planning demand and linking supply with demand is crucial.**

The paucity of demand forecasting models in the agricultural inputs sector is a major gap in the literature available to the Agribusiness Industry. There are models available that forecast output of individual categories of farm products as well as models that predict the impact of factors like rainfall, government policy, etc. on demand and supply of agricultural commodities. However, forecasting models for inputs are rare. Extensive search revealed only one model for forecasting global demand of commodity (major) fertilizers, developed by the Food and Agriculture Organization (FAO). There was no similar forecasting model available in the public domain prepared specifically for India. Considering the growing acceptance of new techniques and technologies of farming and the consequent impact on the demand for specialty fertilizers in India, development of a demand forecasting model for this Industry will be extremely useful. The study will also present a step by step methodology that managers can use to forecast demand in similar dynamic industry environments. The model will be especially useful to industries marketing specialty products or new product concepts where past demand data is unavailable, and the web of demand triggers is known but constantly changing. The study will identify and assess the individual impact of each factor affecting demand separately. Strategies may be formulated to 'influence the influencers' based on this information. Demand estimates would also assist in devising operational frameworks, planning inventories, increasing manufacturing and

supply chain efficiency, etc. The study will therefore, add to the body of knowledge in the field of forecasting and aid planning within emerging markets.

OBJECTIVES

This Study has the following primary Research objectives:

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- ✓ To assess the extent of the relationship between the causal factors and demand for specialty fertilizers
- ✓ To use above to generate a predictive model to forecast demand for specialty fertilizers applicable to India.

METHODOLOGY

Choosing an appropriate forecasting technique:

A detailed review of forecasting techniques was undertaken in order to identify those that would be the most appropriate to this study. This was an essential step in arriving at the research methodology. The various techniques reviewed and the reasons why they were considered appropriate as part of the methodology for this study given below.

(1) **Causal Methods to be used**. Decomposition of 'causal forces' and assessment of impact of each causal factor on the demand for specialty nutrients will be especially useful in improving forecasting accuracy.

(2) **Surveys Method to be used** Intentions based forecasts more accurate than extrapolation of past sales; especially useful when past demand data not available; collecting 'probability of purchase' estimates from farmers is not complicated.

(3)Focus Groups & In depth interviews Method to be used (***only*** for understanding the decision context and trends) Unstructured discussions rarely lead to accurate forecasts. However, they are of value in understanding market dynamics.

(4) Segmentation Method to be used. Increases depth and improves accuracy of the overall forecast. The intentions survey will gather data based on crop wise segments. Thereafter, demand estimates will be made for every specialty nutrient separately and then summed to generate the overall forecast.

DATA COLLECTION METHODS

Administered questionnaire was chosen as the

data collection tool for phase one of the study. The respondents were assembled at multiple locations in meeting rooms where the questionnaire was available in multiple Indian languages. Respondents were free to choose the questionnaire in the language of their choice. The order of questions, overall format and scales were identical in all the questionnaire forms, irrespective of language. The questionnaires were distributed to all present. Every question was read out in English, Hindi and the local language. In case of the local language, help from a local speaker familiar with all the local language, English and Hindi was taken at each meeting location. Uma Sekharan (2003) states "wherever possible, **questionnaires are best administered to groups of people** because of these advantages:

(i) Establishes rapport with the respondents before administering the questionnaire.

(ii) Respondents were able to clarify any doubts that they had on any questions on the spot.

(iii) It provided the opportunity to introduce the research topic and motivate respondents to offer frank answers.

(iv) Administration was possible to a large group of respondents at the same time.

(v) All completed responses were collected before the end of the hour long meeting. This ensured a 100% response rate.

