



ASSESSING THE CONSTRAINTS FACED BY STAKEHOLDERS ALONG THE SUPPLY CHAIN TO PROMOTE ECO-FRIENDLY FERTILIZER USE IN PADDY FARMING IN SRI LANKA

R.H. Prabhashakya^{1}, U.K. Jayasinghe-Mudalige¹, L.H.N. De Silva², A.D.K.S.S. Somarathna¹, R.S. Dharmakeerthi³, W.S. Dandeniya³*

¹*Department of Agribusiness Management, Wayamba University of Sri Lanka, Sri Lanka,*

²*Department of Bio-System Engineering, Wayamba University of Sri Lanka, Sri Lanka,*

³*Department of Soil Science, University of Peradeniya, Sri Lanka*

INTRODUCTION

Despite the fact that traditional agriculture in Sri Lanka is mostly reliant on organic fertilizer, farmers are increasingly turning to chemical fertilizer (CF) due to the rapid increase in food demand as a result of population growth. The continuous application of CF reduces soil fertility, causes heavy metal buildup in food chains, and releases greenhouse gases, all of which have profound consequences for human health, the environment, and ecology (Herath *et al*, 2021). As a result, there has been increased inquiry into creating novel means of diminishing both the amount and recurrence of natural fabric necessities to advance soil health and minimize the country's chemical fertilizer utilization.

The Sri Lankan National Research Council (NRC) has embarked on a multi-objective, multi-phased research project on Eco-Friendly Technologies (EFTs) to lower CF use while securing the country's food security and environmental wellbeing (Silva *et al.*, 2020). The NRC project aims to form a single package of EFTs that combines both 'Bio-Fertilizer' (BF) and 'Slow-Release Urea Fertilizer' (SRUF) utilizing rice husk biochar for paddy farming. The development of a new product is not the end of this process. There is a need to assess the constraints faced by stakeholders along the eco-friendly fertilizer supply chain for paddy farming. Confirming to past research, paddy stakeholders are for the most part willing to incur moderately high expenses for EFTs provided they are customized to meet the stakeholders' needs to neutralize the short-term benefits of CF use (Silva *et al.*, 2020). This study pointed out the factors that can spur paddy stakeholders in Sri Lanka to advance EFTs over CF, and more particularly evaluates the key constraints related to the utilization of eco-friendly fertilizers from the point of view of the potential stakeholders.

METHODOLOGY

Data collection

The constraints faced by a stakeholder associated with the fertilizer supply chain can be classified into several categories including 'Market', 'Government', 'Institution', 'Health and Environment', 'Production', 'Finance', and 'Information' (Herath *et al*, 2021). Based on general perceptions and concepts, twenty-five constraint statements (Table 1) were incorporated into a questionnaire with a 10-point Likert scale which ranged from 'extremely unimportant' (0) to 'extremely important' (10), with 'neither important nor unimportant' (5) serving as the neutral point. The data collection was carried out using the purposive sampling method in February and March 2022 using a structured questionnaire by online (60) and face-to-face (20) interviews with 80 stakeholders from all districts in Sri Lanka who were involved in agriculture-related activities.

Data analysis

Confirmatory Factor Analysis techniques were used to verify the factor structure of a set of observed variables, including scale reliability and unidimensionality tests. The Mean Attribute



Scores (MAS) were then generated using the values indicated by respondents on the Likert scale, and the Aggregated Mean Attribute Scores (AMAS) of the factors were developed using them (Jayasinghe-Mudalige and Henson, 2006). The Relative Importance Index (RII) was used to rank the constraints according to stakeholders’ perceptions (Kariyawasam *et al*, 2007). RII was calculated as follows,

$$RII = \frac{\sum W}{A * N} \dots \dots \dots (1)$$

Here; RII - Relative Importance Index, A - Highest weight, N - Total number of respondents, and W-Weight given to each factor.

RESULTS AND DISCUSSION

Descriptive statistics of the sample

The majority of the respondents were males (58 percent out of 80 respondents). Sixty-seven percent of respondents were below the age of 35 years. The experience in the industry of these stakeholders showed a significant variation.

