RESEARCH REPORT

ORGANIC FERTILIZER USE IN PADDY CULTIVATION:

INSIGHTS INTO FARMERS' PRACTICES AND PREFERENCES

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FOREWARD

As the world faces growing concerns about the environmental and health impacts of conventional agriculture, the need for sustainable and eco-friendly farming practices has become more pressing than ever. In Sri Lanka, where paddy cultivation plays a central role in rural livelihoods and national food security, the integration of organic fertilizers presents a promising pathway toward more resilient and sustainable agricultural systems.

This study offers timely and policy-relevant insights into how organic fertilizers are currently being used by Sri Lankan paddy farmers, and what factors influence their preferences and decision-making. By examining practices across nine major rice-growing districts, the study captures the diversity of farmer experiences across the country.

The findings shed light on both the growing interest among farmers in adopting organic fertilizer practices, and the challenges they face in doing so ranging from limited technical know-how and inadequate supply of quality inputs, to practical difficulties in managing labour and materials. Importantly, the study emphasizes the role of farmer perception, institutional support, and the need for trusted, certified products in shaping the adoption of organic fertilizers.

I believe this research provides a solid evidence base to inform future policy development, extension services, and investment decisions aimed at promoting environmentally responsible nutrient management. I hope the insights and recommendations presented in this report will serve as a valuable resource for policymakers, agricultural professionals, researchers, and development partners committed to advancing sustainable agriculture in Sri Lanka.

Prof. A.L. Sandika
Director/Chief Executive Officer

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EXECUTIVE SUMMARY

In recent years, increasing attention has been given to environmentally sustainable farming practices, primarily due to the negative impacts of conventional agricultural methods. Integrating of organic fertilizers into paddy cultivation become a key strategy to reduce the excessive use of inorganic fertilizers, improve soil health and support long-term agricultural sustainability. However, promoting and adopting of such practices effectively require a clear understanding of farmers' perspectives and preferences. In this context, this study aims to examine the current use of organic fertilizers and identify the preferences of paddy farmers in Sri Lanka regarding their application. The objective is to provide valuable insights that can inform future agricultural policies and development initiatives focused on sustainable nutrient management.

The research involved paddy farmers selected from nine major rice-growing districts across Sri Lanka: Anuradhapura, Polonnaruwa, Kurunegala, Ampara, Trincomalee, Galle, Gampaha, Vavuniya, and Badulla. These districts were strategically chosen to represent the country's diverse agroecological zones and irrigation systems, including major, minor, and rain-fed areas. A multi-stage random sampling technique was employed to ensure the representativeness of the sample.

The study revealed that among farmers who applied organic fertilizers alongside inorganic ones, 50 percent did so voluntarily, motivated by their personal interest, a promising sign of a shift toward more sustainable agricultural practices. Additionally, 31 percent of farmers were influenced by government officials, highlighting the vital role of agricultural extension services in shaping farmer behaviour through knowledge dissemination. Compost was identified as the most commonly used organic input, utilized by 47 percent of farmers, while a significant majority (86 percent) expressed a preference for solid fertilizer forms.

The self-production of organic fertilizers was a notable finding in the study, with 47 percent of farmers engaged in producing their own inputs despite facing several challenges. The most significant barrier reported was the difficulty in sourcing adequate raw materials, affecting 83 percent of these farmers. Other reported constraints, included a lack of technical knowledge, limited space, time constraints, and concerns over the low quality of the fertilizers produced. Government-supplied fertilizers distributed through Agrarian Services Centers (ASCs) accounted for 27 percent of the total, confirming that importance of institutional support in ensuring access to agricultural inputs.

One of the key findings of the study was that 72 percent of farmers who used organic fertilizers reported a reduction in their application of inorganic fertilizers, especially urea. However, most farmers lacked awareness of the precise quantities of organic fertilizers required to meet crop nutrient requirements, highlighting a significant gap in technical knowledge.

The study also assessed farmer awareness of the key benefits of organic farming such as environmental sustainability, improved soil health, and the absence of harmful residues in food. Most farmers displayed a good level of awareness, which they attributed to increased media exposure. However, despite their awareness of environmental and health-related benefits, many farmers lacked in-depth knowledge of best practices for organic fertilizer production and application. This disconnects between awareness and practical know-how emerged as a major barrier to wider adoption. Even though most farmers had over 20 years of experience in paddy cultivation, many were unfamiliar with modern organic fertilizer practices such as the use of bio-fertilizers, and organic pellets.

Farmers' perceptions of organic farming practices varied considerably. A significant majority found organic farming more complex than conventional methods, with 71 percent identifying difficulties in sourcing organic materials and 83 percent citing challenges in managing weeds, pests, and diseases without chemicals. Nearly 95 percent of farmers emphasized the need for demonstrations and hands-on training to build capacity and confidence in organic farming techniques.

According to descriptive data on preferences, 62 percent of farmers favoured granular organic fertilizers, while 70 percent preferred fertilizers produced by external sources such as the government or private companies. A majority (56 percent) were willing to pay between Rs. 5,000 and Rs. 10,000 per acre for organic fertilizers, and 66 percent indicated openness to applying organic fertilizers across their entire paddy land. The most preferred ratio of inorganic to organic fertilizers was 50:50, as chosen by 37 percent of respondents. A striking 97 percent preferred certified organic fertilizers, illustrating the critical importance of quality assurance and trust in promoting organic products.

The results of the choice experiment further validated these preferences, revealing that farmers favour solid organic fertilizers, such as pellets or granules, and show a strong inclination toward externally produced, certified fertilizers. These findings clearly demonstrate that aligning policies with farmer preferences particularly in terms of product type, quality, affordability, and trusted sources is essential to increasing the adoption of organic fertilizers.

A key constraint to the wider promotion of organic fertilizer use was the inadequate availability of sufficient quantities reported by 58 percent of farmers, alongside with concerns about the poor quality of products available in the market, noted by 32 percent. Farmers also noted the labour-intensive nature of organic fertilizer use, particularly in handling, transportation, and application, which may discourage adoption unless more efficient, and user-friendly technologies are developed.

Based on the findings of this study, several policy recommendations are proposed to support the adoption of eco-friendly fertilizer practices in paddy cultivation. Strengthening the capacity of farmers through continuous training, awareness programmes, and the establishment of demonstration farms is essential to bridge existing knowledge gaps and enhance technical skills in organic fertilizer application. Incorporating digital platforms can further improve the dissemination of best practices, complementing traditional extension services. Simultaneously, promoting the production and availability of high-quality organic fertilizers at the market must be prioritized by encouraging the use of diverse raw materials, advancing composting techniques, and supporting the development of community-based production centers. Ensuring consistent market supply and enforcing quality standards will also be critical to building farmer confidence. Most importantly, future policies must align with farmers preferences particularly their inclination toward solid, certified organic fertilizers from trusted sources in order to increase adoption rates and effectively integrate organic fertilizers into national nutrient management strategies for sustainable paddy farming.

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LIST OF ABBREVIATIONS

AI	Agriculture Instructor
ARPA	Agriculture Research and Production Assistant
ASC	Agrarian Services Center
CE	Choice Experiment
CL	Conditional Logit
DAD	Department of Agrarian Development
DCS	Department of Census and Statistics
DOA	Department of Agriculture
FGD	Focus Group Discussion
GAP	Good Agricultural Practices
GMO	Genetically Modified Organisms
GOSL	Government of Sri Lanka
HARTI	Hector Kobbekaduwa Agrarian Research and Training Institute
IIA	Independence of Irrelevant Alternatives
INM	Integrated Nutrient Management
KIIs	Key Informant Interviews
MOP	Muriate of Potash
N	Nitrogen
NAP	National Agriculture Policy
RDOs	Regional Development Officers
RUT	Random Utility Theory
SDGs	Sustainable Development Goals
SPSS	Statistical Package for Social Sciences
TSP	Triple Super Phosphate
UN	United Nation’s
WTP	Willingness to Pay

CHAPTER ONE

Introduction

1.1 Research Background

Rice is the staple diet of the people in Sri Lanka and is the single most important crop occupying the highest extent from total cultivated area (Senanayake & Premarathne, 2016). The paddy sector provides both direct and indirect livelihood for more than 1.8 million farmers engaged in paddy cultivation (Weerahewa, 2010). Demand for rice is projected to increase more than 1.1 percent annually, driven by anticipated population growth in the coming years (Senanayake and Premaratne, 2016).

Proper and balanced plant nutrient management is one of the key factors affecting optimum economic yield of crops (Jat *et al*., 2015; Mukherjee, 2013). Empirical evidence revealed that there is a positive relationship between the quantity of chemical fertilizer applied and the extent of paddy production (Abeysinghe, 2014). The conventional paddy farmers in Sri Lanka have been applying Urea, Muriate of Potash (MOP), and Triple Super Phosphate (TSP) on paddy since the green revolution. Approximately 92 percent of synthetic fertilizers applied by local farmers are imported to the country. Among them, approximately 70 percent of imported fertilizers are used for paddy cultivation (Weerahewa *et al*., 2010). Fertilizer subsidies has accounted for 4 percent of total government expenditure in 2017, reflecting with substantial annual spending on fertilizer imports (Ranathilaka and Arachchi, 2019).

The application of organic sources of nutrients is an efficient and environmentally friendly technology of crop production (Baishya *et al.,* 2015). Organic fertilizers have long been a part of traditional farming practices in Sri Lanka. Incorporating organic manure regulates the uptake of nutrients, positively affecting production, improving soil quality (physical, chemical, and biological), and creates a synergistic effect on crops (Yadav and Kumar, 2000). The recent policy change introduced by the government in May 2021, which imposed restrictions on the imports of inorganic fertilizers, aimed to mitigate the threats to soil and water quality caused by their excessive use.

There is substantial evidence supporting the use of organic materials in paddy cultivations. It has been reported that the use of organics fertilizers in paddy cultivation improves yield and nutrient use efficiency (Singh and Kumar (2014). According to the study findings of Bhardwaj *et al*. (2023), integration of inorganic fertilizers with green manuring and residue compost improves the productivity, nutrient availability, allowing a 50 percent reduction in inorganic fertilizer use within the paddy-wheat production system. According to the Dissanayake *et al.* (2014) the paddy variety Bg 352 responds positively to organic fertilizers in combination with inorganic fertilizers, which illustrates the possibility of substituting a part of inorganic fertilizers with organic fertilizer saving 130 kg urea, 43 kg TSP and 37 kg MOP per hectare. Hence, integration of inorganic and organic fertilizers is an important for sustainable nutrient management and boosting up crop production.

1.2 Research Problem

Many studies have shown that the appropriate use of NPK fertilizers has enhances the yield and substantially improves rice quality (Oikeh *et al*., 2008; Saidu *et al*., 2012). On the other hand, nutritional imbalance in paddy cultivation causes a decrease in grain yield and marginal net returns (Zafar *et al*., 2018; Wattoo *et al.,* 2018). Farmers often increase fertilizer use to maximize yield without adequately considering environmental impacts (Rodrigo and Abeysekera, 2015; Weerahewa, 2010).

The overuse of inorganic fertilizers leads to soil acidity, reduced soil fertility, pollution of air, water, and soil, while depleting essential soil nutrients and minerals, thereby poising environment hazards (Pahalvi *et al.*, 2021). The application of inorganic fertilizers is criticized as it poses multiple threats to human health and the environment (Agbede, 2010). Use of environmentally friendly fertilizer such as compost, green manure, animal manure, sawdust, or the integration of organic fertilizer and inorganic fertilizers, can be an alternative option to reduce the utilization of inorganic fertilizer alone. Compared to inorganic fertilizers, organic fertilizers help maintain soil quality, increase soil organic matter, as well as improve soil physical and chemical properties through the decomposition of its substances (Mäder *et al.,* 2002). The ban on the importation of chemical fertilizers and synthetic pesticides in recent past (since May to November 2021), aimed to transition conventional farming to entirely organic practices. However, according to the official data of Department of Census and Statistics (DCS, 2022), the paddy yield reduction is 34 percent in 2022 compared with 2021 (sum of 2021/2022 *Maha* and 2022 *Yala* season). The majority of farmers held the view that solely relying on organic fertilizers was not a favourable option. Experience from tropical Asian countries generally shows that organic farming alone cannot supply sufficient nutrients, and organic fertilizer need to be supplemented with a basal application of inorganic fertilizer (Morteza, 2011).

The literature shows that the integration of organic fertilizers with inorganic fertilizers is the most sustainable way in management of nutrients (Ghosh *et al*., 2022; Geng *et al*., 2019; Moe *et al*., 2017; Bejbaruha *et al*., 2009). Wickramasinghe & Wijewardena (2003) reported that combining organic and inorganic fertilizers creates beneficial interactions, resulting in yield increase greater than those achieved by applying equivalent quantities of either nutrient source alone. The integrated use of organic and inorganic fertilizers also helps maintain soil nutrient balance, improves soil aggregation, enhance moisture retention capacity, and supports overall soil fertility (Tadesse *et al.*, 2013; Saha *et al.*, 2007).

In Sri Lanka, the integration of organic fertilizer and inorganic fertilizers in paddy farming remain limited. Despite the government's recommendation of combining organic fertilizer with inorganic fertilizers, adoption rates are low (Sirisena, 2013). Farmers tend to favour inorganic fertilizers due to subsidies and established practices, making the transition to a balance approach challenging (Subhashini *et al*., 2021; Kahandage *et al*., 2023). The government of Sri Lanka (GOSL) has extensively used extension and training programmes and special media campaigns to support the promotion of eco-friendly fertilizer application.

The adoption of eco-friendly nutrient management practices faces several challenges, including farmer reluctance, limited market access, knowledge gaps, and inadequate infrastructure (Vishwakarma and Chauhan, 2023). Since farmers play a pivotal role in adopting organic fertilizer practices, understanding their preferences is crucial to facilitating the transition to organic methods. Identifying farmers' needs and preferences is essential for developing strategies that effectively promote sustainable practices. In this context, it is important to identify the key attributes to consider when shifting to organic fertilizer in formulating eco-friendly fertilizer policies.

Furthermore, this study attempted to fill the gap in scientific literature regarding farmer' preference which remain under-researched in Sri Lanka. Specifically, the research seeks to understand farmers' preferences of the organic fertilizer and identify the attributes to be considered when shifting to organic fertilizer. Furthermore, it is essential to comprehensively examine the current nutrient management practices among paddy farmers, as well as the constraints, challenges and potential opportunities related to adopting organic management practices. Finally, the findings of this study could provide valuable guidance to policy makers to formulate and implement the eco-friendly fertilizer policies that effectively promote organic cultivation among paddy farmers.

1.3 Objectives

Main Objective

The main objective of this study is to identify the current organic fertilizer application practices, and to explore farmers' preferences for the use of organic fertilizers in paddy cultivation, with the aim of proposing recommendations to establish a sustainable nutrient management system in Sri Lanka's paddy cultivation.

Specific Objectives

I. To identify the organic fertilizer application practices adopted by paddy farmers in Sri Lanka
II. To elicit the farmers' preferences for various attributes of the usage of organic fertilizers in paddy cultivation.
III. To identify the challenges and limitations in adopting of organic fertilizer application practices in Sri Lanka.

1.4 Significance of the Study

The scope of this study aligns with key priorities highlighted in the national policy framework of both the previous government and also the current government. The 2022 National Agricultural Policy Framework (NAP draft) recognizes the importance of usage of eco-friendly fertilizers in agriculture production (Government of Sri Lanka, 2019). In this regard, the NAP framework includes develop and implement plans to increase the extent of land with organic ameliorations by providing an appropriate incentive package[1], incentivize adoption of Good Agricultural Practices (GAP)/organic agriculture/ecological agriculture[2], introduce and adopt modern eco-friendly input management techniques[3]. In the current government policy framework “A Thriving Nation and a Beautiful Life” it is clearly mentioned the promotion of use of both organic and inorganic fertilizers based on GAP. Further, the environmentally friendly operations are encouraged with increasing the extent of land with organic ameliorations.

