International Journal of Scientific Research & Engineering Trends
Volume 6, Issue 1, Jan-Feb-2020, ISSN (Online): 2395-566X

Supply Chain, Logistics and Technology in Agriculture

Aakash Nar Singh Rout, Monika, Gourav Kumar Yadav, Arpit Barodiya
Symbiosis Institute of Business Management, Bangalore.
Symbiosis International University
Bangalore, Karnataka
Aakash.rout21@sibm.edu.in, Monika.m21@sibm.edu.in,Gourav.yadav21@sibm.edu.in,Arpit.barodiya21@sibm.edu.in

***Abstract* -This paper addresses the issues pertaining to agriculture supply chain along with the effective role played by supply chain & logistics for timely delivery of produce to markets, along with other dimensions such as cold storage, access to market, government schemes.**

***Keywords*-Cold storage, supply chain, fertilizers, market access, aggregate waste.**

I. INTRODUCTION

Supply Chain Management is characterized by lot of approaches which areused to proficiently coordinate providers, makers, warehouses, and stores, with the goal that product is delivered and circulated in the correct amounts, to the correct areas, and at the ideal time, in order to limit expenses while fulfilling administration level prerequisites.

Throughout the years, the definitions have changed and expanded the extent of SCM, yet these definitions are till now constrained to manufactured items and administrations with little consideration being paid to agribusiness. Products from agriculture comprises a significant piece of the world economy and is the crude material for some businesses. The SCM for Agri-fresh produce, frequently alluded to as Agri-freshSCM (FSCM), establishes the procedures from creation to conveyance of the Agri-fresh produce, for example from the farmer to the final client. FSCM is intricate when contrasted with normal SCMs because of the transitory and perishable nature of the products,everytime changing demand and price, expanding customer worries for health and safety. The goal of this paper is to address the major operational issues causing the post-reap squander in leafy foods.

II. RESEARCH GAP

1. Poor data stream from creation to appropriation in production network - The genuine proportion of store network achievement is the manner by which well exercises facilitate over the inventory network to make an incentive for shoppers, while expanding the benefit of each connection in the inventory network. The stockpile chains of various rural wares in India, be that as it may, are laden with difficulties originating from the inalienable issues of the horticulture division. The Agri-store network arrangement of the nation is dictated by various fashion issues like strength of little/minor ranchers, divided stock chains, nonattendance of scale economies, low degree of handling/esteem expansion, deficiency of promoting foundation and so forth.

2. Agricultural market is especially unstable, heterogeneous, and amazingly delicate to monetary and budgetary changes which is hard to quantify - Global horticultural costs have encountered an expanding level of unpredictability in the most recent decade. Request blasting elements, for example, financial development, moving dietary examples in creating nations and development of the biofuel business, and supply easing back elements, (for example, the powerless exchange of market value signs to ranchers) are ascribed to the ongoing ascent in nourishment value instability. The effects of value instability reach out to all nourishment inventory network on-screen characters. Value instability infers hazard to ranchers who may respond by lessening yield supply and interests in beneficial sources of info. , agrarian information value instability uncovered the downstream segment of nourishment supply chains to sourcing vulnerabilities, driving nourishment and horticultural organizations to change their sourcing procedures as a way of dealing with stress.

3. Uncertainty in natural conditions leading to over production and deficits of produce – The factors like rainfall, droughts, natural calamities etc. pose serious threats to Agri produce which in turn cause fluctuations in demand as well as price.

III. RESEARCH OBJECTIVE

1. To determine effective management and technologies used in order to increase yield of agricultural products.
2. To determine how supply chain can be managed in order to increase farmer's profit margin and to keep prices in control.

3. To determine whether farmers have knowledge of all these technologies and different supply chain models or not.

IV. HYPOTHESIS

In the same lines of objectives which, we are having and the presence of research gaps in previous research papers, we have come to research strategy for this paper which, will be focused based on the hypothesis given below. These hypotheses will likely to raise questions on the organization and management of the supply chain, logistic and technology in agriculture.

Ho: Use of technology, logistic lead to increase in return for farmers.

Ha: Use of technology, logistic don't lead to increase in return for farmers.

Ho: More cold storage will lead to increase in returns for farmers.

Ha: More cold storage facilities don't not lead to increase in returns of farmers.

where, 'Ho' gives hypothesis which is generally accepted and 'Ha' gives hypothesis which is needed to prove.