Outcome of the Mean Attribute Scores (MAS) in constraints

The MAS values obtained-, as part of this study confirmed that almost all the constraints presented were accepted as important by stakeholders. The statements were categorized into seven factors (Table 1). The highest MAS was placed on ‘Sufficient opportunities to sell EFT-based paddy in the market’, scoring 9.64, under the ‘Market’ factor. ‘Market’, ‘Production’, and ‘Financial’ factors had the highest AMAS as given in figure 1. In addition, ‘Supportive government policies and regulations’, ‘Knowledge on handling EFTs’, ‘Volatility of market price for EFT based paddy’, ‘Institutional support to overcome risks’, ‘Information on EFT packaging’, and ‘Pathogen invasion compared to chemical fertilizers’ were the constraints with the highest MAS in each factor scoring a mas value of 7.29, 8.08, 8.91, 6.90, 6.71 and 6.63 in ‘Government’, ‘Production’, ‘Finance’, ‘Institution’, ‘Information’, and ‘Environment and Health’ respectively. However, the least concern of the sample was displayed for the ‘Use of eco-friendly packaging for EFTs’ which was in the ‘Health and Environment’ factor, with a generated mean score of 6.14.

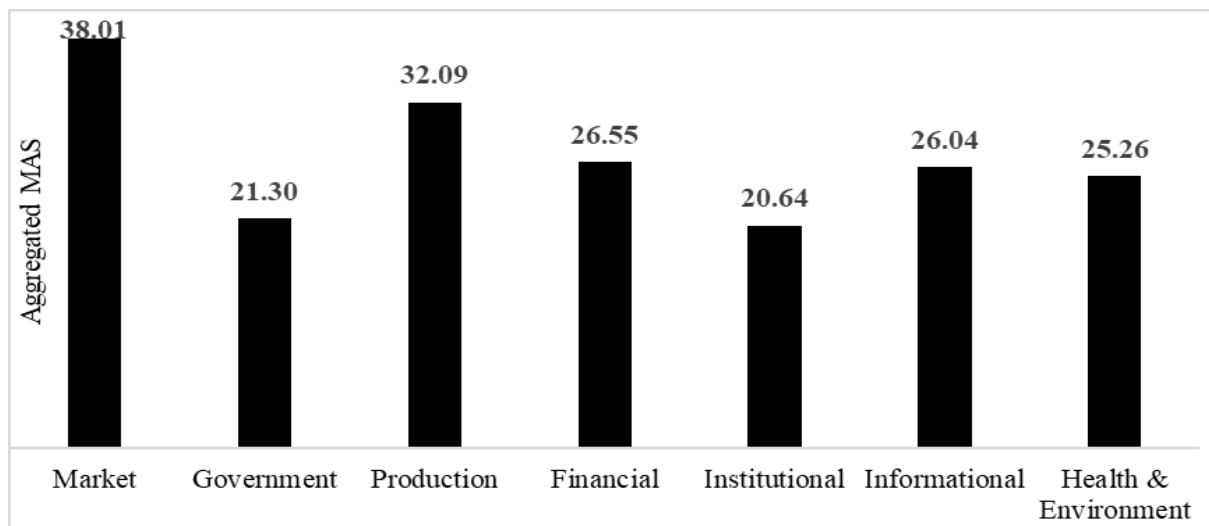


Figure 1. Aggregated MAS of Constraints

Outcome of Relative Importance Index (RII)

The equation (1) was used to calculate RII values for each statement to determine the relative importance of constraint statements based on the survey data. RII values were transformed into



five importance levels. High (H) ($0.8 \leq RI \leq 1$), High-Medium (H-M) ($0.6 \leq RI \leq 0.8$), Medium (M) ($0.4 \leq RI \leq 0.6$), Medium-Low (M-L) ($0.2 \leq RI \leq 0.4$), and Low (L) ($0 \leq RI \leq 0.2$) (Rooshdi *et al.*, 2018). As indicated in Table 1, all the constraints which came under the ‘Market’ and ‘Finance’ factors had the highest RII values including ‘Sufficient opportunities to sell EFT based paddy in the market’ (0.954), ‘Abundance of EFTs to purchase in the market’ (0.961), and ‘Availability of distribution channel’ (0.945). ‘Government’, ‘Information’, and ‘Institution’ factors were ranked in the medium category. Constraints that belonged to the ‘Health and Environment’ factor, namely ‘Disruption from diseases compared to CF’, ‘Use of eco-friendly packaging for EFT’, and ‘Effects on health and safety compared to CF’ had the lowest overall ranking compared to the other factors. This means they were relatively less important from the stakeholder’s point of view.