The global focus is increasingly shifting towards sustainable production systems. The United Nations' (UN) 17 Sustainable Development Goals (SDGs) aim to ensure decent lives for all while protecting a healthy planet by 2030 (United Nations, 2024). The 2021 UN Food Systems Summit emphasized the need for global action to transform food systems into sustainable systems to achieve these goals (United Nations, 2021). Against this backdrop, the current research study holds significant relevance both globally and within Sri Lanka’s evolving agricultural policies, especially as the country navigates toward more sustainable farming practices. Understanding farmers' preferences for eco-friendly fertilizers is crucial to inform these policies that ensuring they align with the practical needs and capabilities of local farmers

1.5 Organization of the Report

The report is organized into six chapters. Chapter One provides an overview of the study, including its background, objectives, and significance. Chapter Two presents a comprehensive review of relevant literature. Chapter Three focuses on the methodology employed in the study. The findings are detailed in Chapters Four and Five. Chapter Four examines the current nutrient management practices in paddy farming, with particular emphasis on organic fertilizer application practices. Chapter Five analyzes farmers’ preferences and choices using a Choice Experiment (CE) approach. Finally, Chapter Six concludes the report with key findings, conclusions, and recommendations.

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[1] Under the thematic area of input management, the policy statement is improved productivity and sustainability of arable lands through optimum use of inputs and far-sighted management while safeguarding farming community and the environment

[2] Under the thematic area of Food Safety & Quality Management, the policy statement is improved access to safe and high-quality food and feed based on national and international standards to safeguard human and animal health

[3] Same thematic area and policy statement in the second foot note.

CHAPTER TWO

Literature Review

2.1 Overview of Nutrient Management in Paddy Cultivation

Rice is the staple food for nearly half of the world's population and serves as the primary food source for many of the world's poor. Approximately 90 percent of the global rice production occurs in the Asian region (Devkota *et al*., 2019). Between 2005 and 2014, the area dedicated to rice cultivation has increased by 30 percent compared to the period from 1961 to 1970, with production increased by 186 percent in major rice-producing countries such as China, Indonesia, Vietnam, Thailand, Myanmar, and Sri Lanka (FAOSTAT, 2019).

According to 2019 FAOSTAT data, the use of nitrogen (N) fertilizers in China, Indonesia, Vietnam, Thailand, Myanmar, and Sri Lanka rose by 34 percent between 2002 to 2014. In the Asia-Pacific region, paddy-producing countries tend to apply higher amounts of fertilizers to close the yield gap, as expanding the area of rice cultivation poses significant challenges (FAO, 2021). In Vietnam, the use of fertilizers, particularly urea, grew from 45 kg per ha in 1988 to 200 kg per ha in 1997 (Le, 1998). In Sri Lanka, there are specific recommendations for fertilizer application in paddy cultivation[4].

The continuous use of inorganic fertilizers has been linked to numerous negative impacts, including human health risks, reduced ecosystem services, biodiversity loss, and contributions to climate change (Weifeng *et al*., 2022; Pathak and Bhatia, 2017). Additionally, paddy cultivation often faces a mismatch between N demand and the N supplied through fertilizers, resulting in 50-70 percent loss of applied N due to processes such as denitrification, ammonia volatilization, leaching, and runoff (Papademetriou *et al*., 2000). A study by Ju *et al*. (2009) highlighted that excessive N fertilization in China has led to both economic inefficiencies and environmental degradation. Similarly, Gaytancıoglu and Yılmaz (2024) found that overuse of inorganic fertilizers has contributed to environmental degradation in Turkey. In India, Pathak *et al*. (2006) observed that fertilizer uses of up to 300 kilo grams per ha in irrigated areas has caused excessive N accumulation in the soil, water, and air. In Sri Lanka, a study by Herath *et al.* (2015) reported that heavily subsidized fertilizer schemes, such as "*Kethata Aruna*[5]" have discouraged farmers from adopting best management practices in paddy cultivation.

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[4] The Department of Agriculture (DOA) initially developed recommendations for paddy cultivation in 2001, taking into account factors such as productivity levels, agroecological zones, and the age of the plant. In 2013, these recommendations were updated to improve the efficiency of fertilizer usage and to maximize the use of naturally available nutrients (Sirisena, 2013).

[5] The "*Kethata Aruna*" fertilizer subsidy programme, launched in 2005, is available exclusively to paddy farmers who meet specific eligibility criteria. Through this initiative, three key fertilizers, Urea, TSP, and MOP was provided at a subsidized rate of Rs. 350 per 50 kilo grams, covering about 92 percent of the total fertilizer cost (Herath *et al.,* 2015).

Sole reliance on organic fertilizers for crop cultivation is not a feasible solution to mitigate the negative impacts of inorganic fertilizers. A notable example is Bhutan, which set an ambitious goal in 2006 to become the first country in the world to achieve 100 percent organic agriculture by 2020 (John, 2023; Feuerbacher *et al.,* 2016; Daniel *et al*., 2014). At that time, only 0.01 percent of its agricultural land, equivalent to just 61 ha, was certified as organic. However, by 2021, this figure had increased to only 5,608 ha, accounting for just 1.09 percent of the country's agricultural area (John, 2023). The primary reason for Bhutan's inability to meet its organic farming targets lies in the absence of a clear and effective strategy. Studies suggest that achieving such ambitious goals requires more comprehensive planning, stronger research, and development efforts and greater emphasis on educating both farmers and consumers about the advantages of organic farming practices.

Given the harmful impacts associated with the use of inorganic fertilizers, many countries are increasingly adopting sustainable nutrient management practices. A key strategy involves integrating organic fertilizers with inorganic fertilizers to minimize environmental damage and improve soil health (Ramu *et al*., 2024; Alam *et al*., 2023; Kahandage *et al.,* 2023; Weifeng *et al*., 2022).

2.2 Organic Fertilizer Application in Paddy Cultivation

Sustainable nutrient management requires an effective fertilization strategy that enhances both agricultural productivity and environmental quality by utilizing a combination of inorganic and organic fertilizers (Kalita and Deka, 2006). The integration of organic and inorganic fertilizers plays a crucial role in improving crop yield and maintaining soil health (Tahmina *et al*., 2022).

In countries such as Japan and Thailand, the combined use of organic amendments and inorganic fertilizers has resulted in higher productivity while preserving ecological balance (Zhang *et al.,* 2024). Research further highlights that integrated nutrient management in lowland rice cultivation, which combines organic and inorganic sources, can enhance yields, improve soil quality, and ensure sustainability, particularly in nutrient deficient acidic soils along the west coast of India (Paramesh *et al.,* 2023).

A study by Pritpal *et al.* (2021) demonstrates that balanced fertilizer application (NPK) significantly enhances nutrient use efficiency, crop productivity, and economic yields, while also reducing greenhouse gas emissions and improving carbon efficiency in the rice-wheat cropping system in Northwestern India. Similarly, Tanmoy *et al*. (2021) found comparable results in West Bengal, India, within a rice-rice cropping system, highlighting the importance of applying recommended nutrient doses to achieve sustainable yields and maintain nutrient balance.

In 2013, fertilizer recommendations for paddy cultivation in Sri Lanka emphasized the mandatory incorporation of organic materials to improve fertilizer use efficiency (Sirisena, 2013). The whole quantity of paddy straw from the previous season can be utilized, along with recommendations for additional organic inputs: 2.5 tons of compost per ha, 4 tons of cow dung per ha, 2 tons of poultry manure per ha, and 1 ton of green manure per ha (Sirisena, 2013). More recently, a research study conducted in Sri Lanka on the application of biofilm biofertilizers in paddy cultivation demonstrated a significant reduction in the need for inorganic approximately 50 percent when biofilm biofertilizers were applied at a rate of just 2.5 liter per ha (Ekanayake *et al*., 2023).

Research conducted over an extended period in Sri Lanka has demonstrated that applying organic fertilizers in paddy cultivation is essential for reducing heavy metal levels in the soil and enhancing long-term soil sustainability (Herath *et al.*, 2021; Kahandage *et al.*, 2023). According to a study by Dissanayake *et al*. (2014), on integrated nutrient management in lowland rice, organic manure alone yielded the best results for the *Kaluheenati* variety. In contrast, the Bg 352 variety responded positive to a combination of organic manures and inorganic fertilizers, which led to reduced fertilizer usage and improved productivity. The study illustrated the possibility of substituting a part of inorganic fertilizers with organic manures saving 130, 43 and 37 kg urea, Triple Super Phosphate and Muriate of Potash per hectare respectively under Bg 352 variety. Additionally, a study on the environmental impacts of inorganic versus organic fertilizers in Sri Lankan paddy fields found that reducing the proportion of inorganic fertilizers in favour of organic alternatives could significantly reduce environmental harm (Kahandage *et al*., 2023). The study's normalized results indicated that adopting to organic fertilizers could reduce up to 82 percent of the current environmental impact.

2.3 Choice Experiment (CE) Method and Empirical Findings of Its Application

A choice experiment approach is widely used to elicit individual preferences. It allows for the valuation of specific attributes of a good or service by presenting individuals with different hypothetical alternatives or scenarios and recording their stated choices. This method falls under the category of stated preference approaches, which are employed to assess the value of goods and services based on their specific characteristics or attributes at varying levels. Choice modeling has been widely applied across various sectors, including health, policy planning and areas beyond the health sector. Preferences have been reported in academic literature for applications in agriculture, water management, transport and tourism (Baidu-Forson *et al*., 1997; Tiwari and Kawakami, 2001).

The following paragraphs provide evidence of the application of CE in understanding farmers' preferences for eco-friendly fertilizer use, both in Sri Lanka and globally. Choice modeling is widely recognized as an established approach for valuing non-market goods in most developed countries. A considerable number of studies have been identified globally in relation to this sector. A study conducted by Praveen, Singh and Adithya (2023) investigated farmers' valuation of various biofertilizer characteristics using a discrete choice experiment. Attributes considered in the study included form, variation in nutrient availability, cost savings from biofertilizers, yield benefits, source and cost per acre. Biofertilizers sourced from government providers were preferred by farmers. Liquid biofertilizers, offering a longer shelf life, were perceived to provide higher utility. Farmers were found to be willing to pay a premium for liquid biofertilizers over solid ones due to differences in shelf life and application methods. Similarly, in Taiwan, a case study was conducted by Chang *et al.* (2015) to examine the preferences of rice farmers regarding policy incentives under the inorganic fertilizer reduction scheme using choice experiments. Their findings revealed that preferences for the amount of enrolled land, incentive payments, contract duration, and eco-labels significantly influenced farmers' policy preferences. In China, a study by Xin *et al*. (2022) found that many smallholder farmers are willing to pay for leguminous green fertilizers, particularly when they are informed about the associated environmental benefits. The willingness to pay (WTP) is strongly linked to farmers' awareness of how these fertilizers improve soil fertility and support sustainable farming practices.

Chen *et al.* (2024) examined the relationship between economic preferences, personality traits, and fertilizer use among 815 rice farmers in Eastern China. Their findings indicated that risk-seeking behaviour and patience were positively correlated with the adoption of organic fertilizers significantly, farmers with a greater willingness to take risks and those capable of delaying gratification were more likely to use organic fertilizers. Additionally, a choice experiment conducted by Zhang *et al.* (2022) involving 1,400 crop farmers in China revealed preferences for replacing synthetic fertilizers with manure. Farmers favoured policy packages that offered field guidance, machinery services, and financial support as incentives to encourage adoption.

In Netherlands, a study was conducted to investigate Danish farmers' willingness to pay for bio-based fertilizers and to identify the key fertilizer characteristics that encourage their use. Farmers were presented with a choice between two bio-based fertilizer alternatives and their current mineral fertilizer. As cited in De Silva *et al*. (2018) the attributes included in the study were fertilizer form, nutrient release rate, price, recommended application volume compared to artificial fertilizers, uncertainty regarding nitrogen content, organic carbon content, and effect on pests and diseases. The results indicated that farmers preferred higher certainty in the N-content, lower volume, organic carbon and hygienization (Bonnichsen *et al*., 2020). As cited in Tur-Cardona *et al*. (2018), common preferences for concentrated products with certainty in N content and lower prices than inorganic fertilizers were found among farmers from seven different European countries. Additionally, the attributes that should be considered by industry when estimating the demand for new bio-based fertilizer products are highlighted.

Dahlin *et al*. (2016) examined the purchasing preferences for fertilizer product features in the home gardening market. The study identified preferences related to brand status, product labeling and nutrient content. The study used attributes such as fertilizer type, brand name, label, nutrient value (N, P, K levels), resource (raw material) and price (2.5 kg package). The findings of Dahlin *et al.* (2016) are intended to assist product managers in the biogas industry in developing marketing strategies to integrate digestate into a sustainable energy production system.

Unlike in many other countries, studies on applying CE to organic fertilizer are scarce. However, despite the current scarcity, there is a notable global increase in research within this sector. in Sri Lanka, such studies remain limited; however, De Silva *et al*. (2018) used the CE method to explore the replacement of inorganic fertilizers with eco-friendly technologies for paddy cultivation. This study was carried out in Kurunegala and Anuradhapura, focusing on biofertilizers as an eco-friendly solution. The selected attributes included the preferred form, nutrient solubilizing rate, purchasing form, environmental impact and the cost of fertilizer application per acre. Several of these attributes have been incorporated into our study, supported by their findings. The study's findings indicate that farmers generally demonstrate positive attitudes and a willingness to pay higher prices for eco-friendly attributes associated with environmentally friendly technologies such as biofertilizers.

The aforementioned facts and evidence underscore the relevance of CE in assessing farmers' preferences for eco-friendly fertilizers, particularly in estimating the trade-offs between inorganic and organic options on a global scale, a context that remains underexplored in Sri Lanka. Consequently, the CE method being increasingly applied across diverse areas, accompanied by various reinforcements and advancements. It is anticipated that CE will evolve into one of the most precise tools for supporting policymakers in the development and implementation of eco-friendly fertilizer policies aimed to promoting organic cultivation among paddy farmers.

2.4 Challenges and Limitations in Adopting Organic Fertilizer Practices

The shift toward eco-friendly fertilizer practices is driven by the global urgency to address soil health degradation, environmental pollution, and the need for sustainable food production. However, the adoption of such practices faces numerous challenges and limitations, particularly in developing countries like Sri Lanka.

One of the primary barriers to adopting organic fertilizer is the high initial cost associated with its production and procurement. Studies indicate that organic fertilizers often require more labour and time for production, such as composting, compared to synthetic fertilizers (Pakeerathan & Vaishnavi, 2022; Stockdale *et al.,* 2001). Farmers' willingness to adopt organic fertilizers is influenced by their economic capacity and level of awareness. For instance, studies show that economic incentives, such as subsidies or price reductions play a critical role in encouraging adoption (Cardona *et al.,* 2018).

Farmers often lack sufficient knowledge about the preparation, application, and benefits of organic fertilizers. A study by Rasul and Thapa (2003) in Nepal found that inadequate technical training and extension services limited farmers' capacity to adopt organic farming practices. Similar findings are found in studies conducted in Sub-Saharan Africa, where training programmes are essential for successful adoption

(Pretty *et al*., 2006). In Sri Lanka farmers frequently resist changing traditional practices due to insufficient training and lack of clear demonstrations of the benefits of organic fertilizers (Silva *et al.*, 2020).

Organic fertilizers typically release nutrients more slowly than inorganic fertilizers, which can lead to lower immediate crop yields. This delayed nutrient availability poses a significant challenge for farmers who depend on quick returns to sustain their livelihoods (Pimentel *et al.,* 1991). Additionally, variability in nutrient content and decomposition rates can lead to inconsistent crop responses, discouraging farmers from widespread adoption (Zhang *et al.,* 2022). The availability and accessibility of organic fertilizers remain a logistical challenge, particularly in rural areas. According to Chang *et al.,* 2015 the lack of well-established supply chains for organic inputs significantly limits their adoption.

