From urban waste to sustainable value chains:
Linking sanitation and agriculture through innovative partnerships

Social and market research on organic waste value chains in Sri Lanka

Prepared by the Institute for Sustainable Futures, Janathakshan and Sabaragamuwa University of Sri Lanka

April 2021

Knowledge and Linkages for an Inclusive Economy Grants Program

Australian Government Department of Foreign Affairs and Trade

This report presents the findings of a study on social and market research of organic value chains. This research was undertaken as part of Activity 2 within the project *From urban waste to sustainable value chains: Linking sanitation and agriculture through innovative partnerships*.

This applied research project in Sri Lanka connects the waste management, sanitation and agriculture sectors through the circular economy, to improve food security and environmental health. This project is a partnership between the Institute for Sustainable Futures at the University of Technology Sydney (UTS-ISF), the International Water Management Institute (IWMI), Janathakshan (GTE) Ltd, Sabaragamuwa University of Sri Lanka (SUSL) and the Sri Lankan Department of Agriculture (DoA).

The project is funded through the Knowledge and Linkages for an Inclusive Economy Grants Program by the Australian Government Department of Foreign Affairs and Trade.

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Citation

Dominish, E., Hettiarachchi, K., Samarakoon, D., Esham, M., Winterford, K. and Jacobs, B., 2020, Social and market research on organic waste value chains in Sri Lanka. Report prepared by Institute for Sustainable Futures at the University of Technology Sydney, Janathakshan (GTE) Ltd and Sabaragamuwa University of Sri Lanka.

Acknowledgments

The authors would like to thank all the research participants, including farmers, compost producers and retailers, Commissioner General of Agrarian Development, Acting Director Western Province Agriculture Department and the AIs and ARPAs for supporting the project by facilitating introductions to the farmers and arranging venues for the research to take place. This research was funded by the Australian Government Department of Foreign Affairs and Trade.

Glossary

AIs	Agriculture Inspectors
ARPAs	Agriculture Research and Production Assistants
DFAT	Department of Foreign Affairs and Trade, Australia
DFS	Dried Faecal Sludge
DS	Divisional Secretariat
IWMI	International Water Management Institute
KMC	Kaduwela Municipal Council
MC	Municipal Council
MSW	Municipal Solid Waste
SUSL	Sabaragamuwa University of Sri Lanka
UTS-ISF	Institute for Sustainable Futures, University of Technology Sydney

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Executive Summary

The project “From Urban Waste to Sustainable Value Chains: Linking Sanitation and Agriculture Through Innovative Partnerships” is funded under the **Knowledge and Linkages for an Inclusive Economy** (KLIE) Grants Program of the Australian Department of Foreign Affairs and Trade (DFAT).

This report presents the findings from the second of four project activities. The main goal of the **social and market research component of the project** is to identify end-user and value chain stakeholder perception of, and demand for, compost derived from municipal solid waste (MSW), including compost enhanced with faecal sludge, for food production. In order to understand perceptions and demand for compost, the research also sought to understand farmer perceptions of existing soil amendments (including chemical fertilisers and animal manure).

The information presented in this report is based on research conducted with farmers and compost producers and retailers. Research was undertaken with farmers in the Kaduwela, Homagama and Seethawaka Divisional Secretariat (DS) Divisions of Colombo District. This research included three components: a questionnaire on demographics, farming practices and current use of soil amendments (compost, chemical fertilisers and animal manure); focus group discussions on perceptions of soil amendments; and a questionnaire on farm variable input costs to construct farming gross margins Interviews were then undertaken with compost producers and retailers, including one from Kaduwela and the remainder from areas beyond the three DS Divisions in Sri Lanka.

Summmary of key research findings

Current use of soil amendments by farming type:

- Most farmers use a mix of soil amendment products, using an average of two types of products.

Current use of compost:

- Around half of all farmers in the study currently use compost. This varies across farming type, with nearly all homegardeners using compost and none of the coconut or pineapple farmers.

Perceptions on chemical fertilisers and animal manure:

- Farmers tend to use chemical fertilisers because of a combination of experience and ease of use, and to a lesser extent price/availability and plant growth response.
- Farmers tend to use animal manure because of a combination of experience, advice and availability.

Perceptions on compost:

- Farmers tend to use compost because they see it as helping to produce healthy food that is free from chemicals, toxins and poisons. Many farmers also commented that compost leads to better quality plants and has benefits for plant growth and yield, particularly if used with chemical fertilisers or animal manure.

Farmer willingness to purchase compost from MSW or made with septage

- Farmers are more willing to purchase compost made from MSW than they are to purchase compost that contains septage, except for coconut farmers who prefer compost with septage.
- **Farmer perceptions on compost samples**
- Within the farming groups there was a wide range of preferences, with almost all the samples selected as the top preference by at least one farmer within the group

- **Compost cost and travel to buy compost**
- There was a wide range in the price that farmers were willing to pay for compost and also distances to buy compost .

Insights from compost retailer and producer interviews

- Increasing demand for Compost; land availability for processing is an Issue; lack of assurance on quality is a barrier to use MSW in composting; compost sales promotion is mostly through peer recommendations; government should give the compost producers/ retailers same benefits and subsidies given to chemical fertilizer importers/ retailers

Implications for future organic waste value chains

Market segmentation: The focus group discussions and gross margin analysis revealed that the values and needs differ between farmer groups (potential market segments). It is unlikely that a single compost product could meet the needs of all potential users. The idea of specialised products was also directly mentioned by paddy and banana farmers in the focus groups.

Education of the use, benefits and application of compost: The concern that the use of compost alone would lead to low yield (i.e. not in combination with chemical fertilisers or animal manure) was mentioned by famers who currently use and don't use compost. This highlights a lack of understanding of the use and benefits of compost, and that it is not a direct replacement for fertiliser.

High quality production and adherence to standards: Farmers from all groups frequently commented that compost in the market is currently poor quality and needs to be produced to a standard. Many commented that they would be willing to use compost made from MSW if it could be guaranteed to be free from contamination. This feedback can be shared with compost producers so that they are informed that there would likely be a higher demand for compost if issues with contamination could be improved.