Table 1. Relative Importance Index for constraints

No	Constraint	RII	Overall Rank	Importance Level
MKT1	Sufficient opportunities to sell in the market	0.964	1	H
MKT2	The abundance of EFTs	0.961	2	H
MKT3	Availability of distribution channel	0.945	3	H
MKT4	The efficiency of the supply chain	0.931	4	H
GOV1	Supportive government policies and regulations	0.729	12	H-M
GOV2	Expert advice on production	0.721	13	H-M
GOV3	High government support in terms of subsidies	0.680	17	H-M
PDN1	Knowledge of handling EFTs	0.783	8	H-M
PDN2	Availability of qualified technical personnel	0.781	9	H-M
PDN3	Proper storage facilities	0.778	10	H-M
PDN4	Need for additional labour	0.763	11	H-M
FIN1	The volatility of the market price	0.891	5	H
FIN2	Additional costs associated with the quality control process	0.883	6	H
FIN3	Availability of capital to buy EFTs	0.881	7	H
INS1	Provide adequate training	0.690	14	H-M
INS2	Institutional support to overcome risks	0.688	15	H-M
INS3	Availability of certification bodies	0.684	16	H-M
INF1	Information on EFT packaging(label)	0.671	18	H-M
INF2	Customer awareness of EFT-based paddy	0.461	20	M
INF3	Availability of information networks on market and price	0.450	21	M
INF4	Providing precise guidelines on packaging	0.521	23	M
HEN1	Pathogen invasion	0.563	19	M



HEN2	Disruption from diseases	0.425	22	M
HEN3	Use of eco-friendly packaging for EFT	0.314	24	L
HEN4	Effects on health and safety	0.311	25	L

RII: Relative importance Index, H: High Importance Level, H-M: High-Medium Importance Level, M: Medium Importance Level, M-L: Medium-Low importance level, L: Low Importance level, MKT: Market, GOV: Government, PDN: Production, FIN: Finance, INS: Institution, INF: Information, HEN: Health & Environment

CONCLUSIONS/RECOMMENDATIONS

The majority of the respondents were concerned about market-related factors, according to both MAS and RII values. These constraints can be mitigated by providing more opportunities in the market through value chains and boosting product awareness. In relation to MAS, no statement received a negative score, implying that all participants believed in all of the constraint statements. In the data gathered using both analytical techniques, health and environmental constraints received the lowest scores, indicating that stakeholders are much more concerned about the ‘Market’ and ‘Finance’ factors. Further, stakeholders are aware and knowledgeable about the detrimental consequences of CF on the environment and human health. The overall outcome of the research indicates, that the ‘Market’ and ‘Finance’ factors have a significant impact on stakeholder perception of the use of eco-friendly fertilizers.

REFERENCES

- Herath, H.M.L.V., Jayasinghe-Mudalige, U.K., Silva, A.P., Jayakodi, J.A.N.S., Jayathilaka, H.A.C.K., Dharmakeerthi, R.S. and Dandeniya, W.S. (2021). An empirical investigation into the policy instruments to promote eco-friendly technologies replacing chemical fertilizer use in paddy farming in Sri Lanka. *Sri Lanka Journal of Technology*, **35**, 18-22.
- Jayasinghe-Mudalige, U.K. and Henson, S. (2006). Use of Confirmatory Factor Analysis techniques to overcome the problems of subjectivity and unobservability of incentives. *Sri Lankan Journal of Applied Statistics*, **7**, 71-89.
- Kariyawasam, S., Jayasinghe-Mudalige, U.K., and Weerahewa, J. (2007). Use of Caswell’s classification on food quality attributes to assess consumer perceptions towards fresh milk in tetra-packed containers. *Journal of Agricultural Sciences*, **3**, 43-46.
- Rooshdi, R.R.R.M., Majid, M.Z.A., Sahamir, S. R., and Ismail, N.A.A. (2018). Relative importance index of sustainable design and construction activities criteria for green highway. *Chemical Engineering Transactions*, **63**, 151-156.
- Silva, A.P., Jayasinghe-Mudalige, U.K., Dharmakeerthi, R.S., Dandeniya, W.S. and Balasooriya, B.L.W.K. (2020). Introducing eco-friendly technologies to reduce chemical fertilizer usage in paddy farming in Sri Lanka. *Sri Lanka Journal of Economic Research*, **7**(2), 01-23.

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