Organic fertilizers are often bulkier and less concentrated in terms of nutrients than inorganic fertilizers, making their transportation and application more labour-intensive (Mäder *et al*., 2002). Moreover, achieving optimal soil fertility using organic practices requires long-term commitment and careful management, which can deter farmers seeking immediate results. Traditional farming practices and resistance to change further limit the adoption of organic fertilizers. Farmers often remain skeptical about the effectiveness of organic methods compared to synthetic fertilizers, as highlighted by Qian *et al.* (2024). Addressing these perceptions calls for targeted educational campaigns and demonstration plots. Moreover, in many regions, subsidies favour inorganic fertilizers overshadow the promotion of organic alternatives, creating a biased incentive structure (Herath *et a.l,* 2021; Scialabba & Hattam, 2002). A study conducted in Sri Lanka found that policy fluctuations, such as sudden bans on inorganic fertilizers, cause confusion and economic loss, further discouraging the adoption of eco-friendly practices (Kaushalya, 2023).

CHAPTER THREE

Methodology

3.1 Selection of Study Locations

The study locations were selected based on the extent of paddy cultivation and their representation of key irrigation patterns and climatic variability, as these factors have a direct impact on paddy production and nutrient management decisions. The three main irrigation methods considered were major irrigation systems, minor irrigation systems, and rain-fed systems. To capture climatic variability, locations representing the dry zone, wet zone, and intermediate zone were included. Based on these criteria, nine paddy-cultivating districts were selected: Anuradhapura, Polonnaruwa, Kurunegala, Ampara, Trincomalee, Galle, Gampaha, Vavuniya, and Badulla. These districts were chosen to provide a comprehensive representation of paddy cultivation areas across the country. Collectively, they accounted for more than 50 percent of the total paddy sown area during the 2022/2023 *Maha* season in Sri Lanka (Table 3.1).

Table 3.1: Sown Extent of Paddy in Selected Districts during the 2022/2023 *Maha* Season

Districts	Paddy Sown Extent (ha)	% Contribution
Anuradhapura	293,605	15
Ampara	199,048	10
Kurunegala	193,368	10
Polonnaruwa	171,705	9
Trincomalee	120,101	6
Badulla	63,668	3
Vavuniya	58,077	3
Gampaha	30,514	2
Galle	30,442	2
Total	**1,160,528**	**58**
Sri Lanka	2,007,977	100

Source: DCS, 2023

3.2 Sample Selection and Sampling Techniques

The Agricultural Household Survey 2016/2017 (DCS, 2019) served as the basis for determining the sample size for this study. According to the survey, the total population of agricultural operators cultivating paddy during the *Maha* season in the nine selected districts was 777,280 individuals. This figure was considered as the study population. The sample size was calculated using the Cochran formula, assumes for a 5 percent margin of error and a 95 percent confidence level. Based on this method, the minimum required sample size was determined to be 384 paddy farmers (Piran-Qeydari *et al*., 2022). Following data collection and the removal of outliers, the final dataset comprised of 428 paddy farmers, which was used for the analysis (Table 3.2).

The study sample was derived proportionally drawn from the total population of paddy farmers within the selected study districts. A multi-stage random sampling procedure was employed to select the sample. The sample selection procedure is explained below.

Stage one: Selection of Districts
Districts were selected based on the criteria outlined in Section 3.1. Accordingly, a total of nine districts were selected for the data collection process.

Stage Two: Selection of ASCs
Within each district, ASCs with the highest paddy cultivation extents were identified for inclusion in the study. The selection process was carried out in involved consultation with agricultural officers, including Agriculture Research and Production Assistants (ARPAs) and Regional Development Officers (RDOs), to ensure the selection of the most relevant ASCs. A total of 19 ASCs were selected for the sample selection process (Appendix A).

Stage Three: Selection of Paddy Farmers
Paddy farmers were randomly selected from the identified ASCs, with the individual paddy farmer serving as the sampling unit. The sample was designed to ensure comprehensive representation by including two categories of farmers: those who applied only inorganic fertilizers and those who used a combination of organic and inorganic fertilizers.

Table 3.2: Distribution of Sample Farmers

Study Location	Selection Criteria	Sample Size
Anuradhapura	Major, Minor, Mahaweli irrigation / Dry zone	89
Kurunegala	Minor irrigation and Rain-fed / Intermediate zone	75
Ampara	Major, Mahaweli irrigation / Intermediate zone	57
Gampaha	Rain-fed farming / Wet zone	38
Galle	Rain-fed farming / Wet zone	37
Badulla	Major irrigation / Intermediate zone	34
Trincomalee	Major irrigation / Dry zone	33
Vavuniya	Minor irrigation / Dry zone	32
Polonnaruwa	Mahaweli irrigation / Dry zone	33
Total		**428**

Source: HARTI Survey Data, 2024

3.3 Types of Data and Data Collection Methods

Both primary and secondary data were used for the study.

3.3.1 Primary Data Collection Method

Questionnaire Survey

Primary data for the qualitative and quantitative analyses of the study were collected through a sample survey conducted among paddy farmers. A semi-structured, pre-tested questionnaire served as the data collection instrument to ensure reliability and relevance of the information gathered. The survey was administered digitally using the Kobo Toolbox platform, which facilitated efficient and accurate data collection.

Key Informant Interviews (KIIs)

Key Informant Interviews (KIIs) were conducted with district-level Assistant Commissioners from the Department of Agrarian Development (DAD), Assistant Directors from the Department of Agriculture (DOA), and Divisional Officers from ASCs. These interviews were instrumental in identifying the attributes and their levels required for the analysis of CE. Additionally, KIIs were utilized to gather other essential information from relevant officials to support the sample selection process.

Focus Group Discussions (FGDs)

Focus Group Discussions (FGDs) were conducted with paddy farmers in selected study locations to accurately identify the attributes relevant to the CE and determine their appropriate levels.

3.3.2 Secondary Data Collection Methods

Secondary data for the study were obtained from various reliable sources, including the Department of Census and Statistics (DCS), ASCs in the selected locations, as well as published and unpublished reports and other relevant literature. These data sources provided essential contextual and supplementary information to support the analysis.

3.4 Data Analysis and Analytical Techniques

Objective One: To identify the current organic nutrient management practices adopted by farmers in paddy cultivations in Sri Lanka

To achieve this objective, the collected data were analyzed using both descriptive and inferential statistics. Frequency distributions, mean comparisons, and standard deviations were computed using Microsoft Excel and Statistical Package for the Social Sciences (SPSS) software version 23. Further the cost of cultivation of paddy under two different production systems such as only with inorganic fertilizers and combination of organic and inorganic was calculated. The results of the analysis were presented through tables, graphs, and charts to facilitate clear and effective interpretation.

Table 3.3 Description of the Variables Used for Objective One

Indicators	Variables
Socio-demographic information	Age of the farmer Gender Education Household size Main income source Farming experience
Paddy land related information	Ownership of paddy land Total extent of paddy land Irrigation methods
Organic fertilizer application	Motivation for using organic fertilizers Reasons for application of organic fertilizers Types of organic fertilizers applied Sources of organic fertilizers Awareness on quantity applied for paddy cultivation Issues related to the use of organic fertilizer Impact of organic fertilizer on usage of inorganic fertilizers
Self-production of organic fertilizers	Types of raw material used Organic fertilizer production issues
Cost of cultivation and productivity of paddy	Cost of main inputs in paddy cultivation such as material, machinery and labour under two different production systems (only inorganic fertilizer and combination of organic and inorganic) Yield per unit extent (kg/ac)

Source: Authors' Own Compilation, 2024

Objective Two: To elicit the farmers' preference for attributes of the usage of organic fertilizer in paddy farming

Theoretical Background of Choice Experiment

This method falls under the stated preference approaches which are used to value goods and services based on by specific characteristics or attributes at varying levels. In choice experiment surveys, survey respondents are asked to choose their most preferred option from a number of alternatives. Choice modeling is based on Random Utility Theory (RUT) (Adamowicz *et al.,* 1998) and Lancaster's Consumer Theory (1966). According to RUT, utility is an unobservable construct that exists in the mind of the consumer but cannot be observed directly. Lancaster (1966) stated that consumer's utility relies on the characteristics of the good to be consumed not on the good itself as it is.

It is mentioned in RUT that the utility (U) gained by person q from alternative i in choice situation t is made up of a deterministic component (V) and a random, unobservable component ($\mathcal{E}$) (Equation 1) (Hensher *et al.,* 2005).

$$U_{qit} = V_{qit} + \mathcal{E}_{qit} \quad (1)$$

An individual will choose alternative *i* over alternative *j* in choice set *t* if and only if Uqit > Uqjt. Hence, the probability that person *q* will choose alternative *i* over alternative *j* is given by equation 2 as follows;

$$P_{ij} = \text{Prob}(V_{iq} + \varepsilon_{iq} > V_{jq} + \varepsilon_{jq}; \forall j \in C \text{ and } j \neq i) \quad (2)$$

Where C is the complete set of all possible sets from which the individual can choose. The part-worth marginal value of a single attribute is represented in equation 3

$$WTP_k = -\beta_k / \beta_{cost} \quad (3)$$

In the above equation, βs represent the coefficient associated with on the vector of attributes and individual characteristics, ultimately yielding the willingness to pay (WTP) as the final outcome (Hensher *et al*., 2005).

The steps of the choice experiment survey used in this study are described below.

I. Identification of Attributes and Levels

Selecting and defining the attributes for the study required a thorough understanding of the target population's perspectives and experiences. To achieve this, preliminary information was gathered through literature review, expert consultations, KIIs with district-level Assistant Commissioners from the Department of Agrarian Development, Assistant Directors from the DOA, and Divisional Officers from ASCs, as well as FGDs with farmers engaged in paddy cultivation. This process facilitated the identification of the most relevant attributes, or the key characteristics of the alternatives, related to paddy cultivation. Based on these consultations, five attributes and their respective levels were determined and are presented in Table 3.4 for inclusion in the CE.

Table 3.4: The Selected Attributes and Attribute Levels for CE

Attributes	Levels
Mode of organic fertilizer	Solid type Liquid type
Source of organic fertilizer	Self-produced Produced by someone else
Ratio of inorganic to organic fertilizers used in paddy cultivation when both are applied based on nutrient (N) content	Inorganic 70%: Organic 30% Inorganic 60%: Organic 40% Inorganic 50%: Organic 50% Inorganic 40%: Organic 60%
Certification for organic fertilizers	Certified Not certified
Cost incurred for organic fertilizer (Rs/ac)	Rs. 4700 (30%) Rs. 6270 (40%) Rs. 7830 (50%) Rs. 9400 (60%)

Source: Authors' Own Compilation based on literature review, KIIs and FGDs, 2024

The mode of fertilizer application is a crucial aspect when considering organic fertilizer use. Two main levels of this attribute were identified: solid and liquid. Since solid organic fertilizers come in various forms such as granules, powders, and pellets, the study treated them collectively. The source of fertilizer attribute pertains to the method of supplying organic fertilizers. Based on information gathered from KIIs, this attribute was categorized into two levels: self-produced and externally produced (mainly by the government or private fertilizer companies).

The 70:30 ratio of inorganic to organic fertilizer was determined based on the nitrogen nutrient contribution from each category 70 percent from inorganic fertilizers and 30 percent from organic fertilizers. This decision was made as part of a policy directive introduced during the 2022/2023 *Maha* season for paddy cultivation (MoA, 2024; Drechsel et al., 2025). Using this as the baseline, the study reduced the inorganic fertilizer proportion by 10 percent increments down to 40 percent, while correspondingly increasing the organic fertilizer percentage. Certification of organic fertilizers emerged as an important consideration, as highlighted in the literature review. Certification ensures verification of nutrient content and overall quality, with two levels certified and non-certified being considered. Lastly, the cost attribute was considered, with the total cost of inorganic fertilizers in paddy cultivation for the 2023 *Maha* season serving as the basis for calculating various cost levels. Table 3.4 illustrates the different cost rates derived from the total inorganic fertilizer expenses, resulting in four distinct levels of the cost attribute.

II. Developing an Experimental Design

After finalizing the attributes and levels for the attributes selected, an appropriate experimental design was decided. Generally, a full factorial design was used which was a design in which all possible choice combinations with all the interaction effects (between attributes, levels, attributes and levels) were generated. A fractional factorial design was used that had an orthogonal and balanced design with main effects if only considers the main effects. Experimental design was generated through IBM SPSS Statistics 23 software.

The full computation of possible choice combinations was equal to L^{MA} for labelled choice experiments and L^{A} for unlabeled experiments. In these computations, L was referred to several levels, M for the number of alternatives and A for the number of attributes. Here, the main effects of the attributes were considered and thus a fractional factorial design was generated considering the main interactions.

III. Designing of Choice Cards

Eight Choice cards were designed using the selected attributes and levels with several alternatives including the status quo which was the current situation of utilizing organic fertilizer for paddy. Each farmer was given one Choice Card with four alternatives. Figure 3.1 presents an example of a choice card developed for the choice experiment. Appendix B explains the total Choice Cards used for the experiment.

IV. Data Collection

The sample selection criterion for CE survey was similar to the samples drawn to achieve objective two. Choice cards were administered in parallel with the questionnaire survey to gather information such as socio-demographic information and other information related to nutrient management practices in paddy cultivation. FGDs were conducted to collect choice data from paddy farmers. Choice cards and the questionnaire were pre-tested prior to data collection particularly to confirm the attributes and levels of the alternatives. One alternative was chosen by each farmer among many alternatives including the status quo in one choice question.

ගොවි මහතාගේ නම: | දිස්ත්‍රික්කය:
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Serial No:

Choice Card 1 | **Block 1**

නිර්ණායකය	කාබනික පොහොර සඳහා යොමුවීමේ ක්‍රමවේදය A	කාබනික පොහොර සඳහා යොමුවීමේ ක්‍රමවේදය B	කාබනික පොහොර සඳහා යොමුවීමේ ක්‍රමවේදය C	කාබනික පොහොර සඳහා යොමුවීමේ ක්‍රමවේදය D
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කාබනික පොහොර ලබාගන්නා ආකාරය	වෙනත් මූලාශ්‍රයකින්	වෙනත් මූලාශ්‍රයකින්	තමන් විසින් නිපදවන ලද	තමන් විසින් නිපදවන ලද
රසායනික සහ කාබනික පොහොර භාවිතා කිරීමට කැමති අනුපාතය	රසායනික 50% : කාබනික 50%	රසායනික 40% : කාබනික 60%	රසායනික 60% : කාබනික 40%	රසායනික 70% : කාබනික 30%
කාබනික පොහොර සහතික කිරීම	සහතික නොකරන ලද	සහතික නොකරන ලද	සහතික කරන ලද	සහතික කරන ලද
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Source: HARTI Survey Data, 2024

Figure 3.1: Example of Choice Set Designed

V. Data Analysis and Model Estimation

Random Utility Theory (RUT) allows for the analysis of probability of choosing one alternative over another based on the individual's preference. Data was analyzed by executing Conditional Logit (CL) model using STATA version 11.2 software.

Conditional Logit (CL) Model

The CL model assumes compliance with Independence of Irrelevant Alternatives (IIA) property. This property states that the relative probabilities of choosing between any two alternatives remain unchanged by the introduction or removal of other alternatives. If the IIA property is violated, then CL results will be biased.

The following equation (4) represents the CL model as applied within the framework of RUT.

$$U_j = \sum_{k=1}^{K} \beta_k X_{kj} + \beta_p P_j + \varepsilon_j \qquad (4)$$

Where *K* is the attribute, *P* is the cost component and *βp* are the coefficients on vector of attributes.

Objective Three: To identify the challenges and limitations in adoption of organic nutrient management practices in Sri Lanka

This final objective was analyzed using descriptive methods to explore the challenges and limitations faced by paddy farmers in adopting organic nutrient management practices in Sri Lanka.

CHAPTER FOUR

Organic Fertilizer Application Practices in Paddy Cultivation

4.1 Introduction

This chapter examines the current practices adopted by paddy farmers in the application of organic fertilizers. Data were collected from a single paddy plot cultivated by each farmer during the year 2024. The chapter begins with an overview of the total sample farmers' socio-demographic characteristics, followed by detailed information on paddy land, including total land extent, ownership patterns, and irrigation methods. It then explores the types of organic materials used, the sources of organic fertilizers, the methods of employed in their production done by farmers who used organic fertilizers in paddy cultivation and the cost of production of paddy. Finally, the chapter discusses the key issues and challenges faced by farmers in utilizing organic fertilizers for paddy cultivation.

