



## STAKEHOLDER PERCEPTIONS ON ADOPTION OF ECO-FRIENDLY TECHNOLOGIES TO MINIMIZE CHEMICAL FERTILISER USE IN PADDY FARMING

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Recent literature points out that eco-friendly technologies (EFTs) identified scientifically possess the potential to reduce the now excessively using levels of chemical fertilizers (CFs) in agriculture that in turn, generates multiple benefits to the society in the areas of, but are not limited to, socio-economic and environmental. To deeply explore this phenomenon following a period of turmoil caused by sudden ban of importing and using agro-chemicals, this study was conducted to inquire about the perceptions of key stakeholders: farmers, experts, related government and private sector administrators with high interest and impact on paddy production in Sri Lanka. To represent those diverse segments pertaining to paddy production, the selection of respondents was based on the principle of purposive sampling techniques, where the individuals possess a previous track record of experience with EFTs and exposure to similar studies. An in-depth in-person and/or online interviews, supported by a structured questionnaire, were conducted to gather first-hand information from 167 individuals, and each was guided to evaluate a set of statements ( $s=30$ ) build up on a 10-point linear numeric scale ranging from "extremely disagree" (0) to "extremely agree" (10). Statements were categorized under three criteria: (1) Social and Regulatory (SR); (2) Economic and Financial (EF) and (3) Environmental (EN). In analysis of data, the comparison of median indicates that those stakeholder perceptions varied significantly in the face of diverse scenarios. It was revealed that in the context of EN, the stakeholders, overall, favoured adoption of EFTs above the use of CFs. The outcome of non-parametric Kruskal-Wallis test shows that there is no significant difference among the medians of responses amongst the stakeholder groups and that their perceptions lie in favour of EFTs over CFs ( $p=0.253$ , 95% confidence level). This signals the importance of institutionalization of those parties responsible for regulation (e.g., setting the standards, licencing/certification) and facilitation (e.g., capacity building, rewarding) in the agri-food value and plant nutrients supply chains with a solid national and overarching agricultural and fertilizer policy frameworks at its earliest.

Keywords: Adoption, chemical fertilizer, eco-friendly technologies, paddy farming, stakeholder perceptions

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### INTRODUCTION

Chemical fertilizers (CFs) have been found to substantially contribute to environmental deterioration and economic losses in paddy production. Due to low fertilizer efficiency, up to 50-70% of the chemical fertilizers used in the cultivation of rice are wasted, resulting in high financial costs (Sirisena et al., 2016).

In such an environment, a multi-stage research project funded by the National Research Council of Sri Lanka has developed eco-friendly technologies (EFTs) like "Nitrogen-fixing bio-fertilizer", "Biochar-based slow-release urea fertilizer" and "Biochar" as solutions to the issue and field experiments conducted in Kurunegala, Anuradhapura and Polonnaruwa districts from 2017 to 2022 have shown the efficacy of EFTs in reducing the use of chemical fertilizers and providing economic, social and environmental benefits. Integrating chemical fertilizers with EFTs is an emerging method that has shown promise in terms of decreasing chemical fertilizer use while maintaining production and soil fertility.

Previous research has revealed that farmers in Sri Lanka have the willingness to use EFTs in place of chemical fertilizers in paddy farming (Chandrasiri et al., 2019; Silva et al., 2018). However, the Sri Lankan government's unanticipated ban on the use and import of CF in April 2021, as well as being introduced of a 100% organic agriculture policy, have produced great uncertainty among the public. This dramatic shift in agricultural policy has had far-reaching implications influencing not just associated policies and regulatory procedures but also the attitudes of major stakeholders spanning from farmers to consumers as well as industrial and commercial interests.

The objective of this study was to investigate the perceptions of key agricultural actors involved in the use and promotion of eft at the farmer level with the reasoning that in the current context, all interested and impacted parties are uncertain about the use of organic or specialty fertilisers in paddy farming. It also investigated stakeholders' perceptions and attitudes towards eft implementation, the influence of recent regulatory changes on their agricultural practices and potential challenges to eft adoption.