Pricing: The need for compost to be available at a low / reasonable price was commonly mentioned as a barrier to use by farmers. Compost retailers also noted that most farmers are focused on price (as well as their previous experience with the particular product), and many didn't want to be using chemical fertilisers but were doing so because the price is cheaper than compost.

Improved transport and purchasing options: Difficulties in purchasing and the high cost of transport were mentioned frequently as barriers by farmers, particularly in comparison to chemical fertilisers or animal manure which is more easily available. Farmers indicated they were willing to travel an average of just over 4 km to purchase compost, with many commenting they would travel a similar distance to what they would travel to purchase fertilisers.

Government support: Some farmers indicated that they trusted the government in terms of advice on compost and fertiliser use. This highlights that an increased involvement of the government could help to promote compost use, including support for options highlighted above such as developing recommendations on compost use, on-farm trials or demonstrations, increasing the technical knowledge of extension officers and supporting standards development and certification.

Promote indigenous seed varieties: A small number of farmers mentioned that traditional varieties of seeds respond better to orgnic inputs. Most hybrid seeds are imported and need high doses of chmical fertiliers. There is potential to increase the availability of traditional seeds and promote their use. This is particularly for home gardeners, as they do not require very high yields. Further research on the benefits of traditional seed varieties would also be useful.

1. Introduction

The project “From Urban Waste to Sustainable Value Chains: Linking Sanitation and Agriculture Through Innovative Partnerships” is funded under the **Knowledge and Linkages for an Inclusive Economy** (KLIE) Grants Program of the Australian Department of Foreign Affairs and Trade (DFAT). This project seeks to answer the question: “What are the enablers and barriers for public and private institutions in Sri Lanka to advance the implementation of sustainable and innovative value chains to improve sanitation, health and food security?” The project will establish the knowledge, linkages and policy foundations for enabling local entrepreneurs and policy-makers to implement innovative value chains that determine how organic urban waste and sanitation systems can be transformed to deliver smallholder farmers with agricultural inputs. The policy impact of the project lies in identified synergies between agriculture, health and sanitation sectors to drive organic waste value chains. Through partnerships with the government, research institutes, the private sector and NGOs, as well as an innovative stakeholder engagement strategy, the project aims to establish an evidence base for driving policy dialogue, reducing policy fragmentation and promoting coordinated action.

This project activity was undertaken as a partnership between Janathakshan (GTE) Ltd, Sabaragamuwa University of Sri Lanka (SUSL) and the Institute for Sustainable Futures at the University of Technology Sydney (UTS-ISF). The three project partners co-designed the activity, which was reviewed by the International Water Management Institute (IWMI). Janathakshan and SUSL undertook the primary research in August to November 2020, with remote support from UTS-ISF.

This report presents the findings from the second of four project activities. The main goal of the **social and market research component of the project** is to identify end-user and value chain stakeholder perception of, and demand for, compost derived from municipal solid waste (MSW), including compost enhanced with faecal sludge, for food production. In order to understand perceptions and demand for compost, the research also sought to understand farmer perceptions of existing soil amendments (including chemical fertilisers and animal manure).

The broader project is focused on the Kaduwela Divisional Secretariat (DS) Division of Colombo District, as decided by the project team in the inception meeting in July 2019. This activity was undertaken following the initial phase of Activity 1 of the broader project, an Organic Waste System Assessment of Kaduwela Municipal Council. Given that there are only a limited number of farmers in the Kaduwela DS Division, the geographical boundary of Activity 2 was expanded to include two neighbouring DS Divisions. While this study focuses on a specific region of Sri Lanka, many of the findings are generalisable for the country more broadly, and we have noted instances where the findings are likely to be specific only to the region.

2. Methodology

The information presented in this report is based on research conducted with farmers and compost producers and retailers.

Research was undertaken with farmers in the Kaduwela, Homagama and Seethawaka Divisional Secretariat (DS) Divisions of Colombo District. This research included three components:

- A questionnaire on demographics, farming practices and current use of soil amendments (compost, chemical fertilisers and animal manure);
- Focus group discussions on perceptions of soil amendments; and
- A questionnaire on farm variable input costs to construct farming gross margins

Interviews were then undertaken with compost producers and retailers, including one from Kaduwela and the remainder from areas beyond the three DS Divisions in Sri Lanka.

Details of the methodological approach for these stakeholder groups, the research practices and study area are presented below.

2.1 Methodological Approach

Research with farmers

Site selection and sampling strategy

The geographical area for the research with farmers was determined by an initial desktop review to understand the areas in which compost produced at the Kaduwela Municipal Council (KMC) is distributed and the different types of farmers in this area. As it was found that there is only a small number of farmers in the Kaduwela DS Division, the geographical boundary for the study was expanded to include two neighbouring districts. From this it was decided that a scoping study would be undertaken in Kaduwela DS Division and two neighbouring DS Divisions of Homagama and Seethawaka.

The scoping study was undertaken in September 2019 to understand the farming systems in the three DS Divisions. This was done through field visits to speak with representatives from the Department of Agrarian Services and the KMC compost plant and interviews with eleven farmers.

Based on the findings of this scoping study, Kaduwela, Homagama and Seethawaka were confirmed as the geographical area for the study. More detailed data on farmers in the DS Divisions was obtained through Agriculture Inspectors (AIs) and Agriculture Research and Production Assistants (ARPAs). Details of overall farmer population data were obtained through the Agriculture Department of Western Province.

Data on farmers was provided under the following groups, as shown in Table 1.