4.2 Socio-demographic Information of the Sample Paddy Farmers

4.2.1 Age Distribution of Paddy Farmers

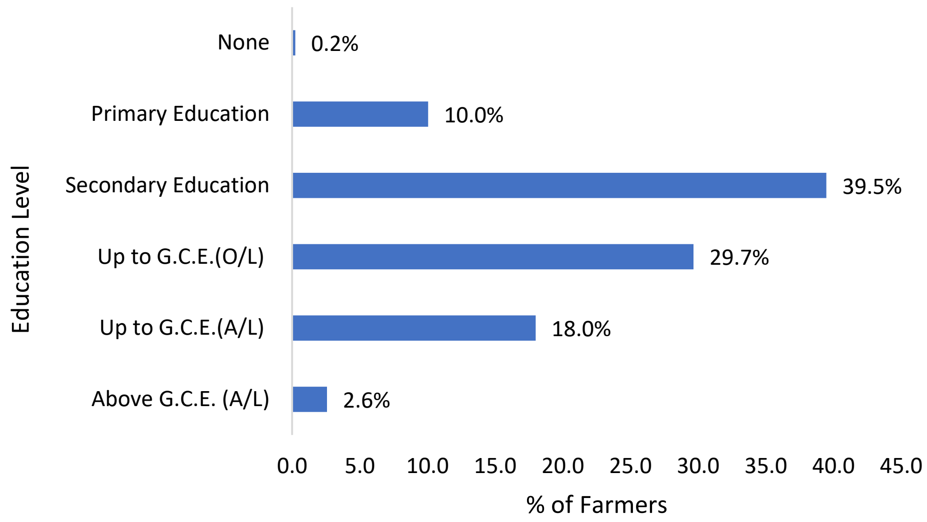
Table 4.1: Age Distribution of Paddy Farmers in the Sample

Age Category (Year)	Frequency	Percentage
<=30	13	3
30<=40	31	7
40<=50	94	22
50<=60	140	33
60<=70	110	26
>70	40	9
Total	428	100

Source: HARTI Survey Data, 2024

The average age of the paddy farmers in the sample is 56 years, with ages ranging from 22 to 88 years. The findings reflect the current situation in Sri Lanka's agricultural sector, where there is minimal participation from the younger generation in paddy farming. Only three percent of the farmers are 30 years old or younger, and just seven percent are 40 years old or younger. The majority of farmers (33%) are aged between 50 and 60 years. Notably, 68 percent of the farmers in the sample are over 50 years old. The majority of key decisions regarding paddy farming are made by male farmers (89%), while only 11 percent made by are female farmers.

4.2.2 Level of Education of Paddy Farmers in the Sample

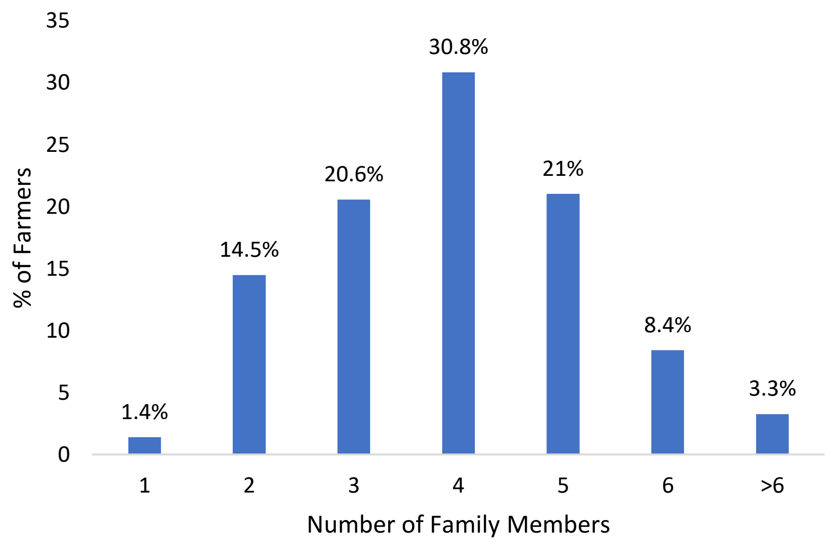


Source: HARTI Survey Data, 2024

Figure 4.1: Distribution of Level of Education of Principal Farmer in the Sample

The educational levels of the sample paddy farmers are illustrated in Figure 4.1. According to the data, nearly 40 percent of the farmers in the sample have attained secondary education. Approximately 30 percent have completed up to the G.C.E. (O/L) examination, while nearly half (50.2%) have reached the G.C.E. (O/L) level. Only one farmer in the sample has not attended school. Among those with only primary education, 88 percent are over the age of 50. Overall, the data indicate relatively low level of educational attainment among paddy farmers in the sample.

4.2.3 Household Size of Paddy Farmers



Source: HARTI Survey Data, 2024

Figure 4.2: Distribution of Number of Family Members in Farmer's Household

The average family size among the sample is four, family sizes ranging from one to nine members and a minimum of one. As shown in Figure 4.2, the majority of farming families consist of four members (30.8%). Additionally, 67 percent of families have four or fewer members. These findings suggest a prevalent trend toward nuclear family structures within the farming communities.

4.2.4 Main Income Source of Paddy Farmers

Table 4.2: Main Income Source of Principal Paddy Farmers in the Sample

Source of Income	Frequency	Percentage
Crop farming	291	68.0
Pension	52	12.1
Government employment	29	6.8
Self-employed other than agriculture	18	4.2
Private sector employment	17	4.0
Skilled labour (Carpenter, Mechanic *etc*.)	18	4.2
Animal husbandry	3	0.7
Grand Total	**428**	**100.0**

Source: HARTI Survey Data, 2024

According to Table 4.2, among the total sample in the study, 68 percent of farmers rely on crop farming as their primary source of income, sustaining their livelihoods through agriculture. Additionally, 12 percent of farmers depend on their pensions as their main income source, having previously worked in government services. Moreover, seven percent of farmers are currently employed in government jobs, while four percent work in the private sector. Only three percent of farmers engage in animal husbandry, primarily focusing on poultry and cattle rearing, as their main source of income.

4.2.5 Share of Crop Farming for Household Income

Table 4.3: Percentage Share of Income from Crop Farming for Household Income

Percentage Share	Frequency	Percentage
<=10	42	10
10<=25	54	13
25<=50	55	13
50<=75	43	10
75<=100	234	55
Total	**428**	**100**

Source: HARTI Survey Data, 2024

Paddy farmers were asked about the contribution of crop farming to their total income. The results show that for the majority (55%), agricultural earnings account for more than 75 percent of their total income (Table 4.3). Among these, 39 percent of farmers derive 100 percent of their income from agriculture, highlighting their full-time engagement in farming. Overall, 65 percent of farmers reported that more than 50 percent of their total income derived from agriculture. In contrast, 10 percent of farmers indicated that agriculture contributes comparatively less their overall income.

4.2.6 Farming Experience of Paddy Farmers

Table 4.4: Distribution of Farming Experience of Paddy Farmers

Farming Experience in Years	Frequency	Percentage
<=10	55	13
10<=20	86	20
20<=30	117	27
30<=40	97	23
40<=50	61	14
>50	12	3
Total	**428**	**100**

Source: HARTI Survey Data, 2024

According to Table 4.4, 67 percent of farmers have over 20 years of experience in paddy farming, with three percent having more than 50 years of experience. In contrast, only 13 percent of farmers have comparatively less experience in paddy farming. These findings indicate that the vast majority of farmers have been engaged in paddy farming for a considerable length of time.

4.3 Information on Paddy Lands in the Sample

4.3.1 Total Paddy Land Extent

Table 4.5: Distribution of Extent of Total Paddy Land of Farmers

Extent of Paddy Lands in Acres	Frequency	Percentage
>=1	100	23.4
1<=2	98	23.0
2<=3	102	23.9
3<=4	28	6.6
4<=5	41	9.6
>5	58	13.6
Total	**427**	**100.0**

Source: HARTI Survey Data, 2024

The study assessed the total paddy land extent among the sample farmers. The majority (70%) owned three acres or less, with the average landholding being three acre per farmer (Table 4.5). Approximately 14 percent of farmers owned more than five acres of land. The smallest recorded landholding was 0.25 acres, while the largest was 20 acres.

4.3.2 Land Extent of Selected Paddy Field for Data Collection

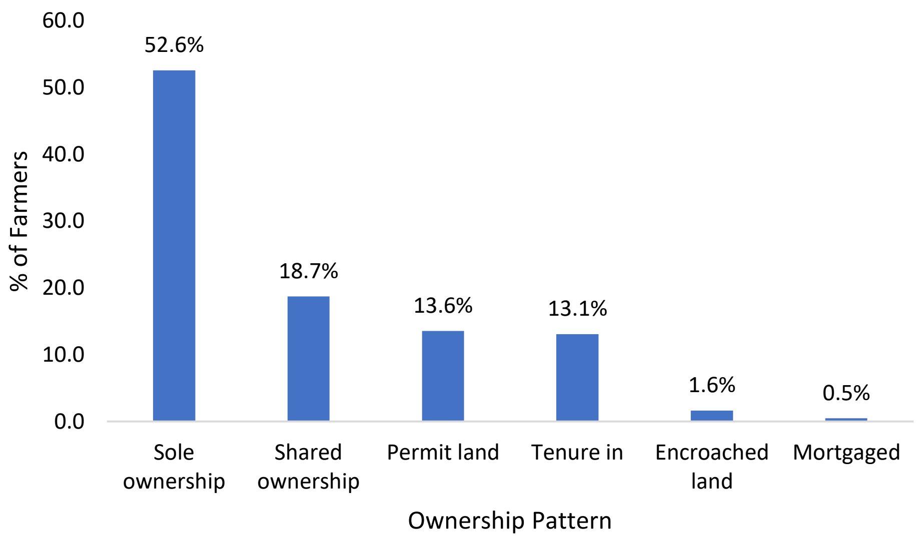
Table 4.6: Distribution of Extent Categories of Selected Paddy Land Plots

Extent Categories (in Acres)	Frequency	Percentage
<=0.25	20	5
0.25 - 0.5	67	16
0.5 - 0.75	26	6
0.75 - 1	79	18
1 - 2	98	23
2 - 3	119	28
>3	19	4
Total	**428**	**100**

Source: HARTI Survey Data, 2024

To ensure the reliability of data collection, a single paddy field was selected from each farmer. Table 4.6 illustrates the distribution of land extent categories for these selected fields. According to the data, more than half (55%) of the selected land plots had an extent greater than one acre. A smaller proportion of land plots measured approximately 40 perches or less. Only three percent of the land plots exceeded three acres in size. All data used in the analysis were based on these selected land plots.

4.3.3 Ownership Pattern of Selected Paddy Land Plots



Source: HARTI Survey Data, 2024

Figure 4.3: Ownership Pattern of Selected Paddy Land Plots

More than half of the farmers (53%) hold sole ownership of their paddy lands, and nearly 19 percent have shared ownership. However, only around two percent of farmers are cultivating encroached on paddy lands. Additionally, 13.6 percent of farmers hold paddy lands under government issued permits.

4.3.4 Irrigation Methods Used for Paddy Cultivation

The study examines four different irrigation methods used in paddy farming. Major irrigation systems in the districts of Kurunegala, Anuradhapura, Ampara, Badulla, and Trincomalee were included. Data from Mahaweli farmers were collected specifically from the Mahaweli C, B, and H systems. Specifically, Anuradhapura, Ampara, and Polonnaruwa districts were selected for data collection. For minor irrigation methods, data were gathered from Kurunegala, Anuradhapura, and Vavuniya districts were chosen. Rain-fed farmers were surveyed from Kurunegala, Galle, and Gampaha districts. Overall, the sample represents all these irrigation methods.

Table 4.7: Main Irrigation Methods Used for Paddy Cultivation

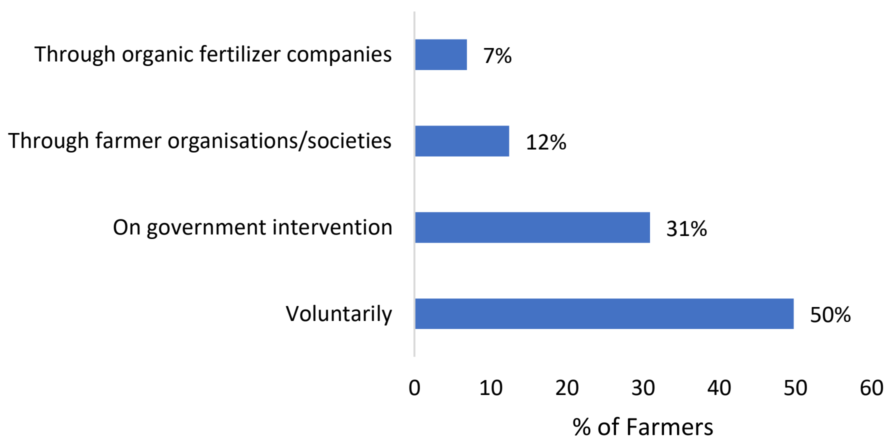
Irrigation Method	Frequency	Percentage
Major irrigation	117	27
Mahaweli	107	25
Rain-fed	109	25
Minor irrigation	95	22
Total	**428**	**100**

Source: HARTI Survey Data, 2024

4.4 Organic Fertilizer Application in Paddy Cultivation

The study aimed to examine the current practices of paddy farmers using both the mix of organic and inorganic fertilizers. To achieve this, data and information were collected from farmers cultivating paddy with both types of fertilizers. From this point onward, the discussion focuses specifically on the organic fertilizer application practices currently adopted by these farmers.

4.4.1 Farmers' Adoption of Organic Fertilizer in Paddy Cultivation

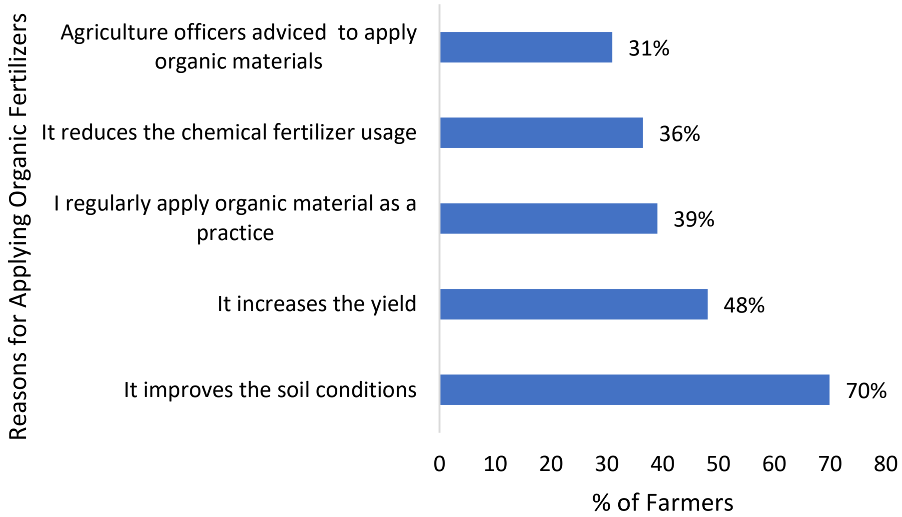


Source: HARTI Survey Data, 2024

Figure 4.4: Motivation for Organic Fertilizer Usage for Paddy Cultivation

According to Figure 4.4, exactly half of the farmers (50%) who applied organic fertilizers did so voluntarily, motivated by their own interest. Among them, 57 percent had been using organic fertilizers even before the policy change regarding the import banning inorganic fertilizer imports in 2021. This is a significant finding, as self-motivation plays a crucial role in adopting such practice. Additionally, 31 percent of farmers were encouraged to use organic fertilizers due to motivation from agricultural officers, such as ARPAs and Agriculture Instructors (AIs). This highlights the substantial contribution of government intervention in shaping farmers' attitudes and actions. Farmers' organizations in the villages also played a considerable role, influencing 12 percent of farmers to adopt organic fertilizers for paddy cultivation. Furthermore, of organic fertilizer companies contributed to promoting the use of organic fertilizers among paddy farmers.