1. Data Collection and Analysis

Data related to the research paper was collected from the local stores, vendors & farmers in the nearby vicinity. During the process of data collection respective person names were recorded with the type of crops they are dealing were also taken into consideration. To limit the focus of the research paper mainly data related to the crops of vegetable & fruits are taken in focus, which will be further scrutinized for various dimensions. The response of these dimensions' questions is recorded on the Likert scale.

The data is recorded through google forms & after recording the data in classification form through Likert scale, it was cleaned for further interpretation process.

An analysis was conducted on the basis of the following variables-

1. Crops
2. Cold Storage Presence
3. Returns/ Profit
4. Reason for particular crop
5. Access to fertilizer
6. Technique
7. Knowledge of fertilizers
8. Government Initiative
9. Market Access
10. Time to Market
11. Waste
12. Infrastructure Satisfaction
13. Mode of Selling

Survey among farmers and vendors was conducted, asking them questions related to above factors and then the results were interpreted. R language is used for the interpretation and coding purpose.

The survey was conducted in well to do areas around Bengaluru among farmers and small fruit vegetable vendors. It is observed that most around 83.8% of farmers grow vegetables and others are divided between fruits, pulses and grains. As this is conducted around well to do area, 41.7% use traditional method, 39% use semi modern methods and others use modern methods? Below are the pie charts for the variables used by us and the division they have.

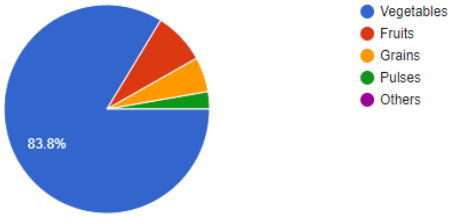


Fig.1. Types of Crops Grown.

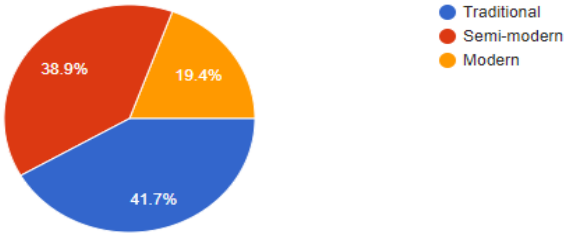


Fig.2. Techniques Used.

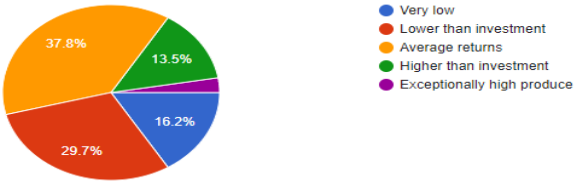


Fig.3. Return from Produce.

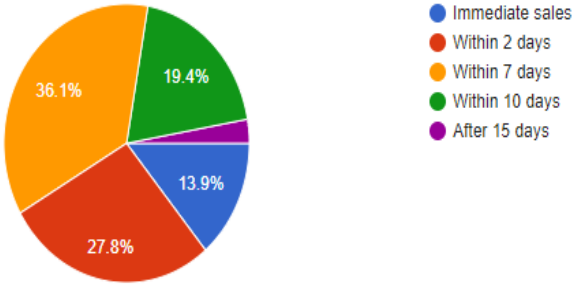


Fig.4. Time to Reach Market.

International Journal of Scientific Research & Engineering Trends
Volume 6, Issue 1, Jan-Feb-2020, ISSN (Online): 2395-566X

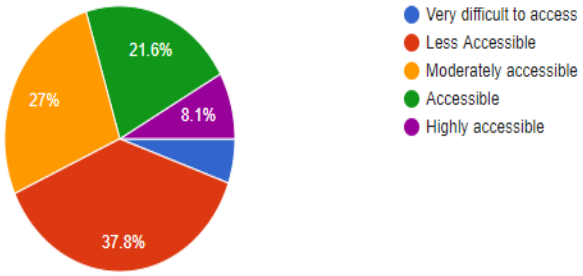


Fig.5. Access to Market.

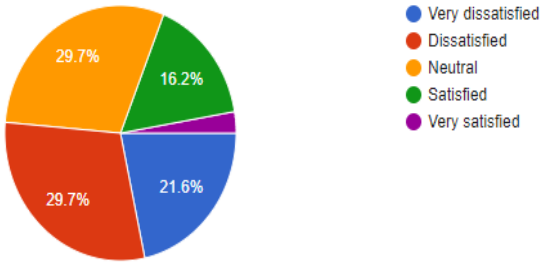


Fig.6. Government Expenditure on Cold Storage.