Table 1: Farmer types

Agriculture	Vegetables and greens (and others)
	Paddy
	Homegardeners
Plantations	Coconut
	Banana
	Pineapple

The sample size for farmers was determined through a purposeful approach. Initially, a percentage based approach was used to determine a number of farmers in proportion to the total number of each farmer type. However, this was modified based on a range of factors. These included:

- Inclusion of vegetables and greens and home gardeners in each DS Division, because of the importance of this farming type to local food security;
- Prioritisation of farmers in Kaduwela as the DS Division closest to the compost plant, even though this district has a lower number of farmers (allocated a higher percentage than other DS Divisions); and
- Inclusion of at least one focus group for each farming type in each DS Division – however, in Homagama paddy farmers were prioritised as it is the dominant farming type with very few plantations, and in Seethawaka plantations were prioritised as this is the dominant farming type.

For homegardeners and vegetables and greens farmers one focus group was planned with only female participants and one with only male participants. For other farmer types, it was decided that female farmers were to be included within the focus groups when possible, noting that for these farming types, female farmers are not common. Where possible, farmers who receive social assistance payments, or have a family member with a disability were included in focus groups. A summary of the number of focus groups by farming type and district is shown in Table 2

Table 2. Focus groups by farming type and division

	Kaduwela	Seethawaka	Homagama	Total
Vegetables and greens	2	1	2	**5**
Paddy	1	1	2	**4**
Home gardeners	2	2	2	**6**
Coconut	1	2	0	**3**
Pineapple	0	1	0	**1**
Banana	0	1	0	**1**
All	**6**	**8**	**6**	**20**

Research design

To collect both quantitative and qualitative data from farmers, a mixed methods approach was designed. The components of the research included:

- Part 1: A short questionnaire with all farmers to collect quantitative data on use of compost, chemical fertiliser and animal manure, including the volumes used, price paid and distanced travelled, as well as demographic information (undertaken individually with researchers).
- Part 2: A focus group discussion to collect qualitative data on farmers practices and perceptions of compost, chemical fertiliser and animal manure and willingness to use compost with MSW and faecal sludge (with approximately 5 participants per focus group).
- Part 3: A short questionnaire with a select number of farmers to collect data on farm variable input costs to construct gross margins.

Research data methods are included in Annex 8.4

A key element of the focus group design was the use of physical compost samples to be shared with farmers to understand their perceptions and preferences. A ‘compost menu’ was developed with a range of compost products, and the research team collected nine physical samples from six compost producers (see Annex 8.3).

Different numbers of farmers participated in the three components of the research. In Parts 1 and 2, 119 farmers participated. This included 38 vegetable and greens farmers; 34 home gardeners; 25 paddy farmers; 14 coconut plantation farmers; 5 banana farmers; and 3 pineapple farmers (see Table 3). After incomplete responses were removed, 115 farmers were included in the analysis. In Part 3, a subset of 34 famers participated, including 11 vegetable and greens farmers; 9 home gardeners; 7 paddy farmers; 6 coconut plantation farmers; and 1 pineapple farmer (no banana farmers participated).

Table 3. List of focus groups and number of participants for Parts 1 and 2

Focus group	Type of farmer	Division	No of participants
1	Vegetable and greens	Kaduwela	5
2	Vegetable and greens	Kaduwela	7
3	Paddy	Kaduwela	6
4	Home gardeners	Kaduwela	6
5	Home gardeners	Kaduwela	7
6	Coconut plantation	Kaduwela	3
7	Vegetable and greens	Seethawaka	6
8	Paddy	Seethawaka	8
9	Home gardeners	Seethawaka	6
10	Home gardeners	Seethawaka	6
11	Coconut plantation	Seethawaka	7
12	Coconut plantation	Seethawaka	4
13	Banana plantation	Seethawaka	5
14	Pineapple plantation	Seethawaka	3
15	Vegetable and greens	Homagama	6
16	Vegetable and greens	Homagama	8
17	Paddy	Homagama	6
18	Paddy	Homagama	5
19	Home gardeners	Homagama	6
20	Home gardeners	Homagama	6
	TOTAL PARTICPANTS		**115**

Table 4. Number of participants for Part 3

	Kaduwela	Seethawaka	Homagama	Total
Vegetables and greens	4	2	5	**11**
Paddy	2	2	3	**7**
Home gardeners	4	1	4	**9**
Coconut	3	3		**6**
Pineapple		1		**1**
Total	**13**	**9**	**12**	**34**

Engagement with AIs and ARPAs

The project team received support from local AIs and ARPAs to engage farmers as research participants. AIs are officers who report to the Provincial Department of Agriculture and each AI is assigned an area which comprises 10-15 GN divisions[1]. The role of the AI is to provide technical advice to farmers on crop selection, treatment and harvesting etc. The project team approached the Provincial Director Agriculture of Western Province, and following this AIs were assigned to support the project by the Deputy Provincial Director Agriculture - Colombo District.

ARPA's provide grassroots level extension services such as fertiliser provision and plant variety distribution, generally overseeing 203 GN divisions each, under the Department of Agrarian Development. The project team met with the Commissioner General of the Department and obtained permission to work with the ARPAs in the area.

The assigned AIs and ARPAs provided the locations for the focus groups, and invited farmers to participate based on the sampling strategy and ethics protocols inclusive of COVID-Safe measures provided by the research team.

Research team, training and pilot focus group

A three day training workshop was conducted in Colombo with Janathakshan and SUSL researchers, with remote support from UTS-ISF. The first two days of training included an overview of the project objectives and key research questions, research team roles and responsibilities, research methods and principles of ethical research. It included practice sessions of facilitation and note taking of the questionnaires and focus group. The third day was a pilot questionnaire and focus group with 2 focus groups in Kaduwela. Following the pilot, minor modifications were made to the questionnaire and focus group guide.

Data collection

Nine researchers led the research, from Janathakshan (3 researchers) and SUSL (6 researchers). The researchers worked in two groups, with a mix of researchers from the two organisations. Each group had a lead facilitator, sub facilitator, lead note taker and an additional note taker.

The questionnaires and focus groups were conducted over 4 days in August 2020. The Part 1 questionnaire was undertaken individually with a researcher collecting data from individual farmers (for approximately 7-

[1] Grama Niladhari Division, the smallest administrative division in the country includes villages around 300-500 families.