4.4.2 Reasons for Applying Organic Fertilizers for Paddy Cultivations



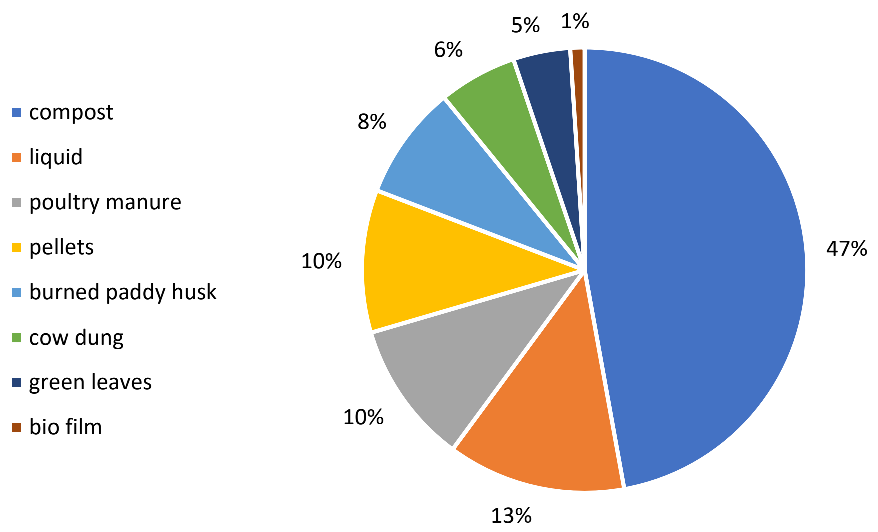
Note: The sum of the percentages exceeds 100 due to multiple answers

Source: HARTI Survey Data, 2024

Figure 4.5: Reasons for Applying Organic Fertilizers in Paddy Cultivation

Farmers apply organic fertilizers for paddy cultivation for various reasons. The most common reason, cited by 70 percent of farmers is that organic materials help improve soil conditions (Figure 4.5). Following this, increasing yield was cited by 48 percent of respondents, highlighting the role of organic fertilizers in enhancing productivity. Additionally, 45 percent of farmers applied organic fertilizers based on agricultural officers' advice, highlighting the influence of official guidance. Furthermore, 39 percent of farmers regularly use organic materials on their paddy lands. Finally, 36 percent of respondents mentioned that using organic fertilizers reduces the reliance on inorganic fertilizers, reflecting growing preferences for more sustainable farming practices.

4.4.3 Types of Organic Fertilizers Used by Paddy Farmers



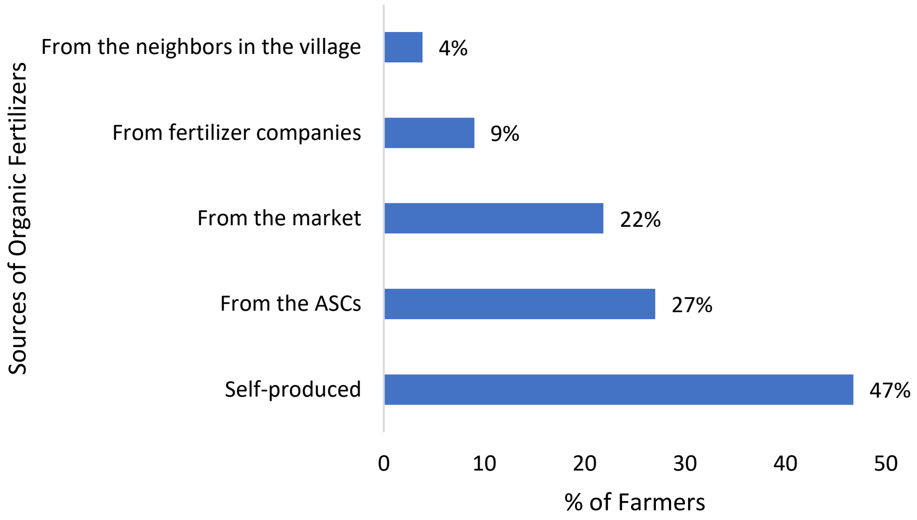
Source: HARTI Survey Data, 2024

Figure 4.6: Types of Organic Fertilizers Used by Farmers in Paddy Cultivation

Figure 4.6 shows the distribution of different types of organic materials used by paddy farmers. The highest percentage of farmers (47%) apply compost as their primary source of organic fertilizer, as solid organic fertilizers. Following compost, liquid fertilizers are utilized by 13 percent of farmers, while poultry manure and organic pellets are each used by 10 percent each. A significant number of farmers in the Gampaha district have used organic pellets, primarily due to their availability through fertilizer companies. The presence of poultry farms within or near these villages has also contributed to the use of poultry manure. Cow dung and green manure, such as *Gliricidia*, are utilized by a smaller number of farmers in the sample. Only two farmers in the Kurunegala district have used bio film fertilizers.

The results reveal that paddy farmers predominantly use conventional organic fertilizers that are readily available at the village level. However, newer types of organic fertilizers, such as biofilm fertilizers and organic pellets, have been introduced, although their adoption remains limited among rural farmers. In this study, farmers were surveyed regarding their awareness of these modern organic fertilizers. The findings indicate that only 52 percent of the farmers were familiar with these advanced fertilizer types.

4.4.4 Sources of Organic Fertilizers

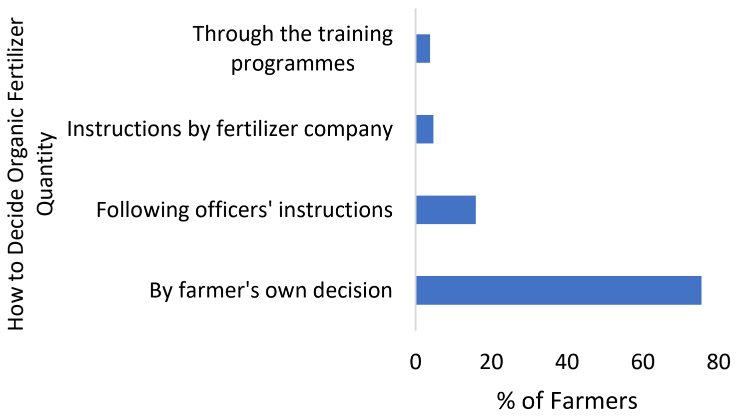


Note: The sum of the percentages exceeds 100 due to multiple answers
Source: HARTI Survey Data, 2024

Figure 4.7: Sources of Organic Fertilizers Used by Paddy Farmers

Farmers acquire organic fertilizers from various sources. The most common method of obtaining these fertilizers is through self-production at their households, practiced by 47 percent of farmers, highlighting a growing trend of farmers producing and using organic fertilizers independently. Additionally, 27 percent of farmers obtain organic fertilizers from ASCs, distributed by the government. According to Figure 4.7, 22 percent of farmers purchase organic fertilizers from the open market based on their specific needs. Furthermore, nine percent of farmers acquire them directly from fertilizer companies. A smaller proportion of farmers (4%) obtain fertilizers from neighbouring farmers within their villages.

4.4.5 Determining Organic Fertilizer Rates for Paddy Cultivation



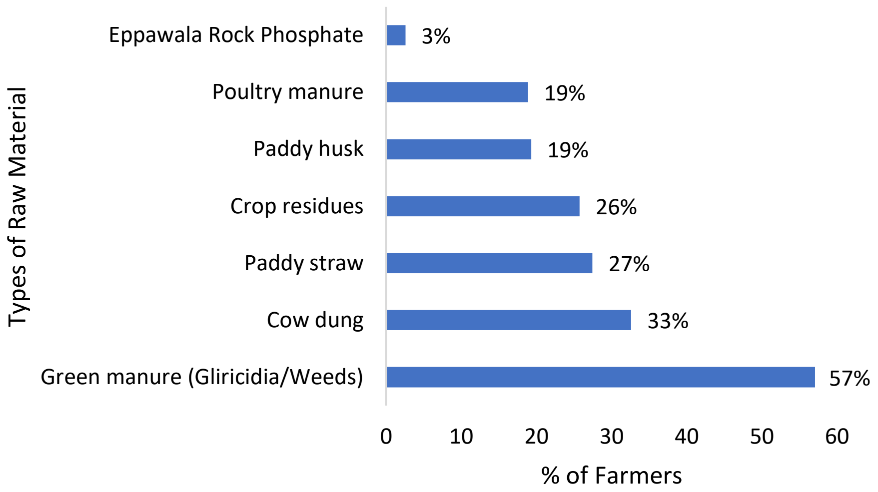
Source: HARTI Survey Data, 2024

Figure 4.8: Distribution of Farmers on Determining Organic Fertilizer Rates

Correct recommendations for applying organic fertilizers in for paddy cultivation are crucial. Most farmers in the sample (75%) applied organic fertilizers based on their own decisions. They typically used compost fertilizers, poultry manure, cow dung, green leaves and paddy husks according to their availability and preference. Liquid organic fertilizers, however were applied following the instructions on the labels. Sixteen percent of farmers have received the instructions from the agricultural officers such as ARPAs and AIs. Farmers who purchased organic fertilizers from companies generally followed their instructions. However, only three percent of farmers obtained knowledge on correct quantities through formal training programmes.

4.4.6 Production of Organic Fertilizers (Compost) by Farmers

4.4.6.1 Raw-material Used for Organic Fertilizer (Compost) Production



Note: The sum of the percentages exceeds 100 due to multiple answers
Source: HARTI Survey Data, 2024

Figure 4.9: Types of Raw Material Used for Organic Fertilizer (Compost) Production

Forty seven percent of farmers in the sample produced organic fertilizers, mainly compost at their home. They have used various types of raw materials to produce compost fertilizers. More than half of these farmers (57%) incorporated green manure with common types including *Gliricidia sepium*, aquatic weeds such as Salvinia and other weeds, banana leaves. The second most frequently used raw material was cow dung influenced by cattle rearing in the vicinity of the village. Poultry manure, another type of animal waste, was used by 19 percent of farmers in the sample. Paddy straw, a readily available dry plant material, was used by 27 percent of farmers as it was more abundant in each area. Additionally, some farmers used chopped banana trunks, grasses, and vegetable peelings as crop residues in their compost fertilizer production.

4.4.6.2 Issues in Organic Fertilizer Production at Farmer's Level

The data highlights key challenges that farmers face in the production of organic fertilizers, revealing several critical issues that hinder the process. The majority (83%) of farmers identified insufficient raw materials as the primary obstacle in organic fertilizer production. These findings align with the study conducted by Buhary *et al*. (2022), which examined the intensification of active paddy land use in the low-country wet zone through youth participation and organic paddy cultivation. That study also identified the inadequate availability of raw materials as the main barrier to adopting organic paddy cultivation in the region. Farmers typically source raw materials nearby areas to avoid the high costs and time involved in travelling farther. As a result, they use whatever materials are readily available locally. This shortage significantly limits farmers' ability to produce enough organic fertilizer to meet their crop needs, thereby affecting the sustainability of organic farming.

Lack of knowledge is the second most significant challenge, reported by 28 percent of farmers reporting it as a challenge. This gap in knowledge may relate to technical aspects of organic fertilizer production, such as proper composting methods, the correct ratio of materials, and or understanding the nutrients requirement of different crops.

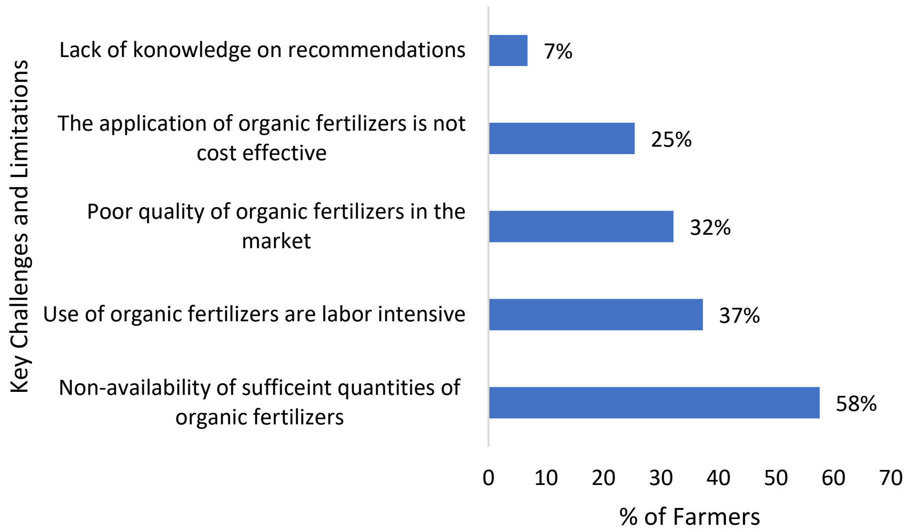
Insufficient space for large-scale organic fertilizer production, particularly for large cultivations, is another notable challenge reported by 14 percent of respondents. This challenge is more prevalent in areas such as Gampaha and Galle. The prolonged duration of the organic fertilizer production process is reported as a challenge by 11 percent of respondents. Composting often requires several months for decomposition, which can span several months depending on the materials used and environmental conditions, making this extended timeframe poses a significant limitation for many farmers.

Although many farmers produce organic fertilizers at the farm level, a significant issue is the poor of quality of these fertilizers, reported by 11 percent of respondents. This problem largely stems from insufficient knowledge of proper production methods and techniques, resulting in substandard final products. Variability in nutrient content and availability is common, directly affecting the effectiveness of the fertilizers. Moreover, farmers often lack confidence that their products contain adequate nutrients to meet crop needs. As a result, despite their efforts, the quality of farm-produced organic fertilizers produced at the farm level remains low.

4.4.7 Impact of Organic Fertilizer Usage on Inorganic Fertilizer Application

Farmers were inquired about the changes in the usage of inorganic fertilizers following the application of organic fertilizers in paddy cultivation. According to the data, 72 percent of farmers have reduced the quantity of inorganic fertilizers, especially urea used in paddy farming due to their use of organic fertilizers. This indicates a positive trend where organic fertilizer application is contributing to decreased reliance on inorganic inputs. The remaining farmers have not altered their inorganic fertilizer usage, contributing to apply the same quantities alongside organic fertilizers.

4.4.8 Challenges and Limitations in Applying Organic Fertilizers for Paddy Cultivations



Note: The sum of the percentages exceeds 100 due to multiple answers
Source: HARTI Survey Data, 2024

Figure 4.10: Key Challenges and Limitations in Applying Organic Fertilizers for Paddy Cultivation

Farmers reported several challenges related to the use organic fertilizers in paddy cultivation. Figure 4.10 highlights key issues faced by farmers in utilizing organic fertilizers. The most significant concern cited by 58 percent of respondents is the insufficient availability of organic fertilizers in the market, indicating a notable supply shortage. Despite the need to apply organic fertilizers over large cultivation areas, farmers are unable to access them in a timely manner due to the limited market supply. Furthermore, 37 percent of farmers find the application of organic fertilizers to be labour-intensive, particularly for those managing large paddy fields. Applying substantial quantities of compost requires additional manpower, making it difficult to meet the demands of large-scale paddy cultivation. The use of other types of organic fertilizers, such as poultry manure and cow dung, also poses similar challenges due to the effort required for transportation over long distances. Many farmers emphasized the need for user-friendly, easy-to-apply forms of organic fertilizer products to address these challenges.

Another concern reported by 32 percent of respondents is the poor quality of available organic fertilizers, particularly regarding liquid fertilizers distributed by both those government and market. Additionally, 25 percent of farmers feel that organic fertilizers are not cost-effective, often failing to produce satisfactory yields. While some farmers recognize the long-term benefits of organic fertilizers in improving soil quality, many focus primarily on the immediate results offered by inorganic fertilizers and may not fully appreciate these advantages. Finally, seven percent of respondents cited a lack of knowledge regarding proper application recommendations, indicating that many users are not adequately informed about on how to use organic fertilizers effectively.

4.5 Cost of Cultivation and Productivity of Paddy

The production costs of paddy in 2023/2024 *Maha* season who used only inorganic fertilizers and those who used a combination of organic and inorganic fertilizers were analyzed for comparison. These costs were calculated both with and without the imputed cost of paddy cultivation. The imputed cost included the value of family labour and other own inputs, while the calculation excluding imputed cost did not account for these components.