### METHODOLOGY

According to Lange et al. (2015), the economic and financial, social and regulatory and environmental aspects were used to examine stakeholders' perspectives on fertilizer. A set of statements was developed to reflect these aspects and underline the need to advocate written in favour of the use of EFTs instead of CFs.



Taking previous studies into account, the 30 statements derived (Table 1) were supported with a 10-point linear numeric scale ranging from "extremely disagree" (0) to "extremely agree" (10) and included in a structured questionnaire to gauge the stakeholders' levels of agreement with these statements based on their perceptions. If a value less than five is assigned to a statement, it implies disagreement and that CF outperforms EFT on the criterion in the statement. A value higher than five, on the other hand, indicates agreement and thus EFT outperforms CF in the criteria. Point five indicates a neutral perspective, indicating neither agreement nor disagreement.

From February to March of 2023, data was collected through interviews and online surveys with the involvement of 167 stakeholders in the agriculture sector, including farmers (n=31), experts (n=57), government administrators (n=42) and private industry professionals (n=37). Purposive sampling was employed in the survey for selecting individuals who possessed knowledge of or practical experience with EFTs.

For the purpose of analysing the data, the multiple-item scales (i.e., attitudinal statements) corresponding to each construct (i.e., criterion) were first applied Cronbach Alpha to check reliability. For each statement, the values on the linear numeric scale were used to determine the median score of each respondent and statement separately. Non-parametric Kruskal-Wallis test was then performed to compare the perceptions of the stakeholder groups concerned.

Table 1: Generalized form of statements

		<b>Statement</b>
SR1		Competitiveness among farmers for raw materials and final products
SR2	Social and Regulatory	Improvement of the value system of society and inspires eco-friendly, humanistic thinking
SR3		Maintenance and enhancement of Food security of households
SR4		New employment opportunities and attraction of more youth to agriculture
SR5		Knowledge and training in the use and technology of EFTs
SR6		Support and guidance from the government and regulatory agencies
SR7		Design and implementation of good policies to promote EFTs over CFs
SR8		Workload associated with the application
EF1		
EF2		Use of external inputs and related costs (i.e., soil treatment, production health, machinery)
EF3	Economic and Financial	Productivity in cultivation
EF4		Availability in the market for purchasing for agricultural purposes
EF5		Facilities for purchasing in the market
EF6		Long-term sustainability of production in farming fields
EF7		Maintenance activities (i.e., weeding, watering) and related costs
EF8		Excessive use and wastage of resources and fertilizers
EF9		Labour requirement for application for a unit of land
EF10		Ability to better off in revenue generation
EF11		Reduction in the risk of diminishing yield
EN1		Environmental
EN2	Water conservation and management	
EN3	Ensuring and promoting of sustainability of ecosystems	
EN4	Improvement to soil health	




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EN5	Reduction in the causative effects of climate change and transformation of cultivations into systems that can withstand its harmful effects
EN6	Resistance of crops to diseases, pests, and other unfavourable conditions
EN7	Consumption of energy (i.e., fossil fuels for machinery, water etc.)
EN8	Dependence of farming practices on soil, water and weather conditions
EN9	Depletion of natural resources during the production of the fertilizer
EN10	Maintenance of the balance of biodiversity
EN11	Wastage generated due to farming activities

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*Note: SR – Social and Regulatory, EF – Economic and Financial, EN - Environmental*

## RESULTS AND DISCUSSION

Among the respondents, 59 percent of stakeholders were men and the majority of stakeholders (59%), were between the ages of 35 and 65. The sample was mostly composed of experts (34%), with 19% of farmers involved in paddy cultivation. A post-graduate qualification was held by 43% of stakeholders, and the majority of respondents (33 %) had 5-15 years of experience in their respective fields.