(vi) The method is less expensive and less time consuming as conducting personal interviews"

To take advantage of these benefits, this method of questionnaire administration was chosen. Open ended questions were avoided completely in the survey questionnaire. This was to ensure uniformity across all respondents. Moreover, since respondents were reading and responding in multiple languages, open ended responses would complicate data analysis which would require translation of answers into English prior to coding. The interpretation of the translators would add bias to the responses and it was thought best to avoid this. Closed ended questions used in the survey form centered around **ten broad focus areas**:

(i) Ownership and size of farm land.

(ii) Top three crops grown in the area.

(iii) Identifying any change in cropping patterns over the last two years.

(iv) Assessing level of usage of specialty plant nutrition across different crop types.

(v) Impact of individual factors affecting demand for specialty plant nutrition solutions.

(vi) Usage of specialty plant nutrition solutions in the previous season.

(vii) Probability of using specialty plant

nutrition solutions in the next season, assuming certain changes occur in the farming practices or due to external factors (measuring the **'intention to try'**)

(viii) Identifying who decides on agricultural input purchases.

(ix) Identifying which single influencer has the highest impact on the buying decision for Specialty plant nutrition solutions.

(x) Classification questions that asked for information regarding location (state, district, and village), contact numbers and size of the family unit.

The survey also requested the respondents to provide contact details of three persons in their area who could be contacted for In depth Interviews on the subject. This list was used as the sample frame for Phase Two of this study. Considering the demographic profile of the respondents (farmers and agricultural input retailers from Rural India) and the diversity in languages, cultures and educational backgrounds, it was essential that all measurement scales be kept extremely simple. Questions in the survey only required "Yes/No" answers, ranking top 3 crops as "1-2-3" and indicating responses using tick marks on a 4 point interval scale. The interval scales used were deliberately kept 'unbalanced', allowing no neutral choice point. This ensured that every Respondent had to necessarily state if a particular factor had an impact on specialty plant nutrition demand or not. This was essential as the factor either had an impact on demand or did not have an impact on demand. There was no reason for a "may or may not have an impact" choice point. Also, considering that the respondents were not very familiar with answering detailed Questionnaires or long rating or ranking scales, the number of intervals was limited to four. Increasing the number of choice points on the measurement scale would only confuse the respondents. The final two questions also asked for only tick marks to indicate the influencers in the purchase decision for agricultural inputs. Phase Two involved In depth Interviews and Focus Groups which provided ample opportunity to gain deep insights into the buying process, using open ended questions and probing. There was no structured questionnaire handed out to the respondents during this phase of the study. Respondents were met at their homes or on their farms to ensure that they are at ease during the process. It also ensured that they were able to speak at length on the subject. Each interview lasted close to an hour and was video taped (with permission) for ease of qualitative analysis. All respondents were

familiar with Hindi and this helped the process of questioning and probing immensely. A check list of questions and focus areas to be covered during the In-depth Interviews was drawn up. This check-list was common across all respondents interviewed during this phase of the study. However the interview was not structured with rapid fire questions. Each respondent was asked to talk at length on the decision making process for agricultural inputs and this discussion was gradually focused onto specialty plant nutrition solutions. Respondents spoke at length about their farming practices as well. This provided deep insights into the minds of the farmers and the factors that influence their buying behaviour. Each interview was videotaped and summarized into a concept map.

RESULTS

The key research results gathered from the quantitative and qualitative phases of this study are summarized below:

1. The core factors that influence demand for specialty nutrients are market prices of agricultural output (past and current season), usage of hybrid seeds, nature of farming practices, recommendations (by other farmers, private companies, etc.) and others (weather, external funding, size of area under cultivation, age of farmer, financial strength of farmer, etc.)

2. Based on the 'intention to buy' data, a farmer is most likely to purchase specialty fertilizers if he switches over to using hybrid seeds. The next six influencers (in descending order of importance) are neighboring farmer's reports, recommendations by company staff, retailer recommendation, sales promotion schemes, change over to horticultural crops and installation of micro irrigation systems.