10 minutes per farmer), the Part 2 focus group was then conducted for about 80 minutes including the visual observation of samples and the Part 3 questionnaire was undertaken for approximately 10-15 minutes with each farmer.

Research with compost producers and retailers

Site selection and sampling strategy

Following the research with farmers, interviews were undertaken with compost producers and retailers. Producers and retailers were interviewed from a broader geographic area than the three DS Divisions for the farmer interviews. One producer is located in the Kaduwela DS division, and the remainder are outside of the region, ranging from 10 to 300km from Kaduwela. The broader geographic area for this set of research participants was because it was revealed during the research with farmers, farmers obtain their supplies from producers outside the province. There are also limited producers and retailers in the three DS Divisions, so a broader area allowed for more perspectives from research participants. Five compost producers and five retailers were selected to represent producers and retailers of the same types of sample products that were shared with farmers in the focus groups. They were also selected to include a representation of government and private sector, and medium and large scale organisations.

Research design and data collection

Two semi-structured interview guides were developed. The interviews were undertaken in November 2020 by researchers from the Janathakshan team, mostly remotely (over the phone) with a small number in-person.[2] The responses of the interviewees were recorded into a template as handwritten notes.

Research practices

Ethical research practice

The research was undertaken in line with ethical research practices and approved through UTS-ISF's ethics process.

Farmers and compost producers and retailers were provided with an information sheet which included details about the research, what their participation would involve and how the information collected would be used. Participants were provided with this information before attending the focus group or interview, and the information was reiterated before undertaking the research to confirm the research participants had provided their informed consent. Verbal consent for each participant was recorded by the research team.

Adaptations due to COVID-19

The option to undertake the farmer focus groups remotely was considered by the research team, but it was decided that face-to-face research was the best option for this group of research participants. The farmer questionnaire was developed in March 2020. The research was initially planned to take place in April or May 2020, but it was postponed to avoid risk to the research participants and research team from the emerging COVID-19 pandemic, and later because of a country-wide lockdown. The focus groups were undertaken in August 2020 when the research team felt it was a safe period to travel. During August 2020 Sri Lanka had no active COVID-19 cases, and it had been two months since the removal of the lockdown.

A COVIDSafe Research Activity Risk Assessment Checklist was completed for the face-to-face component of the research as part of UTS-ISF's research ethics process. The level of interaction and time spent with

[2] 5 compost producers - over the phone; 1 retailer - over the phone; and 4 retailers – in person

the groups was adjusted from the original plans. Measures were introduced to ensure safety, including social distancing, undertaking focus groups outdoors where possible or in a ventilated space, providing hand sanitiser and wearing of face masks by participants and the research team. Participants were advised to not attend if they had been in contact with a COVID-19 case in the last 14 days or had symptoms, and this was confirmed with participants on arrival. Records were kept of all participants including the time and location.

The retailer and compost producer interviews were conducted remotely and in-person.

Method of analysis

Notes were taken by hand during the questionnaires, focus groups and interviews. All raw data was then entered into word and excel, and a data cleaning process was undertaken. Quantitative data were analysed, with a focus on looking for differences between farmer types or men and women. Thematic analysis was undertaken for qualitative data (such as farmer perceptions) and the findings were grouped in terms of themes that emerged as important.

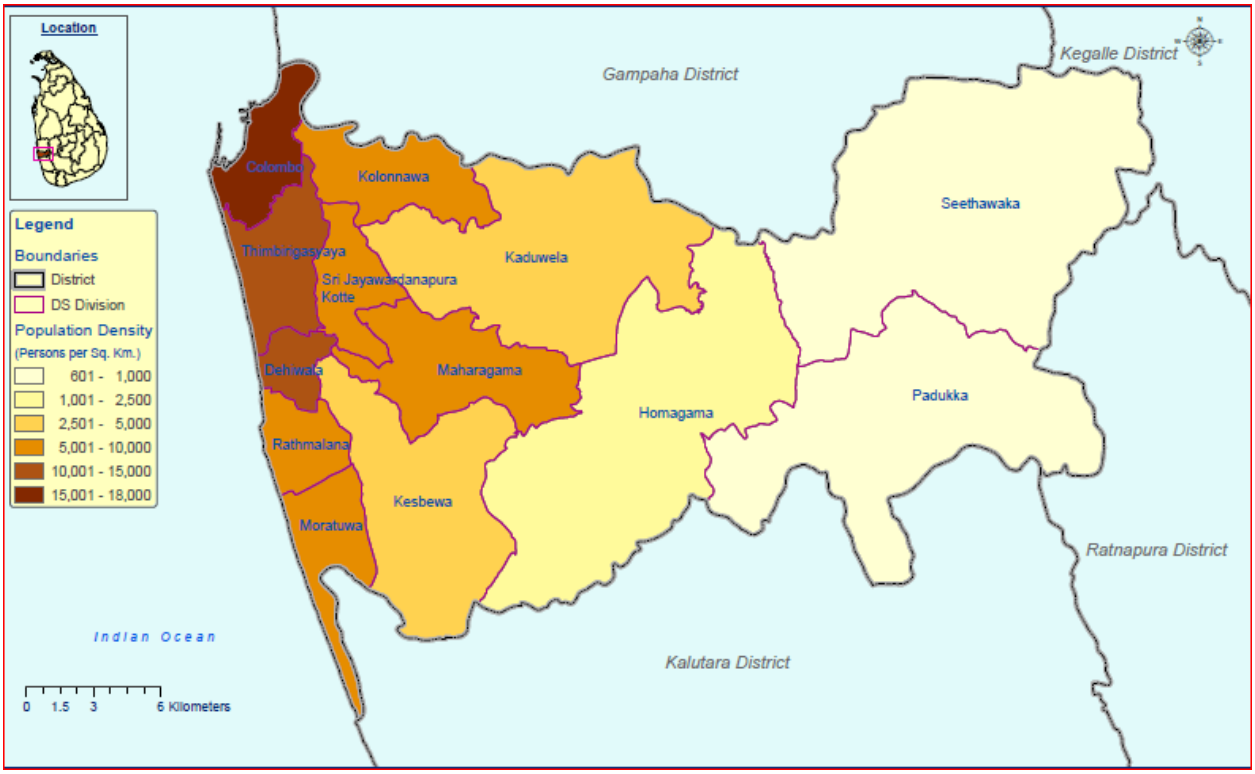
2.2 Study area

The Kaduwela, Homagama and Seethawaka DS Divisions are administered by the Colombo Administrative District of the Western Province. Kaduwela, Homagama and Seethawaka DS Divisions are three of the largest sized divisions, out of 13 DS divisions in Colombo District (see Figure 1).