Going for logistic regression, we have taken returns as dependent variable and other factors as independent variable. The collinearity between the variables needs to be checked and then the model is selected to interpret or foresee future predictions for returns based on the selected variables. As many variables like 'Techniques used' and 'Waste' are asked in the survey on Likert scale, these variables are converted into factor variables.

1. First Model

In the first model we are taking independent variables 'Cold Storage Presence', 'Technique used' and 'percentage of waste' as independent variables based on their collinearity among them. We perform logistic regression on them and get the below as output.

```
Coefficients:
              Estimate Std. Error z value Pr(>|z|)
(Intercept)     1.1238     2.4928   0.451   0.6521
ColdStorePresYes 0.2716    1.1816   0.230   0.8182
Technique       2.0329     1.0597   1.918   0.0551 .
Waste          -1.6692     0.8812  -1.894   0.0582 .
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

(Dispersion parameter for binomial family taken to be 1)
```

Fig.7. Logistics Regression output (Cold Storage, Technique Used and percentage of waste.).

From the above output we can see that waste is having negative effect on returns that is returns decreases when waste from produce increases, which is also a well-known fact but is proved here. Technique is having positive effect that is more modern the techniques used, more is the return from produce to the farmers. But the problem is that many farmers are not aware of the modern techniques, and even if government is trying to bring these initiatives, they need to be more active while doing so. But this model does not explain all the factors and the accuracy from this model is not at par with what it should be.

2. Second Model

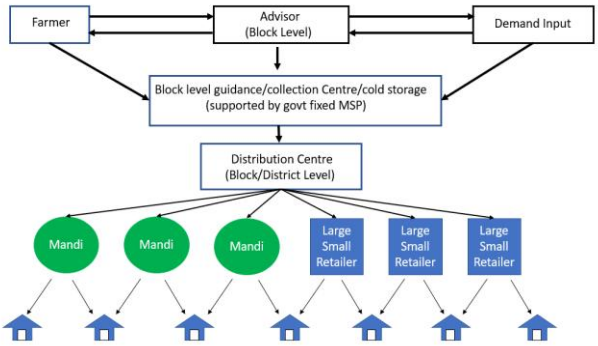
In second model we tried independent variables like 'access to fertilizers', 'techniques used' and 'knowledge of fertilizers to farmers' for prediction of returns on produce.

```
Coefficients:
                                          Estimate Std. Error z value Pr(>|z|)
(Intercept)                               -23.001   8691.663  -0.003    0.998
AccessToFertilizerEasily accessible        42.331  11476.392   0.004    0.997
AccessToFertilizerModerately difficult     23.035   8691.663   0.003    0.998
AccessToFertilizerVery difficult to access -17.678  12537.265  -0.001    0.999
AccessToFertilizerVery easily accessible   41.712  19746.165   0.002    0.998
TechniqueTraditional                       20.113   8691.663   0.002    0.998
KnowledgeOfFertilizersYes                   1.856      1.426   1.301    0.193

(Dispersion parameter for binomial family taken to be 1)

    Null deviance: 41.455  on 29  degrees of freedom
Residual deviance: 13.290  on 23  degrees of freedom
AIC: 27.29
```

Fig.8. Second Model Regression Output.

The model explained that how the return are affected negatively, when the access to fertilizers by farmers become difficult and how this is a persisting problem that needs to be solved. Knowledge about fertilizers and how to use them affects the return but not to a great extent because fertilizers when used, even if not in very accurate proportions increases produce.

3. Final Model



In final model we looked at multicollinearity and p values from previous model and selected the following variables as independent variables- 'Cold storage presence', 'Techniques used', 'Knowledge of fertilizers', 'Waste out of produce'. This model fits to interpret our results.

International Journal of Scientific Research & Engineering Trends
Volume 6, Issue 1, Jan-Feb-2020, ISSN (Online): 2395-566X

```
Coefficients:
                                Estimate Std. Error z value Pr(>|z|)
(Intercept)                      18.3279  4809.3410   0.004    0.997
ColdStorePresYes                 -0.4974     1.2987  -0.383    0.702
TechniqueTraditional             -2.0141     1.3461  -1.496    0.135
KnowledgeOfFertilizersYes         1.2382     1.4620   0.847    0.397
Waste16%-30%                    -19.3759  4809.3410  -0.004    0.997
Waste30%-50%                    -38.3110  8932.2348  -0.004    0.997
Waste6%-15%                     -16.6190  4809.3411  -0.003    0.997
WasteMore than 50%              -35.3825 11780.4312  -0.003    0.998

(Dispersion parameter for binomial family taken to be 1)

    Null deviance: 41.455  on 29  degrees of freedom
Residual deviance: 17.601  on 22  degrees of freedom
AIC: 33.601
```

Fig.9. Final Model Regression Output.