3. Insights from farmers revealed that advertising and recommendations by government officials) have no significant influence on demand. Women also have very little influence over the buying decision for agricultural inputs, including specialty nutrients, though majority of them are working on the fields.

4. Half of the farmers make purchase decisions regarding specialty nutrients themselves. Elder male family members and agricultural input retailers are the two next most important decision makers.

5. A basic model to identify potential users who are likely to use specialty fertilizers has been drawn up using crop type, area of farm land and change in cropping patterns as the basis. The model has accurately identified users 78% of the times. The model has used

only three variables. Adding more variables could improve the predictive ability of the model further.

6. Given awareness about the concept and having conducted or witnessed a successful trial

using specialty nutrients (two necessary conditions to be fulfilled before any demand arises), the mean probability of purchase, taking all factors collectively, is estimated at 73.13%.

7. The actual purchase behaviour indicates that mean purchase intentions were understated by11.8%. This difference must be incorporated into the forecasting model.

IMPLICATIONS

This model can be applied to industries beyond specialty fertilizers. It can be used for any specialty product where building awareness about the concept and its utility is critical. For example, in the pharmaceuticals industry, when a new drug is introduced, the model may be applied to estimate demand for the new drug in the short term. The 'Area' may be substituted with 'Population' (read as 'target population', in case the drug is relevant to only a particular age group or gender or geographic area, etc.) and Agronomic requirement (Ag**j**) may be substituted with 'prescribed dosage'. A survey of buyer intentions can be conducted to ascertain the probability of usage (Pi) of the new drug, subject to each of the listed factors. A weight age (Wi) may also be assigned to each factor.

LIMITATIONS OF STUDY

This study has surveyed buyer intentions for specialty fertilizers across India. The 'probability of purchase' estimates and importance (weight age) of individual factors have been evaluated on an All India basis. There may be certain changes in these estimates and weight ages within individual states. Considering this limitation, the model has been applied and demand estimates prepared only on an All India basis. In case, state specific demand estimates are required, assessment of state specific purchase intentions would become necessary using a representative sample from each state. The structure of the forecasting equation would however remain unchanged. The assessment of difference between actual purchase behaviour and stated intentions is critical to the accuracy of the model. This 'adjustment factor' addresses issues of affordability, availability, ability and willingness to buy as well as under and overstated intentions. In case this factor is not available to users of the

model, the accuracy of the demand estimate would be lower. The qualitative phase of this research identified a few factors that were not specifically included in the survey questionnaire. 'Probability of purchase' estimates exclude the impact of these variables. The factor analysis results indicate that close to two thirds of the influencing variables have been explained by the survey). The impact of the remaining variables has not been specifically identified by this study. These could perhaps be identified in a follow up study and included as additional variables within the forecasting equation. It must be however borne in mind that while adding and assessing the impact of more variables would increase accuracy of the model, it would add to respondent fatigue and model complexity.

RECOMMENDATIONS

This model is useful to estimate demand in the short term only. It is dependent on a survey of Buyer intentions which gets more subjective as the time horizon increases. A respondent cannot be expected to give an indication of the probability of purchase of a product beyond the near term (say six months to one year). Future research could seek to extend this model to try and develop demand estimates for the medium and long term. The model has been developed and tested in this study on the specialty nutrients industry in India. Research opportunities exist in applying the model on the specialty nutrients industry overseas, and also comparing its applicability across different geographies. Considering the fact that the 22 specialty nutrients industry is at varying levels of maturity in different countries, cross country comparisons would be interesting. Factors that affect the demand for specialty nutrients and their levels of importance may differ across countries. They will also change over time. Some factors may lose their importance. New factors may emerge. Continuous research on the identifying the nature, evaluating the impact and estimating the importance of these factors that affect demand would need to be conducted to keep the forecasts accurate. Moreover, the model can also be applied to any other industry where the product or service being offered is new and concept marketing is involved. Application of the model across industries with a portfolio of specialty offerings will be useful. Another area of continuing importance would be to continuously track the intentions survey data and actual purchase patterns. Over time, it may become possible to estimate (within confidence limits) this level of difference between stated intentions and actual buying

behaviour. Recognizing that the profile of buyers is different across different industries, it is only fair to suggest that these estimates would be largely industry or sector specific. However, attempts to arrive at such an estimate and also identify the factors that cause this difference would be very useful.