The total population of the DS Divisions is approximately 260,000 in Kaduwela, 264,000 in Homagama and 121,000 in Seethawaka.[3] The three DS divisions are situated in the Kelani River flood plain and fall under the wet lowland agro ecological zone which receives over 1500 mm of annual rain fall.

These three districts have lower population density and higher levels of agriculture compared to other DS Divisions in the District. They are considered peri-urban areas, however they are rapidly becoming urbanised with new residents moving from more rural districts. The area also has a high number of people who travel to the Colombo city area during day for work.

Figure 1: Study area map (Source: Population Atlas of Sri Lanka 2012, Department of census and statistics, Ministry of Finance and Planning)



Data on the number of farms and estimated farming area is provided in Figure 2 and Figure 3.

Homegardening is the most common type of farming across the three DS Divisions based on the number of farmers. In terms of farming industry, Seethawaka has a high number of plantations, whereas Homagama is dominated by paddy farming. Kaduwela also has a high number of poultry farmers.

In addition to agriculture, Kaduwela and Seethawaka have industries such as beverage and garment manufacturing, while Homagama is planned to be developed as an education hub.

[3] Resource Profile 2017 – Kaduwela Divisional Secretariat, Resource Profile 2017 – Homagama Divisional Secretariat, Divisional Secretariat Seethawaka – website

Figure 2: Number of farms in Kaduwela, Homagama and Seethawaka DS Divisions

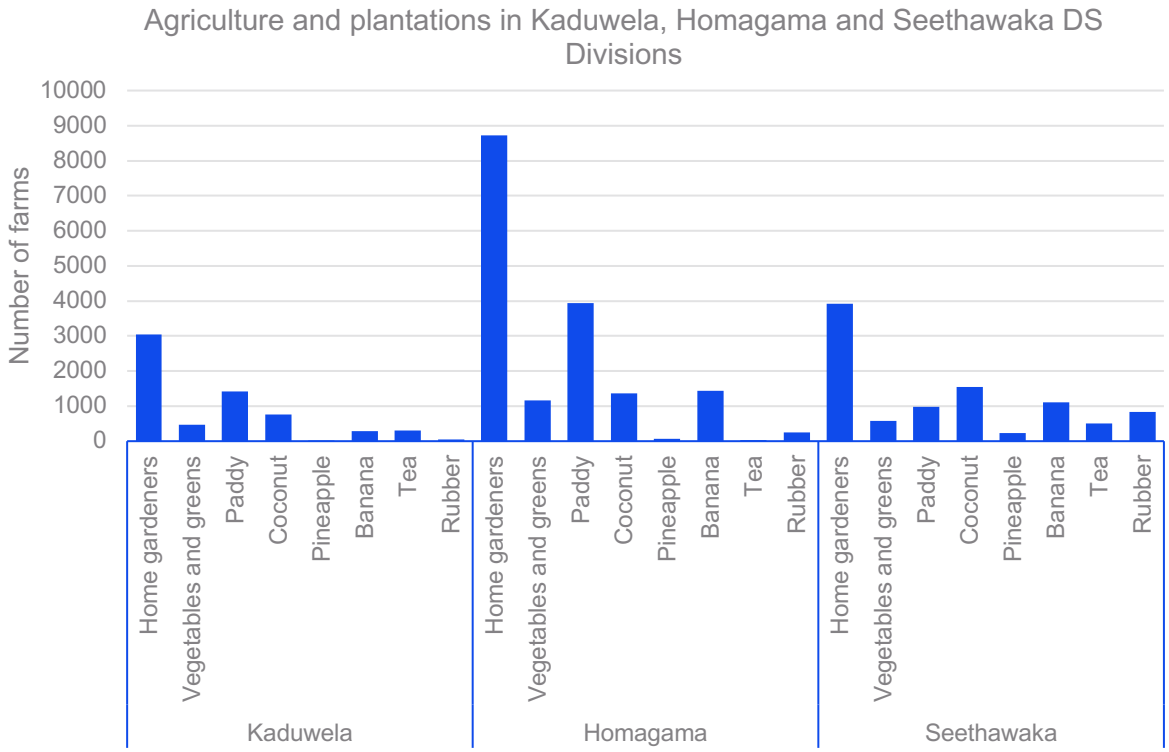
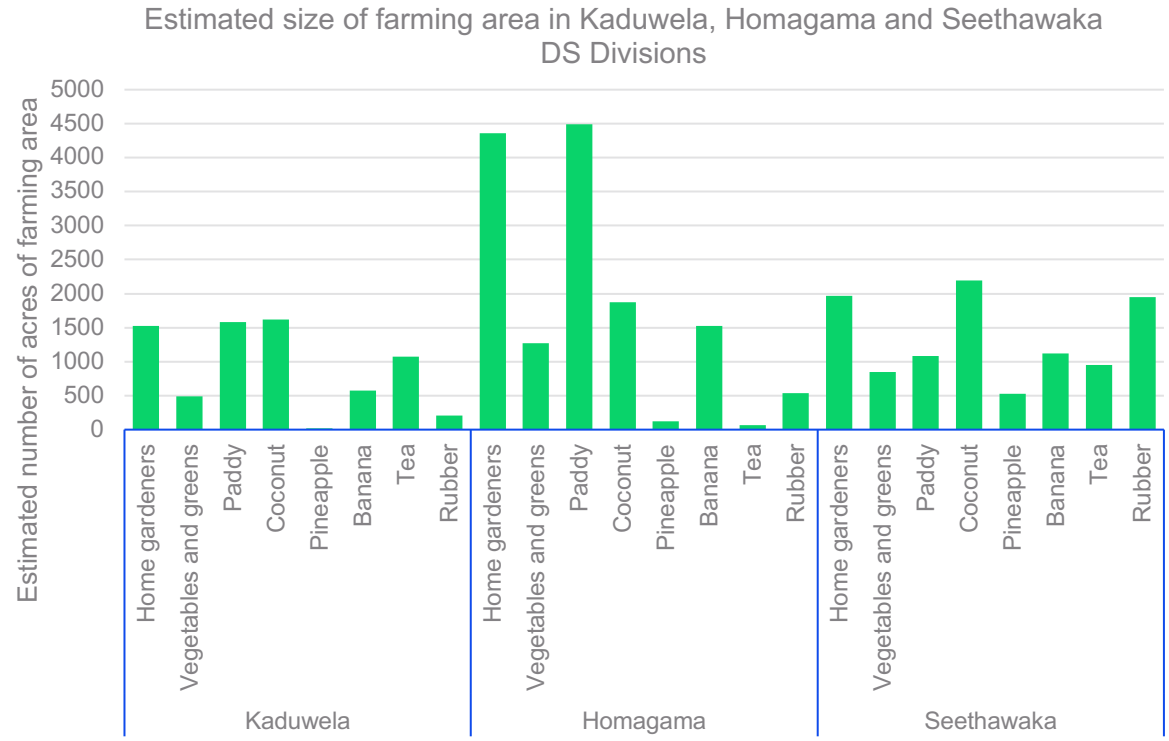