Anuradhapura and Kurunegala districts were selected to represent irrigated and rain-fed paddy farming systems, respectively. The primary focus of the analysis was on fertilizer application costs, aiming to compare the cost differences between farmers applying only inorganic fertilizers and those using a combination of organic and inorganic fertilizers. The summary of the mean values of fertilizer application costs are presented in Tables 4.8. The detailed cost of cultivation data is presented in the Appendix C, D, E and F.

Table 4.8: Cost of Fertilizer Application in Paddy Cultivation

Water supply	Cultivation system	Cost component	Cost (Rs/Ac)		
			Labour	Material	Total
Irrigated	Only inorganic fertilizer	Inorganic fertilizer application	3324	24778	28102
	Combined organic and inorganic fertilizer	Organic fertilizer application	3662	2235	5897
		Inorganic fertilizer application	2079	16916	18995
Rain-fed	Only inorganic fertilizer	Inorganic fertilizer application	2395	21292	23687
	Combined organic and inorganic fertilizer	Organic fertilizer application	1505	3893	5397
		Inorganic fertilizer application	2070	17331	19401

Source: HARTI Survey Data, 2024

The average cost of applying only inorganic fertilizer under irrigated conditions is LKR 28,102. In comparison, the average total cost of applying a combination of both inorganic and organic fertilizers is LKR 24,892, which is 11 percent lower than the cost of using only inorganic fertilizer (Table 4.8). There is a significant difference between the fertilizer application cost in two systems under irrigated conditions ($t = 3.347$, $p = 0.001$ assuming equal variance $F = 0.120$, $p = 0.730$).

When looking at only the material costs, the average for inorganic fertilizer alone is LKR 24,778, whereas the average material cost for the combined application of organic and inorganic fertilizers is LKR 19,151, a 23 percent reduction. The average material cost for organic fertilizers alone is LKR 2,235. Notably, 47 percent of farmers produce organic fertilizers at the farm level, often using freely available household materials. This likely contributes to the lower material costs associated with organic fertilizers.
However, the average labour cost for applying organic fertilizers (LKR 3,662) is significantly higher than that for inorganic fertilizer application (LKR 2,079). This may be attributed to the relatively greater effort and bulk involved in handling organic fertilizers, making the application process more labour-intensive compared to the relatively easier application of inorganic fertilizers.

When consider the rain-fed condition, the total average cost of inorganic fertilizer application is LKR 23687 in only inorganic paddy farming. It is LKR 24793 in both inorganic and organic combination. There is no significant difference between the fertilizer application costs (t = 1.974, p = 0.054 equal variance not assumed F =9.790, p = 0.003) in two systems. However, when consider the average material costs under two different condition, LKR 21292 has spent for inorganic fertilizer per acre by only inorganic fertilizer applied farmer. Though, it is LKR 17331 in combination conditions. This indicated that the cost for inorganic fertilizer has reduced when farmers apply organic fertilizers. The reduction is 19 percent.

Productivity of Paddy Cultivation

To assess the impact of fertilizer type on productivity, paddy yield per acre was calculated for two systems: one using only inorganic fertilizers and the other using a combination of organic and inorganic fertilizers. In irrigated paddy cultivation, the average yield was 1,731 kg per acre for the inorganic-only system and 1,925 kg per acre for the combined system (Appendix C & D). Although the combined fertilizer application resulted in slightly higher productivity, the difference was not statistically significant under irrigated conditions (U = 944, p = 0.108). Under rain-fed conditions, the productivity of the inorganic-only fertilizer system was 1,607 kg per acre, compared to 1,444 kg per acre in the mixed (organic and inorganic) fertilizer system (Appendix E & F). While the inorganic system recorded a higher yield, the difference in productivity between the two systems was not statistically significant in this context either (U = 445, p = 0.276).

CHAPTER FIVE

Farmers’ Awareness and the Preference on Organic Fertilizer Application in Paddy Cultivation

5.1 Introduction

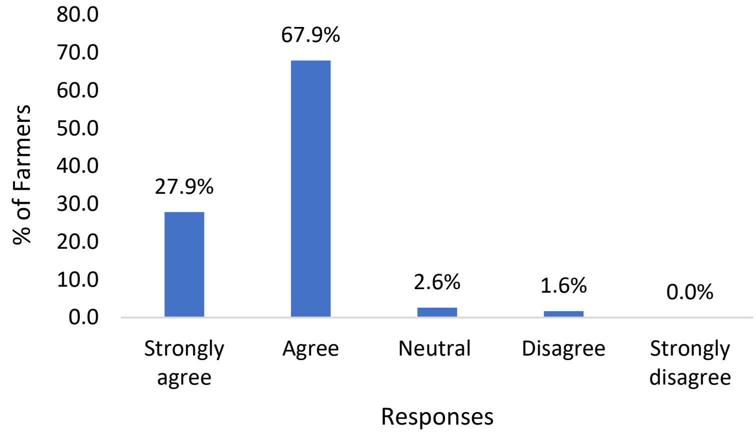
This chapter discusses the information on farmers’ level of awareness, their perspectives and preferences regarding organic agricultural practices. It captures farmers’ personal views on organic farming as they are primary implements at the ground level. The chapter explores how farmers preference influence the transition from inorganic to organic paddy farming. This analysis helps to identify further areas where farmers need encouragement to adopt organic farming and to improve their knowledge in this regard. The information was collected from both types of farmers involved in the study those who used only inorganic fertilizers and those who used a combination of organic and inorganic fertilizers.

5.2 Farmers’ Awareness on Organic Farming Practices

Organic farming has emerged as a sustainable alternative to conventional agriculture, emphasizing environmental preservation, soil health, and the production of chemical-free crops. However, the success of organic farming largely depends on farmers' awareness and understanding of their principles and practices. Awareness plays a crucial role in shaping farmers' attitudes toward adopting organic methods. Despite its potential benefits, limited knowledge and restricted access to information often hinder farmers from transitioning to organic farming. Therefore, assessing the level of farmers' awareness is essential for designing targeted interventions and policies to promote sustainable agricultural practices. In this study, farmers were presented with a series of statements related to organic farming, and their responses were recorded using a Likert scale method.

5.2.1 Environmentally Friendly Nature of Organic Farming

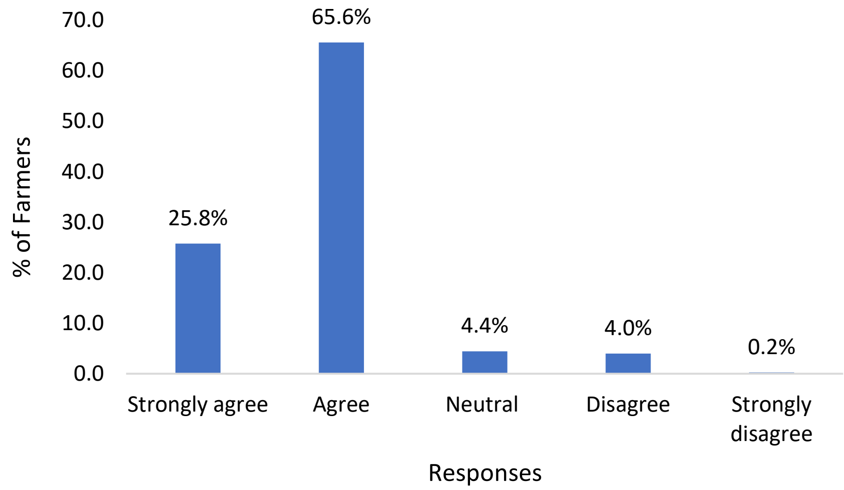
The study focused on paddy farmers’ level of knowledge regarding organic practices in paddy cultivation. One of the primary aspects examined was their understanding of the environmental benefits of using organic fertilizers. Since organic fertilizers do not contain any synthetic materials, they are generally considered environmentally friendly. As shown in Figure 5.1, 67.9 percent of farmers are in an agree that organic farming is environmental beneficial while 27.9 percent are strongly agreed. Although they are aware of the environmental benefits, their understanding often remains superficial. Their knowledge is mostly based on information received from media, neighbours, fellow farmers, and extension officers. However, this information tends to be basic and lacks depth, which prevent them from gaining a comprehensive understanding of organic farming practices.



Source: HARTI Survey Data, 2024

Figure 5.1: Farmers' Awareness on Environmental Benefits of Organic Farming

5.2.2 Enhancing Soil Health through Organic Fertilizer Application

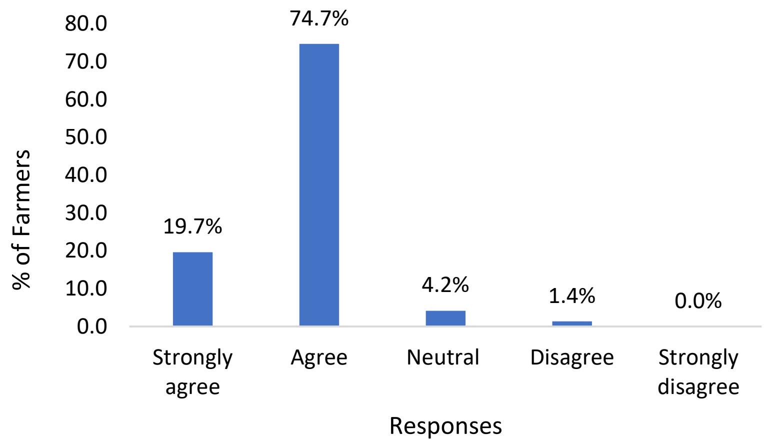


Source: HARTI Survey Data, 2024

Figure 5.2: Farmers' Awareness of Organic Material for Soil Improvement

The application of organic matters significantly improves soil condition by enhancing its structure, water retention, and aeration, all of which supports healthier plant growth. Additionally, it also stimulates microbial activity and nutrient cycling, contributing to improved soil fertility and long-term agricultural sustainability. According to the findings, nearly 91 percent of farmers in the sample are aware of the benefits of organic materials in terms of soil improvement (Figure 5.2). Among remaining farmers, 4.4 percent reported having no knowledge of this benefits, while the rest disagreed with the statement, believing that organic materials do not enhance the soil conditions.

5.2.3 Rising Awareness on the Absence of Harmful Residues and Contaminants in Organic Food

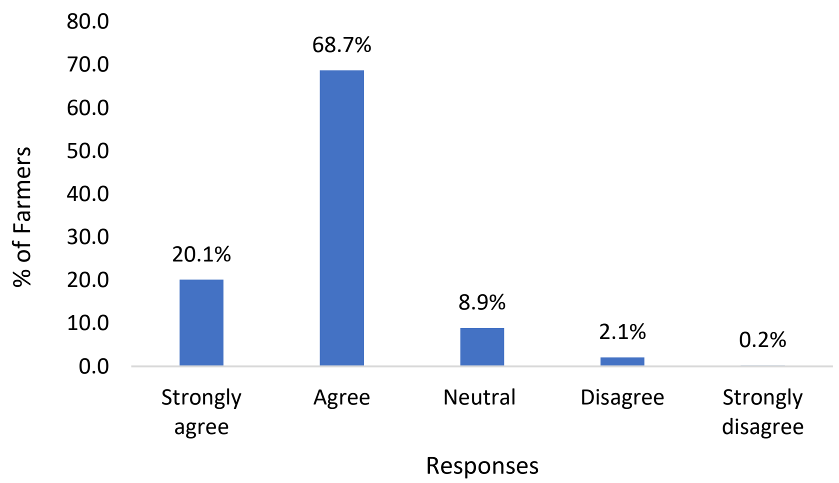


Source: HARTI Survey Data, 2024

Figure 5.3: Farmers' Awareness of the Absence of Harmful Residues in Organic Food

Organic food is produced without the use of synthetic pesticides, inorganic fertilizers, or genetically modified organisms (GMOs), thereby reducing the risk of harmful chemical residues in the final product. In the sample majority of farmers (75%) were aware that organically produced food is free from harmful residues or wastes. However, six percent of farmers showed limited awareness of this fact, with some expressing neutral views and others disagreeing with the statement (Figure 5.3).

5.2.4 Nutritional Value of Organic Food vs. Non-Organic Food



Source: HARTI Survey Data, 2024

Figure 5.4: Farmers' Awareness on Nutritional Value of Organic Food

The nutritional value of organic food is generally higher compared to non-organic food (Smith *et al.,* 2018). Research has found that organic crops tend to have higher concentrations of polyphenols and other bioactive compounds, which are associated with enhanced nutritional quality and potential health benefits (Jones & Robinson, 2019). According to survey results, 89 percent of farmers were aware that organic food has a higher nutritional value than inorganic food (Figure 5.4). Among the remaining farmers, 8.9 percent reported having no knowledge of this, while nearly two percent disagreed with the statement. Thus, overall 11 percent of the farmers demonstrated minimal awareness regarding the nutritional benefits of organic food.

5.3 Farmers' Perceptions on Organic Farming Practices

Farmers' perceptions of organic farming play a crucial role in its adoption and overall success. These perceptions are influenced by several factors such as awareness, knowledge, personal experiences, and exposure to organic practices. in this study, the sample paddy farmers were consulted to explore their mindsets and perspectives on the relevance of organic farming to paddy cultivation. Understanding these perceptions is essential to identifying the barriers farmers face and for developing strategies to promote the adoption of organic farming practices.

Table 5.1: Farmers' Perceptions on Organic Farming Practices

Statement on Organic Farming	Percentage of Responses of Farmers (%)				
	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
Organic farming poses challenges in sourcing organic fertilizers and raw materials	9.9	61.4	0.5	27.1	1.2
Controlling weeds, pests, and diseases in paddy fields without chemicals is challenging	28.0	55.4	0.7	13.8	2.1
There is a promising market for organic products in Sri Lanka	6.3	35.9	5.4	48.1	4.2
Demonstration and training programmes on organic farming methods should be implemented	19.2	75.6	0.7	4.2	0.2
Organic farming is more complex than inorganic farming	8.7	74.0	1.6	14.3	1.4

Source: HARTI Survey Data, 2024

Table 5.1 presents the frequency of responses to a set of questions designed to assess farmers' perceptions of organic agricultural practices. In recent years, organic fertilizer production in Sri Lanka has gained significant momentum in recent years due to the growing demand for sustainable agricultural practices. However, a majority of farmers

(71%) reported that sourcing raw materials for organic fertilizer production at the village level remains a challenge, underscoring the need of an effective mechanism to ensure the availability of these inputs. In contrast, 28 percent of farmers indicated that they do not find organic fertilizer production particularly challenging.

In the context of weed, pest, and disease control in paddy cultivation, 83 percent of farmers believe that chemical control methods are necessary. This reliance is largely due to the long-standing use of chemical inputs, which provide quick and visible results. However, 16 percent of farmers believe that alternatives to chemical methods exist. While some recognize the potential of environmentally friendly approaches, the majority prefer an integrated method that combine chemical and sustainable practices for effective pest and disease management.

Regarding market opportunities for organic products, more than half of the farmers (52%) believe there is no proper market for organic products in Sri Lanka. Despite the potential, many farmers struggle to connect with buyers and navigate market dynamics, resulting in underutilization of available opportunities. Additionally, a lack comprehensive knowledge about the benefits and demand for organic products further limits their market engagement.

A significant majority (95%) of farmers expressed a strong need for more training and practical demonstrations on organic agriculture. While they are somewhat aware of its environmental and health benefits, the transition to organic farming remains limited. Key barriers include insufficient understanding of organic fertilizer production, application methods, appropriate usage rates, and overall management practices. Farmers emphasized that gaining more hands-on knowledge and experience, would increase their willingness to adopt organic methods. They specifically requested awareness programmes and training focused on producing high-quality organic fertilizers at the grassroot level.

Finally, 83 percent of farmers perceive organic farming as more complex than inorganic farming. This complexity stems from the reliance on natural processes and the exclusion of synthetic chemicals, which demand more labour-intensive and knowledge-driven practices. Farmers also noted that fully transitioning to organic farming would requires a deeper understanding of soil health, biodiversity, and ecosystem management, as well as compliance with strict certification standards. Additionally, managing organic fertilizers such as compost and poultry manure can be challenging, particularly for larger-scale operations.