CONCLUSION

The specialty nutrients industry has been in existence in India since the 1970s. However, it is still rather small in terms of absolute market size. The application of such a model will be extremely useful to companies operating within this industry. Considering the fact that this industry and companies within it are growing fast, planning operations using a good estimate of near term demand scenarios will lead to establishing long term operational efficiencies. A similar study or demand estimation model is currently not available to this industry. From a strategic perspective, understanding the impact and importance of the individual variables that affect demand will be extremely useful. The results of the study would be useful to other agribusiness companies selling specialized products, like new molecules of crop protection products, new generation seeds, etc. Companies can identify the core factors and develop strategies to try and 'influence the influencers'. For those variables that are not within the organization's control but of high importance, tracking the influencers would become possible The demand forecasting model proposed by the study can also find application across a wide spectrum of nascent and growth markets. It illustrates a step by step methodology that marketers can use to plan for markets where published data regarding past demand is unavailable. It is an attempt to move beyond extrapolation and other econometric models for forecasting demand.

REFERENCES

1. Agricultural Economics

(a) Kurian, Vinson (2004). "Weather still best guide to rural demand." Hindu Business Line Online. http://www.blonnet.com/2004/10/18/stories/2004101800901300.htm (accessed Jan 9, 2006)

(b) Mahadevan, Renuka (2003). *Productivity Growth In Indian Agriculture: The Role Of Globalization And Economic Reform.* Asia-Pacific Development Journal Vol. 10, No. 2, December 2003.

(c) Ministry of External Affairs (2003): *The Indian Economy.*

http://www.divest.nic.in (accessed on January 6, 2005).

2. **Agricultural Technology**
   (a) Aggarwal, P.K. et al (2002) : *Impact of Climate Change Scenarios on Indian Agriculture.* Indian
   (b) Agricultural Research Institute, New Delhi-110012 & Central Research Institute for Dryland Agriculture, Hyderabad.
   (c) Dhar, Biswajeet & Kallummal, Murali (2004) : *Trade Liberalisation & Agriculture – Challenges before India.* International Development Economics Associates. Asia-Europe Dialogue & Partne
   r- www.ased.org
   (d) Directorate of Economics and Statistics (2006). "Statistics at a Glance : State-wise consumption of fertilizers" http://agricoop.nic.in/statistics/consum 4a.htm (accessed January 20, 2006).
   (e) Ministry of Commerce & Industry, Government of India (2001) : *Conference of Chief Ministers on WTO Agreement on Agriculture & Food Management.* May 30, 2001. http://commin.nic.in/doc/wto-may01.pdf. (accessed on January 6, 2005)

3. **Consumer Behaviour and Marketing**
   (a) Agarwal Nitin & Agarwal Manish (2003). "Theory of Trying – Implications for Marketing New-Concept Products." *IIMB Management Review*, Dec 2003, pp. 15–21

4. **General Management & Strategy**
   (a) Ashton, Alison H. (1985), Does consensus imply accuracy in accounting studies of decision making? *Accounting Review* 60, 173-185.

5. **Planning and Forecasting**
   (a) Arkes, M. R. (2001), "Overconfidence in judgmental forecasting," in J. S. Armstrong (Ed.) *Principles of Forecasting*. Norwell, MA: Kluwer Academic Publishers, pp. 495-515.
   (b) Armstrong, J. Scott (1980). "The Seer-Sucker Theory: The Value of Experts in Forecasting." *Technology Review*, June/July, 1980, pp 16-24.