Figure 3: Estimated size of farming area in Kaduwela, Homagama and Seethawaka DS Divisions



2.3 Study objectives

The overall goal of this study is to identify end-user and value chain stakeholder perception of, and demand for, compost derived from municipal solid waste (MSW), including compost enhanced with dried faecal sludge (DFS) from septage, for food production. This includes the following key areas of inquiry:

Practices and perceptions on chemical fertilisers and animal manure

- What are farmers' current practices in relation to chemical fertilisers and animal manure? What products do they use?
- Why do farmers use these products? (e.g. form, price, nutrient content, ease of use, crop yield, past experience, recommendations)
- How do these practices and perceptions differ between farmer types and other criteria, such as gender?

Practices and perceptions on compost

- What are farmers' current practices in relation to compost? What products do they use?
- If farmers use compost, why do they use it? (e.g. form, price, nutrient content, ease of use, crop yield, past experience, recommendations)
- If farmers do not use compost, why do they not use it?
- How do these practices and perceptions differ between farmer types and other criteria, such as gender?

Willingness to use compost made from MSW and septage (dried faecal sludge (DFS))

- Are farmers willing to use compost made from MSW, and why or why not?
- Are farmers willing to use compost made with dried faecal sludge, and why or why not?
- Which specific compost products are farmers most interested in, and why?

Practices and perceptions relating to cost of compost

- What distance are farmers willing to travel to purchase compost?
- How much are farmers willing to pay for compost?
- How does this differ to current practices?

Barriers and enablers

- What are the current barriers to farmers using compost?
- What would help farmers to use compost?

3. Research participants

3.1 Farmer research participants

Demographics

- **Gender split:** 64% of participants are female and 36% male, however this varies between farmer types (see Table 5). A high proporttion of home gardeners, vegetables and greens, coconut and banana farmers are female, while paddy and pineapple farmers and predominately male.

Table 5: Farming type and gender split of farmer research participants

	All farmer types	Home gardeners	Vegetables and greens	Paddy	Coconut plantation	Banana plantation	Pineapple plantation
All farmers	115	33	35	25	14	5	3
Female	74	30	22	7	9	5	1
Male	41	3	13	18	5	0	2

- **Farmer age:** 6% of participants are 40 years old or younger, 28% 40-49 years, 25% 50-59 years, 41% 60 years or older
- **Number of family members:** 20% of participants have 2 or fewer family mumbers, 36% 3-4 family members and 44% 5 or more family members
- **Education level:** 8% of participants have primary level education, 20% secondary education, 34% OL, 32% AL and 6% above
- **Samurdhi or other benefits:** 17% of participants receive samurdhi or other benefits, 83% receive no benefits
- **Family members with a disability:** 10% of participants have a family member with a disability, 90% do not
- **Land ownership:** 81% of participants own their land, 10% rent land, 5% both own and rent and 3% have another land ownership model

Farming practices

- **Farm size:** Homegardeners have an average farm size of 12.5 perches and vegetables and greens farmers have an average size farm of approximately 100 perches (or 0.6 acres).[4] Paddy, coconut and banana farmers have an average sized farm close to 1 acre. Pineapple farmers who participated in this study have much larger sized farms, with an average of 35 acres.