5.4 Farmers' Preferences for Organic Fertilizer Application in Paddy Cultivation

Farmers' preferences play a crucial role in the application of organic fertilizers in paddy cultivation. Understanding these preferences helps design targeted interventions that address farmers' practical needs and encourage wider adoption in sustainable practices. The preferred organic fertilizer application methods among farmers were assessed using descriptive statistics, and the results are presented in Table 5.2.

Table 5.2: Farmers' Preferences for Organic Fertilizer Use in Paddy Cultivation

Attribute of Organic Fertilizer Application	Frequency	Percentage
Mode of Organic Fertilizers		
Granular	264	62
Pellets	67	16
Liquid	64	14
Powder	33	8
Total	**428**	**100**
Source of Organic Fertilizers		
Government	172	40
Self-production	126	30
Open market	66	15
Directly from fertilizer companies	64	15
Total	**428**	**100**
Investing in Organic Fertilizers (per ac)		
Rs. 5000-10000	238	56
< Rs.5000	151	35
> Rs. 10000	39	9
Total	**428**	**100**
Share of Land Convenient for Organic Cultivation		
1	282	66
0.5	73	17
0.25	60	14
0.75	13	3
Total	**428**	**100**
Preferred Ratio of Inorganic: Organic Fertilizers		
50%: 50%	159	37
30%: 70%	95	22
70%: 30%	81	19
60%: 40%	54	13
40%: 60%	40	9
Total	**428**	**100**
Necessity for Certification of Organic Fertilizers		
Yes	416	97
Not necessary	12	3
Total	**425**	**100**

Source: HARTI survey Data, 2024

The majority of farmers (62%) preferred granular-type organic fertilizers due to the ease of application and handling. Commonly used organic fertilizers they typically use, such as compost, cow dung, and poultry manure, pose certain challenges in terms of handling and transportation, often requiring significant labour and efforts to carry over long distances. Granular fertilizers address these issues, offering greater convenience. In comparison, 16 percent of farmers preferred pellet-type fertilizers, while 14 percent favoured liquid fertilizers. Farmers showed a lower preference for powdered types of organic fertilizers.

The source of supply of organic fertilizers supply whether through government, self-production, private companies, or the open market is crucial for ensuring consistent access, affordability, and quality. A reliable and balanced supply system supports sustainable agriculture by meeting the specific needs. In the sample, the majority of farmers preferred the government as their primary source of organic fertilizers. Despite expressing concerns about the quality of some fertilizers distributed during the 2021 inorganic fertilizer import ban, they still believe that the government can provide high-quality organic fertilizers with a reliable and continuous supply. Notably, 30 percent of farmers preferred self-producing organic fertilizers rather than relying on the government market sources. They believe they can produce sufficient quantities of high-quality fertilizers themselves. An equal proportion of farmers (15%) opted for the open market and private fertilizer companies as their preferred sources for purchasing organic fertilizers. Overall, the majority (70%) of farmers are willing to procure organic fertilizers from external sources or ventures.

Investing in organic fertilizers reflects farmers' willingness to spend on sustainable farming inputs that enhance soil health and crop productivity. More than half (56%) of the farmers in the sample indicated a preference for spending between LKR 5,000 to LKR 10,000 per acre on organic fertilizers. This suggests a moderate investment in quality organic inputs, indicating that these farmers see value in using organic fertilizers but are constrained by affordability. Among the remaining farmers, 34 percent preferred to spend less than LKR 5,000, reflecting a preference for lower-cost options due to financial constraints or concerns about the high costs of organic fertilizers. About nine percent expressed interest in spending more than LKR 10,000, representing a smaller but significant group that recognizes the potential long-term benefits of higher investments in organic fertilizers for improved soil health and increased yields.

Farmers' preferences regarding the allocation of their paddy lands for organic fertilizer application were explored. According to Table 5.2, the majority of farmers preferred to allocate their entire paddy land for organic fertilizer use. However, they emphasized the need for a continuous supply of inputs and government support to make the transition to organic farming viable. Additionally, 83 percent of farmers expressed a preference to convert half of their paddy land to organic cultivation, indicating a willingness to adopt organic practices while still maintaining some conventional methods.

The ratio of inorganic to organic fertilizers is a critical factor in implementing an integrated nutrient management system for paddy cultivation. From the sample 19 percent of farmers preferred 70:30 ratio while 36 percent of farmers favoured a balanced 50:50 ratio, reflecting an integrated combining both fertilizer types. Additionally, 22 percent of farmers preferred a 30:70 ratio, indicating a stronger preference for relying on organic inputs.

Certification of organic fertilizers ensures that the products meet established standards for quality, safety, and sustainability. In the sample, a vast majority of farmers (97%) expressed a strong preference for certified organic fertilizers in paddy cultivation valuing the assurance that these fertilizers meet specific standards on quality, safety, and sustainability.

5.5 Model Specification for Choice Data

The CL model operates under the assumption that preferences or choices remain consistent across all respondents in the sample. Additionally, it assumes that the independence of irrelevant alternatives (IIA) property holds true. The IIA property implies that adding or removing an alternative does not alter the relative probabilities (odds ratio) between any two existing alternatives (Morrison *et al*., 1999).

The choice cards used in this survey included five attributes, each with different levels. The alternatives presented were Method A, Method B, Method C and Method D for shifting to organic fertilizer. Using CL estimates, the probability of choosing a particular method is determined by the several factors: the mode of organic fertilizer, the source of organic fertilizer, the ratio of organic to inorganic fertilizer applied, certification status of the organic fertilizers and the cost incurred for organic fertilizer. The CL estimates for this context are reported in Table 5.3. The log-likelihood estimate for the model in this sample is -769.18. The model's overall fit was assessed using McFadden's ρ^2[6]. According to Hensher and Johnson (1981), McFadden's ρ^2 values ranging between 0.2 to 0.4 indicate a good model fit. As the McFadden's ρ^2 value (0.0865) for this sample is estimated to fall within the specified range, the conditional logit model is assumed to have a better fit. Although, the overall fit of the estimated CL model for this sample is regarded as a better model fit. According to Hensher *et al.* (2005), the pseudo-R^2[7] value in a choice model differs from the R^2 value used in linear regression models.

The results were presented with respect to the reference attribute levels. The reference attribute levels included liquid form, self-production, 40 percent inorganic and 60 percent organic and no certification requirement. The coefficients of the organic fertilizer attribute levels (solid form, externally produced as source and need a certification) for this sample were found to be significant at the 0.05 α level except the ratios applied when both inorganic and organic fertilizer are applied (inorganic 70% and organic 30%, inorganic 60% and organic 40% and inorganic 50% and organic 50%) and cost incur for organic fertilizer per acre as they reported higher p values, 0.948, 0.611, 0.604 and 0.203 respectively. These findings indicate that paddy farmers prefer solid forms of organic fertilizers, such as pellets and powder. There is also a clear preference for sourcing organic fertilizers from external providers such as private companies and DOA along with ensuring certification for quality assurance, underscoring the importance of product standards in organic farming practices.

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[6] McFadden's ρ^2 value differs from the R^2 values used in linear regression, particularly when significance is observed at lower levels (Hensher and Johnson, 1981).

[7] A good model fit for a choice model is indicated by a pseudo-R^2 value of 0.3, which roughly corresponds to an R^2 value of 0.6 in linear regression models (Hensher, Rose, and Greene, 2005).

Table 5.3: Conditional Logit Estimates for Organic Fertilizer Attributes

Attributes	Coefficient	*P* value
Mode of organic fertilizer (solid)	1.364727*	0.000
Source of organic fertilizer (produced by someone else)	0.3906183*	0.033
Ratio applied when both organic and inorganic fertilizer are used (inorganic 70% and organic 30%)	-0.0126271	0.948
Ratio applied when both organic and inorganic fertilizer are used (inorganic 60% and organic 40%)	-0.1104166	0.611
Ratio applied when both organic and inorganic fertilizer are used (inorganic 50% and organic 50%)	0.1251813	0.604
Certification for organic fertilizers (certified)	0.5496227*	0.002
Cost incurs for organic fertilizer (LKR/ac)	-0.0000468	0.203
Log likelihood / Log pseudo likelihood		-769.18791
ρ^2		0.0865
Number of observations		1536
* Significance at α = 0.05		

Source: HARTI Survey Data, 2024

On the other hand, the results imply that the paddy farmers in this sample prefer the aforementioned attribute levels when transitioning from inorganic fertilizers to organic fertilizers.

The results of the CL model show that paddy farmers exhibit a strong preference is exhibited by paddy farmers for solid form of organic fertilizers, as indicated by the positive and relatively large coefficient compared to the liquid form. This suggests a higher probability of selecting methods that include solid organic fertilizers when transitioning from inorganic option. A positive coefficient for the solid form means it is more likely to be selected by paddy farmers than liquid form of organic fertilizers. Similarly, De Silva *et al.* (2018) found that the powder forms significantly influence farmers' choices in adopting eco-friendly technologies in paddy cultivation aligning with this study's findings. This finding is found to be similar to the findings of this study regarding the solid form. However, Praveen, Singh and Adithya (2023) reported a contradicting result, noting that farmers mostly preferred liquid biofertilizers due to their longer shelf life, and higher utility. Further, the preference for having solid forms of organic fertilizer (granular, pellets and powder) over liquid form was preferred elicited by 85 percent of the paddy farmers in this sample. This finding also supported the results of the CL model estimates.

A positive sign for the requirement of certification for organic fertilizer indicates that methods including this certification level are more likely to be selected by paddy farmers compared to methods without certification when transitioning to organic fertilizer usage in paddy cultivation. This reflects the second highest probability of selecting a method including this attribute level over without certification methods. This finding is confirmed by the majority of paddy farmers (97%), who expressed a preference for certification from any government body to ensure the quality of organic fertilizer with an optimum nutrient content. Certified organic fertilizers could also boost consumer confidence in local organic produce, supporting the growth of domestic organic markets.

The preference for self-production reflects the availability of agricultural residues and organic waste in Sri Lanka. Many farmers already practice composting and recycling organic materials due to limited access to commercial organic fertilizers. Since the impact of the external production of organic fertilizer has a positive impact on choice, methods involving externally produced fertilizer are more likely to be selected. The positive coefficient for external production suggests paddy farmers prefer it over self-produced organic fertilizer. This finding is supported by questionnaire survey, in which 70 percent of paddy farmers expressed a preference for obtaining organic fertilizers from external sources such as the government, the open market or companies.

De Silva *et al.* (2018) noted that purchasing from private markets also has a significantly influences farmers' choices when replacing inorganic fertilizers with eco-friendly technologies in paddy cultivation, second only to regional agricultural service stations. This finding aligns with the results of this study regarding the preferred sources of organic fertilizer. However, Praveen, Singh and Adithya (2023), reported a negative coefficient for private companies as a source, indicating that farmers associate disutility with this option. Consequently, biofertilizer products sourced from private companies are less likely to be chosen by farmers compared to those sourced from government agencies.

According to the CL model estimates, the ratios of inorganic and organic fertilizers used in combination were found to be statistically insignificant, indicating that these ratio levels do not significantly influence farmers' preferences when selecting methods for transitioning to organic fertilizer use in paddy cultivation. In other words, the specific ratio applied does not affect the likelihood of a method being chosen. However, a majority (37%) of the paddy farmers in the sample were found to preferred a balanced 50 percent organic and 50 percent inorganic fertilizer usage. This preference suggests that many farmers are not yet ready to fully shift to organic paddy farming, possibly due to concerns about the reliability, availability or productivity of organic fertilizers compared to chemical alternatives. This finding suggests that policies promoting organic farming should focus on gradual adoption strategies, such as integrated nutrient management (INM) to make the transition more feasible and attractive for farmers.

According to the CL model estimates, the cost incurred for organic fertilizer per acre was found to be statistically insignificant, indicating that it had only a marginal influence on farmers' choices when selecting a method for transitioning to organic fertilizer in paddy cultivation. In other words, the monetary attribute had limited impact on decision-making in this context. As a result, it cannot be reliably used to value other attribute in the model. Since the monetary attribute is found to be insignificant, it presents an opportunity to refine and explore this aspect further in future research. By revising and considering the monetary attribute more comprehensively in subsequent studies, researchers can gain a deeper understanding of its potential impact on farmers' preferences and willingness to pay. This will help provide estimates that are more accurate and improve the overall quality of insights regarding farmers' economic considerations in the transition to organic fertilizer usage. Though this attribute is insignificant, the negative sign of coefficient in this monetary attribute implies that it affects negatively on the utility of selecting a method of transitioning to organic fertilizer with a higher monetary value. In other words, paddy farmers prefer a method of transitioning to organic fertilizer usage with a low cost incurred of organic fertilizer per acre.

In the Sri Lankan context, these findings could provide valuable insights into farmers' preferences for organic fertilizers. Following the former government’s 2021 ban om inorganic fertilizer, there has been a strong national push towards organic agriculture, and increased interest in sustainable farming practices. Overall, these preferences identified in this study suggest that policies and programmes promoting solid organic fertilizers, encouraging self-production and supporting certification processes could be effective strategies for advancing organic agriculture in Sri Lanka.

CHAPTER SIX

Key Findings, Conclusions and Recommendations

6.1 Introduction

This study explores current practices related to organic fertilizer application in paddy cultivation, with a particular focus on farmers' awareness and preferences regarding different organic fertilizer methods. It covers a broad range of paddy farming areas in Sri Lanka, capturing farmers' perspectives on the integration of organic practices into paddy cultivation. The key findings and conclusions of the study are presented in the first part of this chapter followed by recommendations derived from these insights in the latter part of the chapter.

6.2 Key Findings and Conclusions

The average age of paddy farmers in the sample was recorded as 56 years, with 68 percent of the farmers being over the age of 50 and only three percent under the age of 30. These findings clearly indicate that the majority of individuals engaged in farming belong to the older generation, with minimal participation from youth. Attracting younger generations to organic farming is essential for ensuring the long-term sustainability and growth of the agricultural sector. Therefore, the transition from conventional cultivation to organic cultivation practices must be accompanied by the provision of appropriate technologies and other necessary resources to make farming more appealing to younger individuals.

The findings from the sample reveal that for the majority of paddy farmers (68%), crop farming serves is their primary source of income. Furthermore, for more than half of the farmers (55%), agricultural income contributes more than 75 percent to their total household income. This highlights the vital role agriculture plays in sustaining rural livelihoods, providing financial stability, food security and employment within rural communities. Given the significant reliance of these households on agriculture, any transition to organic farming practices must be carefully managed to protect both household income and crop productivity.

The study found that among the farmers who applied organic fertilizers with inorganic fertilizers, 50 percent did so voluntarily, motivated by their own interest and initiative. This is a particularly encouraging finding, as it highlights a positive shift in farmers' attitudes toward adopting more sustainable practices in paddy cultivation.

Furthermore, the study found that 31 percent of farmers were motivated by government officials to apply organic fertilizers, representing more than a quarter of the sample. This highlights the significant role that agricultural extension services and government officers play in promoting the adaption of organic agricultural practices. Their active involvement provides farmers with essential knowledge, resources, and technical support facilitating a smoother transition to sustainable agriculture.

Among the key reasons for applying organic fertilizers to paddy cultivation, the majority of farmers (70%) identified the improvement of soil conditions as their primary motivation. This indicates that farmers who adopt organic fertilizers are generally well-informed about their purpose and benefits, particularly in enhancing soil health. Such awareness reflects a positive trend towards greater understanding and acceptance of organic farming practices.

The findings indicate that farmers predominantly utilized commonly available organic fertilizers within the study area. A significant proportion of farmers (47%) reported using compost fertilizers, while 86 percent relied on solid organic fertilizers. These organic fertilizers were typically sourced from nearby locations within the village. Poultry manure and cow dung were also among the most popular materials used by paddy farmers.

The study revealed that 47 percent of farmers, constituting the majority, utilized organic fertilizers produced by themselves. Despite the challenges associated with organic fertilizer production, many farmers have produced organic fertilizers. Therefore, it is important to support and encourage these farmers to enhance the quality of farm-level organic fertilizers production.