From this model we can see that waste in whatever amount has a negative effect on the returns from produce. So, farmers have to take care of the increased waste percentage from actual produce. Traditional techniques reduce returns in comparison to modern produce and so the farmers should be more aware of and should more use semi modern or modern techniques. Because it may cost them in the beginning but will increase their yield and returns.

A major observation was that as thought by us previously that cold storage presence will increase returns, this hypothesis was proved wrong and it is confirmed from the results above that farmers do not think in this way. This may be possible because in the region where the survey was done most of the produce was of vegetables and the types of vegetables produced mat not require so much of cold storage facilities. Or it might be that people are not aware of the facilities provided by government and do not take full advantage of them.

Interpretation through SPSS package tool for statistical analysis to find the Pearson correlation between the various dimensions for which was data was collected.

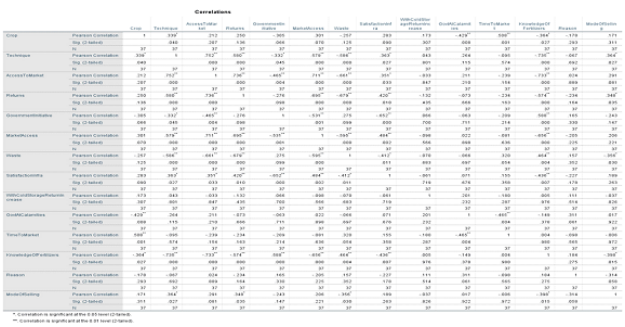


Fig.11. SPSS output (Finding correlation between various dimensions.)

Through the correlation run in SPSS, we were able to find correlation between the various dimensions. Different levels of correlation were found between all the dimensions present, among which specific correlation at 99.997% confidence level was taken and with the Pearson correlation value of less than (-0.70) & more than (0.70) were in focus. Below is the confusion matrix of this model.

```
Confusion Matrix and Statistics

          prediction
           1 2
         1 3 1
         2 0 3

                Accuracy : 0.8571
                  95% CI : (0.4213, 0.9964)
     No Information Rate : 0.5714
     P-Value [Acc > NIR] : 0.1243
```

Fig.10. Confusion Matrix.

Here we can see that this model is best fit because the residual deviance decreases due to the addition of those independent variables. And the accuracy of prediction of this model that we get is 85%, which is very good for a model.

From the above step we able to find out the following information:

1. The market access by the farmers are directly related to returns which they get through selling the produce. Which means that more easily the market access more returns they will get from selling.
2. One of the most important correlation we found out was the wastage of the crop produce was inversely related to the time required to sell the crop, in terms of the access to market for the producer and also, the inverse relation with the returns which, is received by the producer or vendors.
3. Techniques which are used, have direct relation with knowledge of fertilizer and technological equipment available.
4. Satisfaction related to government expenditure towards the infrastructure & cold storage is having direct relation with the government initiative which means that more the government is willing to work for the agricultural aspects more the farmers & vendors are satisfied from it.
5. Others dimensions were not having any significant relation with the each other.

V. RECOMMENDATION

In our proposed model, we have tried to address the research gaps we found during this research. The major problem was the land distribution among the farmers. The land owned by the farmers for cultivation was as less than 1 hectares in size, and they produce different crops based on their preference and market demand. Agriculture on such small plots doesn't generate enough income for their families. Whatever these farmers produce the keep approx. 40% for their consumption and the rest they sell to wholesalers. We identified as a significant issue

because farming of different crops nearby distorts the soil composition. In the proposed model, we suggest combining many small farmlands from form vast land for cultivation on single yield and crop rotation to get maximum yield from the same land size. One more critical aspect of the proposed model is to appoint advisors cum consultant at block level to farmers, we could solve a lot of problems of farmers related to farming techniques, fertilizer composition and soil mapping. The government should take measure to assess the demand for different products and distribute the demand through advisors to farmers. Infrastructure for cold storage, warehouse and supply chain is required at the ground level. Hub and spoke model for food supply chain, Collection center at the subdivision level and warehouse and cold storage at the district level.