[4] Note there are 160 perches to 1 acre

Table 6: Maximum, mininum and average farm sizes of farmer reserach participants

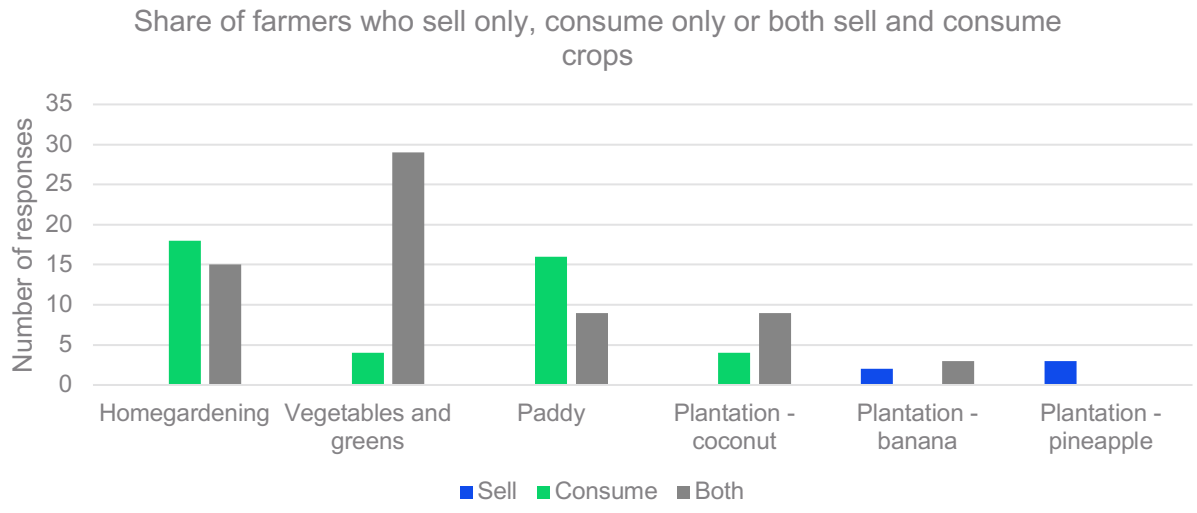
	Perches			Acres		
	Homegardeners	**Vegetables and greens**	**Paddy**	**Coconut plantation**	**Banana plantation**	**Pineapple plantation**
Maximum	80.0	400.0	800.0	4.0	2.5	55.0
Average	12.4	98.7	168.0	1.1	0.8	35.0
Minimum	1.5	1.4	32.0	0.0	0.1	5.0

- **Length of time farming:** 60% of farmers have been farming for more than 10 years, 10% for between 6 and 10 years and 30% for less than five years.
- **Time allocation for farming:** 60% of farmers farm full time and 40% part time.
- **Share of farmers who sell only, consume only or both sell and consume crops:** The majority of farmers both sell and consume their produce (see Figure 4 and Table 7). More than half of homegardeners and paddy farmers only consume their produce and do not sell any. Only banana (40%) and pineapple (100%) plantation farmers have a significant share of farmers only sell their produce and do not consume themselves.

Table 7: Share of farmers who sell only, consume only or both sell and consume crops

	All farmers	**Home-gardeners**	**Vegetables and greens**	**Paddy**	**Coconut plantation**	**Banana plantation**	**Pineapple plantation**
Sell	4%	0%	0%	0%	0%	40%	100%
Consume	37%	55%	11%	64%	29%	0%	0%
Both	57%	45%	83%	36%	64%	60%	0%

Figure 4: Share of farmers who sell only, consume only or both sell and consume crops



- **Market details:** Approximatley half of vegetables and greens farmers sell their produce to local markets. Coconut farmers sell most frequently to private buyers / wholesalers, followed by at their own shop or farm or directly to nearby households. Banana farmers sell most frequently to local markets or

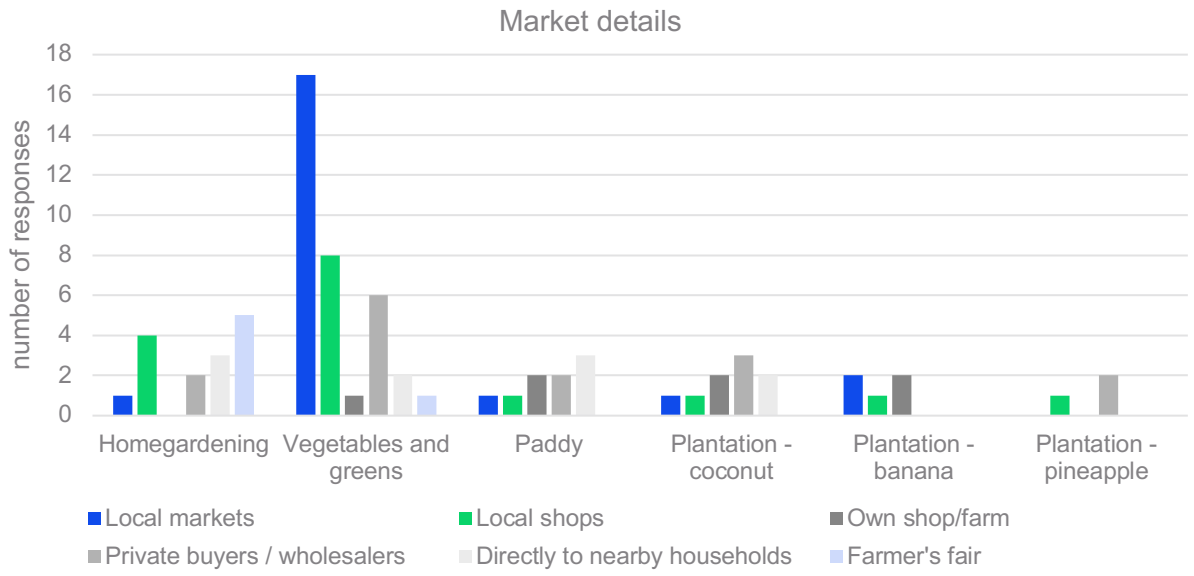
at their own shop or farm. More than half of pinapple farmers sell to private buyers / wholesalers.

As noted above, more than half of homegardeners and paddy farmers only consume their produce and do not sell any. For those who sell, homegardeners sell most frequently to farmer's fairs or local shops, and paddy farmers most commonly sell directly to nearby households.

Table 8: Market details

	All farmers	Home-gardeners	Vegetables and greens	Paddy	Coconut plantation	Banana plantation	Pineapple plantation
Local markets	19%	3%	49%	4%	7%	40%	0%
Local shops	14%	12%	23%	4%	7%	20%	33%
Own shop / farm	6%	0%	3%	8%	14%	40%	0%
Private buyers / wholesalers	13%	6%	17%	8%	21%	0%	67%
Directly to nearby households	9%	9%	6%	12%	14%	0%	0%
Farmer's fair	5%	15%	3%	0%	0%	0%	0%
Does not sell	*37%*	*55%*	*11%*	*64%*	*29%*	*0%*	*0%*

Figure 5: Market details



- **Yearly sales:** There is a very wide range in the total sales made by farmers (see Table 9).