A considerable proportion of farmers (27%) relied on organic fertilizers supplied by the government through ASCs. Following self-production, these farmers turned to government-supplied organic fertilizers, indicating that a segment of the farming community still depends on government support for their fertilizer needs. Although many farmers expressed dissatisfaction with the quality of organic fertilizers distributed during the inorganic fertilizer import ban in 2021, their continued reliance reflects a level of trust in government provision. Therefore, it is imperative to establish a well-structured and efficient mechanism to ensure the consistent and reliable supply of quality organic fertilizers to farmers.

Among the various challenges in organic fertilizer production, the primary issue identified is the insufficient availability of raw materials, affecting 83 percent of farmers. A majority (57%) reported using green manure sources such as *Gliricidia*, *Salvinia*, banana leaves, and weeds, along with other materials like cow dung, paddy straw, crop residues, paddy husk, and poultry manure. Addressing this raw material shortage requires a comprehensive approach that incorporates sustainable practices, efficient resource management, and supportive policy interventions.

Lack of knowledge (28%) and the low quality of organic fertilizers produced by farmers (11%) were also been identified as significant challenges in organic fertilizer production. These findings highlight the critical need for awareness programmes and knowledge dissemination to enhance farmers' capacity to produce high-quality organic fertilizers.

The study identified insufficient space to produce large quantities of organic fertilizer (14%) as a significant challenge, particularly in regions such as Galle and Gampaha.

Addressing this issue requires innovative, resource-efficient, and community-oriented solutions to optimize space use and support sustainable organic fertilizer production. The majority of farmers (76%) independently decided the amount of organic fertilizer to apply in paddy cultivation. However, many lacked knowledge of the correct application rates and often used whatever fertilizer was available to them. Only 16 percent of farmers followed the recommendations provided by agricultural officers regarding organic fertilizer application. Therefore, raising awareness about the appropriate quantities of organic fertilizer for paddy cultivation is essential to improve adherence to recommended practices.

All efforts to use organic fertilizers aim to reduce reliance on inorganic fertilizer and promote an eco-friendly, sustainable agricultural system. Consequently, incorporating organic fertilizers in paddy cultivation is expected to decrease the use of inorganic fertilizers. In this study, 72 percent of farmers who applied organic fertilizers reported reduced their use of inorganic fertilizers, particularly urea. However, a significant majority were unaware of the exact amounts of organic fertilizers applied or the corresponding reduction in inorganic fertilizers required to meet the nutrient requirements of paddy cultivation.

Among the key challenges in using organic fertilizers for paddy cultivation, the primary concern was unavailability of sufficient quantities (58%). Additionally, 32 percent of farmers reported poor quality of organic fertilizers available in the market as a significant issue. These findings highlight the need for a well-structured mechanism to ensure a continuous and reliable supply of high-quality organic fertilizers, particularly through government intervention to ensure a continuous and reliable supply of high-quality organic fertilizers. Furthermore, some farmers noted that organic fertilizer use is labour-intensive, involving application, transportation, handling, and production. Therefore, it is crucial to focus on developing and adopting innovative technologies for producing user-friendly organic fertilizers, such as pelletized forms and biofilm-based formulations.

Several reasons were identified for why some paddy farmers continue to rely solely on organic fertilizers by paddy farmers who continue to rely solely on inorganic fertilizers and do not apply organic alternatives. Many cited the same challenges associated with organic fertilizer use as barriers. Additionally, reluctance to adopt organic fertilizers (32%) and anxiety and mistrust related to the government’s 2021 organic fertilizer policy (11%) were identified as key factors. As a result, many farmers remain concerned about the potential negative impacts of the government's 2021 decision to mandated a complete transition to organic farming. Therefore, it is essential to reconsider such policies, and a gradual transition to organic practices may offer a more practical and sustainable approach.

Farmers demonstrated a good level of awareness regarding key characteristics of organic production practices, such as environmental friendliness, soil health improvement, the absence of harmful residues, and the high nutritional value of organic food. This heightened awareness has emerged recently, reflecting the growing prominence of these topics in public discourse. Farmers are believed to have acquired this knowledge from various sources such as television, newspapers, radio, and social media.

Although most of farmers recognize the benefits of organic agriculture, particularly for terms of environmental and human health, a lack of knowledge regarding organic fertilizer use, production quality, and best practices remains a major obstacle to the adoption. This knowledge gap is critical, as understanding is essential for embracing new technologies. Despite many of farmers in the sample having over 20 years of farming experience, they are often unfamiliar with recent advancements, particularly in organic fertilizer practices. Therefore, raising awareness is a fundamental strategy to encourage wider the adoption of organic fertilizer application.

Farmers' attitudes towards organic farming practices varied. The majority fount it challenging, primarily due to difficulties in sourcing organic materials (71%) and managing weeds, pests, and diseases in paddy fields without chemical inputs (83%). Furthermore, a significant proportion of farmers (95%) emphasized the importance of demonstration and training programmes to enhance knowledge and improve organic farming methods. Additionally, 83 percent of farmers perceived organic farming as more complex compared than conventional, inorganic farming practices.

According to the descriptive statistics on farmers' preferences for various attributes related to organic fertilizer practices, the majority (62%) preferred granular fertilizers. A significant proportion (70%) favoured outsourced organic fertilizers and willing to pay between LKR 5000 to 10000 per acre (56%). Additionally, 66 percent expressed willingness to allocate their entire paddy land for organic fertilizer application. The preferred ratio of inorganic to organic fertilizer was 50:50, as indicated by 37 percent of farmers. Furthermore, 97 percent preferred a preference for certified organic fertilizers, highlighting the importance of quality assurance in organic farming practices.

According to the choice experiment results, paddy farmers demonstrated a preference for solid forms of organic fertilizers, such as pellets and granules. They also favoured obtaining organic fertilizers from external sources, such as private companies and the government, with an emphasis on certification to ensure the quality and reliability of the fertilizers. These findings highlight the importance of incorporating farmers' preferences when promoting organic fertilizer application practices in paddy cultivation, which is essential for developing an effective, eco-friendly fertilizer policy in Sri Lanka.

6.3 Recommendations

The following recommendations aim to promote organic fertilizer application practices and support the adoption of eco-friendly fertilizer usage in paddy cultivation:

1. **Capacity development of paddy farmers and officers on organic agricultural practices**
    - Conduct ongoing education initiatives to enhance farmers' knowledge on organic fertilizer application, production of quality organic fertilizers, introduction of novel organic fertilizer products and balanced nutrient management tailored to local conditions.
    - Create demonstration farms to showcase effective organic farming methods, providing hands-on learning opportunities and highlighting the benefits of organic fertilizer use.
    - Develop and integrate digital tools to efficiently promote and disseminate organic fertilizer application practices among paddy farmers, serving as a practical and alternative solution to traditional extension services.
    - Provide specialized training and capacity building for agriculture officers who work closely with farmers, equipping them to offer technical assistance and expert guidance on organic fertilizer applications and production at the farm level.

2. **Enhance quality organic fertilizer production and availability**
    - Set up community-based organic fertilizer production centers at regional levels to foster collective efforts and improve organic fertilizers availability.
    - Promote advanced and diversified organic fertilizer production and application methods, including vermicomposting, pelletization, granulation, and the incorporation of user-friendly forms such as organic pellets, granules, and biofilm fertilizers. These innovations enhance the efficiency, handling, storage, and field application, thereby supporting more effective organic fertilizers use in paddy cultivation.
    - Develop a well-structured mechanism to ensure continuous supply of quality organic fertilizers in the market.
    - Establish proper quality standards and certification mechanism to ensure the effectiveness and reliability of organic fertilizers.

3. It is important to consider the farmer-level preferences when developing policies and programmes promoting of organic fertilizer use. Since farmers predominantly favour solid fertilizers, particularly granules sourced from certified, reputable suppliers, with high-quality, acknowledging these preferences will enhance the adoption and effectiveness of organic fertilizers in paddy cultivation.

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APPENDICES

Appendix A: Selected Districts, Agrarian Services Centers and Sample Distribution

District	ASCs	Sample
Anuradhapura	Kekirawa	32
	Bulnewa	24
	Galenbindunuwewa	21
	Negampaha	12
Kurunegala	Ganewaththa	32
	Panduwasnuwara	26
	Nugawela	17
Ampara	Sandunpura	34
	Mahaoya	19
	Dehiaththakandiya	4
Gampaha	Mudungoda	21
	Galahitiyawa	17
Galle	Baddegama	37
Badulla	Mahiyanganaya	17
	Nagadeepaya	17
Trincomalee	Kantale	20
	Agbopura	13
Polonnaruwa	Walikanda	33
Vavuniya	Cheddikulam	32
Total		**428**

Appendix B: Experimental Design for Choice Experiment

Card List						
Card ID	**Mode of Organic Fertilizer**	**Source of Organic Fertilizers**	**Ratio (Chemical: Organic)**	**Certification**	**Cost Incurs for Organic Fertilizer (Rs.)**	**Block**
1	Liquid Type	Self-produced	60%-40%	Certified	4700	3
2	Solid Type	Produced someone else	70%-30%	Certified	7830	2
3	Solid Type	Self-produced	50%-50%	Not certified	4700	2
4	Solid Type	Self-produced	40%-60%	Not certified	4700	4
5	Solid Type	Self-produced	50%-50%	Certified	7830	6
6	Solid Type	Produced someone else	70%-30%	Not certified	4700	6
7	Liquid Type	Produced someone else	50%-50%	Not certified	7830	1
8	Liquid Type	Self-produced	40%-60%	Not certified	6270	2
9	Liquid Type	Self-produced	60%-40%	Not certified	7830	7
10	Solid Type	Produced someone else	60%-40%	Not certified	4700	8
11	Solid Type	Produced someone else	40%-60%	Not certified	9400	1
12	Liquid Type	Produced someone else	40%-60%	Not certified	7830	3
13	Solid Type	Self-produced	60%-40%	Certified	6270	1
14	Liquid Type	Self-produced	50%-50%	Certified	9400	8
15	Liquid Type	Produced someone else	40%-60%	Certified	4700	7
16	Liquid Type	Produced someone else	60%-40%	Not certified	6270	6
17	Solid Type	Self-produced	40%-60%	Certified	7830	8
18	Solid Type	Produced someone else	50%-50%	Not certified	9400	3
19	Liquid Type	Produced someone else	50%-50%	Certified	4700	5

20	Liquid Type	Produced someone else	70%-30%	Certified	9400	4
21	Solid Type	Self-produced	70%-30%	Not certified	9400	7
22	Liquid Type	Self-produced	70%-30%	Certified	4700	1
23	Solid Type	Self-produced	70%-30%	Certified	6270	3
24	Liquid Type	Self-produced	40%-60%	Certified	9400	6
25	Solid Type	Produced someone else	50%-50%	Certified	6270	7
26	Liquid Type	Self-produced	70%-30%	Not certified	7830	5
27	Liquid Type	Self-produced	50%-50%	Not certified	6270	4
28	Solid Type	Produced someone else	40%-60%	Certified	6270	5
29	Solid Type	Produced someone else	60%-40%	Certified	7830	4
30	Liquid Type	Produced someone else	70%-30%	Not certified	6270	8
31	Liquid Type	Produced someone else	60%-40%	Certified	9400	2
32	Solid Type	Self-produced	60%-40%	Not certified	9400	5

Appendix C: Cost of Cultivation of Paddy Anuradhapura (Irrigated) – Inorganic Fertilizer

	Cost (Rs/Ac)			
	Labour	**Machinery**	**Material**	**Total**
All nursery preparation	7000			7000
General land preparation	6355			6355
Ploughing	3406	23455		26861
Plastering bunds	12660			12660
Levelling and broadcasting	7957		10028	17984
Inorganic fertilizer application	3324		24778	28102
Weedicides application	1784		2699	4482
Pesticide application	673		4473	5146
Fungicide application	875		3013	3888
Harvesting	10763	22235		32998
Processing	8809			8809
Transportation	2455			2455
Total including imputed cost	**66062**	**45690**	**44990**	**156741**
Total excluding imputed cost	**41131**	**45690**	**44990**	**131810**
Yield and returns				
Average yield (kg/ac)				1731
Price of produce (Rs/kg)				113
Gross income (Rs)				195603
Profit incl. imputed cost (Rs)				38862
Profit excl. imputed cost (Rs)				63793
Unit cost (incl. imputed cost) (Rs/kg)				90.5
Unit cost (excl. imputed cost) (Rs/kg)				76.1

Source: HARTI Survey Data, 2024

Appendix D: Cost of Cultivation of Paddy Anuradhapura (Irrigated) – Inorganic & Organic Fertilizer

	Cost Rs/Ac			
	Labour	**Machinery**	**Material**	**Total**
All nursery preparation	8951			8951
General land preparation	3513			3513
Ploughing	4997	13707		18703
Plastering bunds	11033			11033
Levelling and broadcasting	9024		8008	17032
Organic fertilizer application	3662		2235	5897
Inorganic fertilizer application	2079		16916	18995
Weedicides application	1326		2669	3995
Pesticide application	1739		4065	5805
Fungicide application	4375		4533	8908
Harvesting	10608	31574		42182
Processing	6338			6338
Transportation	1567	2574		4141
Total including imputed cost	**69212**	**47855**	**38427**	**155494**
Total excluding imputed cost	**40665**	**47855**	**38427**	**126946**
Yield and returns				
Average yield (kg/ac)				1925
Price of produce (Rs/kg)				118
Gross income (Rs)				227150
Profit incl. imputed cost (Rs)				71656
Profit excl. imputed cost (Rs)				100204
Unit cost (incl. imputed cost) (Rs/kg)				78.8
Unit cost (excl. imputed cost) (Rs/kg)				64.3

Source: HARTI Survey Data, 2024

Appendix E: Cost of Cultivation of Paddy Kurunegala (Rain-fed) – Inorganic Fertilizer

	Cost Rs/Ac			
	Labour	**Machinery**	**Material**	**Total**
General land preparation	4528			4528
Ploughing	3645	22000		25645
Plastering bunds	10309			10309
Levelling and broadcasting	11844		8716	20560
Inorganic fertilizer application	2395		21292	23687
Weedicides application	3053		4530	7583
Pesticide application	2118		5942	8060
Harvesting	11777	18977		30754
Processing	6114			6114
Transportation	1663	5000		6663
Total including imputed cost	**57445**	**45977**	**40481**	**143903**
Total excluding imputed cost	**17115**	**45977**	**42814**	**105906**
Yield and returns				
Average yield (kg/ac)				1607
Price of produce (Rs/kg)				99
Gross income (Rs)				159093
Profit incl. imputed cost (Rs)				15190
Profit excl. imputed cost (Rs)				53187
Unit cost (incl. imputed cost) (Rs/kg)				89.5
Unit cost (excl. imputed cost) (Rs/kg)				65.9

Source: HARTI Survey Data, 2024

Appendix F: Cost of Cultivation of Paddy Kurunegala (Rain-fed) – Inorganic and Organic Fertilizer

	Cost (Rs/Ac)			
	Labour	**Machinery**	**Material**	**Total**
General land preparation	5743			5743
Ploughing	5658	32674		38331
Plastering bunds	9444			9444
Levelling and broadcasting	12723		8001	20725
Organic fertilizer application	1505		3893	5397
Inorganic fertilizer application	2070		17331	19401
Weedicides application	2138		4933	7071
Pesticide application	2683		5004	7687
Harvesting	10550	11200		21750
Processing	4973			4973
Transportation	2114	927		3041
Total including imputed cost	**59600**	**44801**	**39161**	**143562**
Total excluding imputed cost	**27048**	**44801**	**41161**	**113010**
Yield and returns				
Average yield (kg/ac)				1444
Price of produce (Rs/kg)				104
Gross income (Rs)				150176
Profit incl. imputed cost (Rs)				6614
Profit excl. imputed cost (Rs)				37166
Unit cost (incl. imputed cost) (Rs/kg)				99.4
Unit cost (excl. imputed cost) (Rs/kg)				78.2

Source: HARTI Survey Data, 2024

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