From this place produce can be moved easily as the transportation infrastructure between districts is better compared to blocks and subdivision. Using this supply chain model Agri produce can be transferred to a distant location where there is a demand for them and farmers can get a good return and steady income flow. This model helps to cut down the wastage percentage, earlier the burden of wastage was born by farmers. Still, under the proposed model will be less dependent on farmers as the government/ private players will acquire the product. Because producing on tha vast land, the crop will have economies of scale, and they can provide the product at a cheaper rate while maintaining the quality. Quality will be good because farmers will have to ensure only one type of crop. Farming on the vast land will also provide work opportunity to farm labors.

Based on the above analysis of data collected, here are some of the recommendations or changes proposed which when implemented can increase in returns of produce.

1. Express or freight trains should have refrigerated coaches which can take products of farmers to distant places. And these trains can focus on north east and tribal districts in the beginning.
2. Cold Supply chain properly managed and monitored by government which can carry perishable products.
3. Solar facilities to be given to farmers nationwide.
4. Warehouses to be built in villages for increasing holding capacity which will also result in logistics cost reduction in return.
5. Geo maps and some techniques from precision agriculture can be used which will help in soil mapping for proper use of fertilizers and chemicals.
6. Mapping of cold storage vans and refrigerators, so that villagers can know their position when near them and can use them for preserving or sending their produce.
7. And the most important of all, to make farmers aware about all these initiatives taken. And for this every village needs to be assigned to a development member.

VI. CONCLUSION

From the above research, we can conclude that the returns are mainly affected by the market access, technique used, government initiative, waste & knowledge of fertilizers and technological equipment. Moreover, from above modelling we have observed that the returns are positively affected by technique (traditional to modern), knowledge of fertilizers and technological equipment and government initiative. And thuswe can state that if more value is added to above given factors then, it will help to increase the returns for farmers. Furthermore, to reduce the losses of the farmers, wastage should be taken care of. Adding to previous statement, time taken to reach the market i.e. in terms of market access due to infrastructure should be made better by the respective government authorities.

A major observation was that as thought by us previously that cold storage presence will increase returns, this hypothesis was proved wrong and it is confirmed from the results above that farmers do not think in this way. This may be possible because in the region where the survey was done most of the produce was of vegetables and the types of vegetables produced mat not require so much of cold storage facilities. Or it might be that people are not aware of the facilities provided by government and do not take full advantage of them.

VII. ACKNOWLEDGMENT

Authors would like to express our deepest appreciation to all those who provided the supervision, direction and guidance to us for this research. Authors owe our most sincere thanks to our faculty mentor Mrs. Anuradha Goswami for her guidance, along with benevolent and sustained encouragement bestowed on us during the course of the research. This research would not have been completed without the effort and co-operation among the authors. Last but not the least; we would like to express thanks to our friends and classmates for their unconditional love, patience, motivation and support.

REFERENCES

[1]. Opara, Linus U. "Traceability in agriculture and food supply chain: a review of basic concepts, technological implications, and future prospects." Journal of Food Agriculture and Environment 1 (2003): 101-106.

[2]. Ali, J., & Kumar, S. (2011). Information and communication technologies (ICTs) and farmers' decision-making across the agricultural supply chain. International Journal of Information Management, 31(2), 149-159.

[3]. Wilson, T. P., & Clarke, W. R. (1998). Food safety and traceability in the agricultural supply chain: using the

Internet to deliver traceability. Supply Chain Management: An International Journal, 3(3), 127-133.
[4]. Lehmann, R. J., Reiche, R., & Schiefer, G. (2012). Future internet and the agri-food sector: State-of-the-art in literature and research. Computers and Electronics in Agriculture, 89, 158-174.
[5]. Abatekassa, G. and Peterson, H.C. (2011), "Market access for local food through the conventional food supply chain", International Food and Agribusiness Management Review, Vol. 14 No. 1, pp. 63-82.
[6]. Ali, J. (2012), "Factors influencing adoption of postharvest practices in vegetables", International Journal of Vegetable Science, Vol. 18 No. 1, pp. 29-40. Aramyan, L., Ondersteijn, C.J., Van Kooten, O. and Lansink, A.O. (2006), "Performance indicators in agri-food production chains", in Ondersteijn, C.J., Wijnands, J.H., Huirne, R.B. and Van Kooten, O. (Eds), Quantifying the Agri-Food Supply Chain, Springer, Berlin, pp. 49-66.
[7]. Assefa, T.T., Meuwissen, M.P. and Oude Lansink, A.G. (2015), "Price volatility transmission in food supply chains: a literature review", Agribusiness, Vol. 31 No. 1, pp. 3-13. M.