### *Outcome of tests of scale reliability and adequacy*

The Cronbach Alpha value was used as an outcome of the scale reliability analysis which was higher than 0.7 for all criteria; SR (0.746), EF (0.839) and EN (0.817), which implies the scale reliability and internal consistency (Jayasinghe-Mudalige and Henson, 2006) based on the scores which were provided by the stakeholders. Furthermore, the Kaiser-Meyer-Olkin (KMO) test resulted in 0.845 and since the value was higher than 0.5, the sample adequacy could be ascertained. Bartlett's test of sphericity (Significance level of  $p < 0.005$ ) was done to confirm the patterned relationship between the variables and the result being 0.000 ( $< 0.005$ ) suggests that there is a patterned relationship among the variables of the study.

### *Median scores and outcome of the Kruskal-Wallis test*

When the medians for each statement were compared, it was apparent that stakeholder perceptions varied significantly in the face of diverse scenarios (Figure 1). Based on the medians of responses for the statements under the environmental criterion, it was determined that the general view of stakeholders favoured EFTs above CFs. Respondents perceive that using EFTs instead of CFs can promote the long-term sustainability of paddy production (EF6) and reduce excessive fertiliser usage (EF8). However, it turned out that CFs outperformed EFTs in certain aspects as well including market availability for purchasing specific fertiliser for agricultural purposes (EF4), market purchasing facilities (EF5) and labour requirements in paddy production (EF9). The median score for the statement SR7 revealed that all stakeholders in general lacked belief that effective policies are in place that promote EFTs over CFs. Furthermore, farmers were sceptical that the use of EFTs in agriculture will result in a reduction in energy consumption (fossil fuels, electricity, etc.) (EN7).

According to the results of the non-parametric Kruskal-Wallis test, there was no significant difference between the medians of the stakeholder groups ( $p = 0.253$ , 95% confidence level), and it was statistically proven that the perceptions of all stakeholder groups favoured EFTs over CFs (Figure 2).

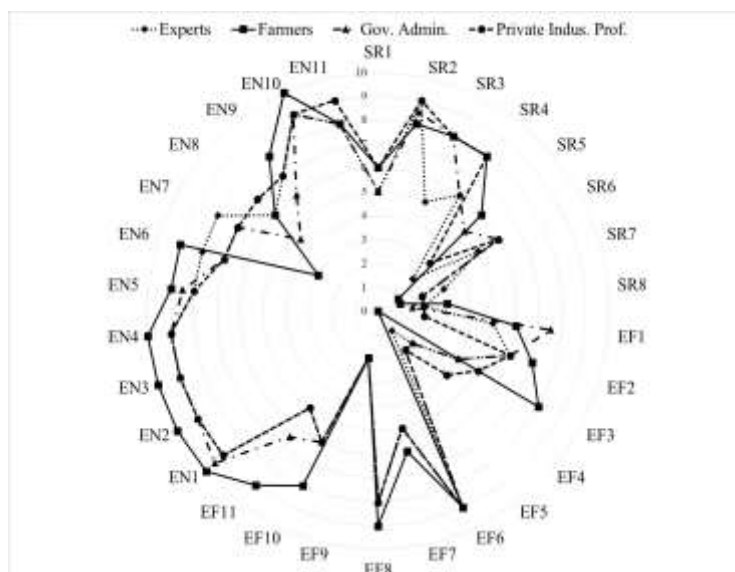


Figure 1:- Medians for each statement by each stakeholder group

## CONCLUSIONS/RECOMMENDATIONS

The study, which was carried out to determine the key stakeholders' perceptions on the adoption of EFTs and reduced CFs use revealed that all stakeholders believe that EFTs outperform CFs in general.

The study recommended that farmers and other stakeholders receive adequate and further training and education (i.e., capacity building) regarding the use and technology of EFTs as well as the necessary support and guidance (i.e., facilitation and regulation) from the government and regulatory institutions to facilitate the adoption of EFTs. Effective policies that promote and facilitate the availability of EFTs in the market are regarded important. Such regulations would promote the use of EFTs and push the shift away from CFs encouraging sustainable production practices. Therefore, it has been proved that it is critical to build a robust and comprehensive agricultural and fertiliser policy framework at national level as soon as possible.

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