Table 9: Yearly sales of produce (Sri Lankan Rupees)

	Home-gardeners	Vegetables and greens	Paddy	Coconut plantation	Banana plantation	Pineapple plantation
Maximum	125,000	1,476,000	140,000	735,000	240,000	7,000,000
Average	30,000	232,655	57,722	185,785	167,200	2,900,000
Minimum	1,800	192	1,600	2,400	93,600	500,000

4. Findings from farmer research

4.1 Current use of compost, chemical fertilisers and animal manure

Current use of soil amendments by farming type:

- Most farmers use a mix of soil amendment products, using an average of two types of products.
- Homegardeners and banana farmers have high rates of compost use, and many also use animal manure, chemical fertilisers and organic matter.
- Chemical fertilisers are used at high rates by vegetables and greens, paddy and pineapple farmers.
- Many vegetables and greens farmers also use animal manure in addition to chemical fertilisers.
- Coconut farmers frequently use animal manure, often in combination with chemical fertiliser or organic matter.

Current use of compost:

- Around half of all farmers in the study currently use compost. This varies across farming type, with nearly all homegardeners using compost and none of the coconut or pineapple farmers.
- Overall female respondents are more likely to use compost compared to male respondents; however this is because homegardeners have high rates of compost use and more than 90% of homegardeners are female. There is no difference in compost use between female and male respondents from other farming types.
- Farmers with a higher education level are more likely to use compost, however homegardeners are also likely to have higher education levels which influences this.

In the focus group discussions, farmers were asked which soil amendment products they currently use – categorised as compost, chemical fertilisers, animal manure and organic matter (defined as organic products that are used directly, rather than as a compost, such as hay, paddy straw, coconut husk, leaf litter and kitchen waste) and bio-liquid fertiliser (digestate from biogas units and plant extracts).

Number of farmers who use compost, chemical fertilisers, animal manure and organic matter

The soil amendment products used by farmers are presented by farming type as number of responses (Figure 6) and percentage of responses (Figure 7), and collated data are presented in Annex 8.1. As described in Section 2.1, the sample size for banana and pineapple farmers is much smaller than for the other farming types, so care should be taken in applying results from these farming types more broadly.

- Homegardeners had very high rates of compost use (94%), and more than 50% also used animal manure and more than 40% used chemical fertilisers and organic matter.
- Vegetables and greens farmers had very high rates of chemical fertiliser use (91%) and three quarters also used animal manure.
- Paddy farmers had very high rates of chemical fertiliser use (96%), but low rates for other fertiliser types
- Coconut farmers had very high rates of animal manure use (93%) and none reported using compost.
- Although only a small sample size, banana farmers had high rates of compost use (80%) and pineapple farmers only reported using chemical fertiliser.

Figure 6: Use of compost, chemical fertiliser, animal manure, organic matter and liquid fertiliser – categorised by farming type (number of responses)

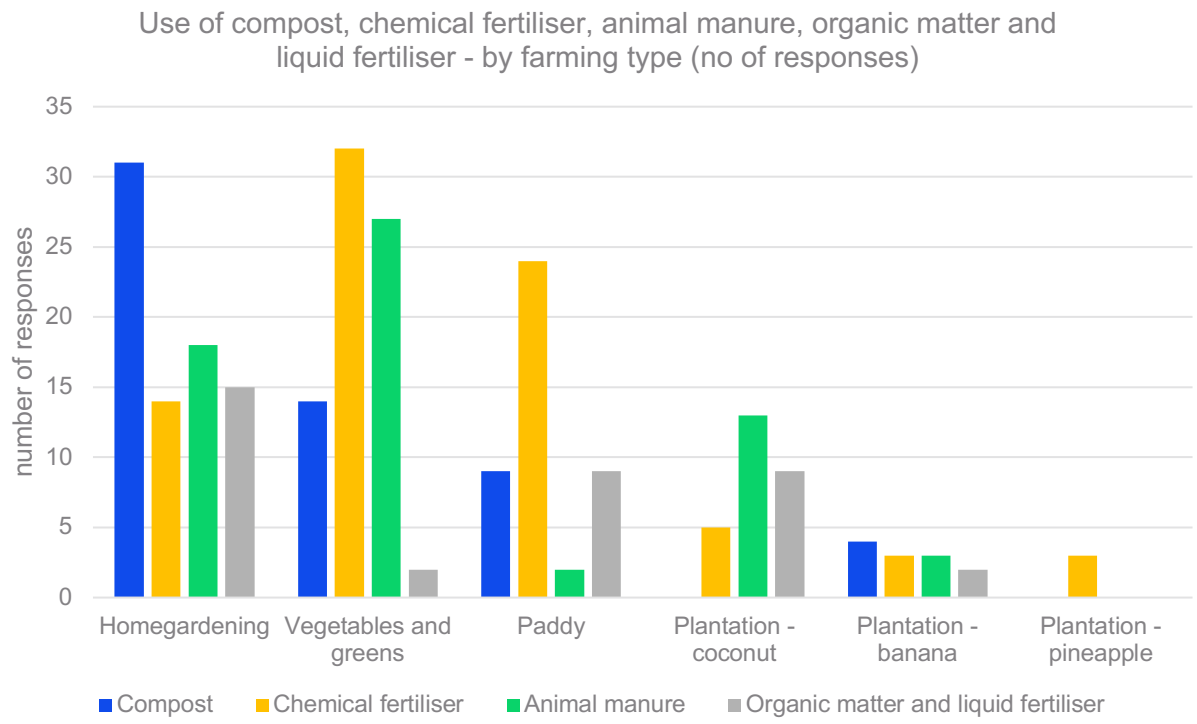
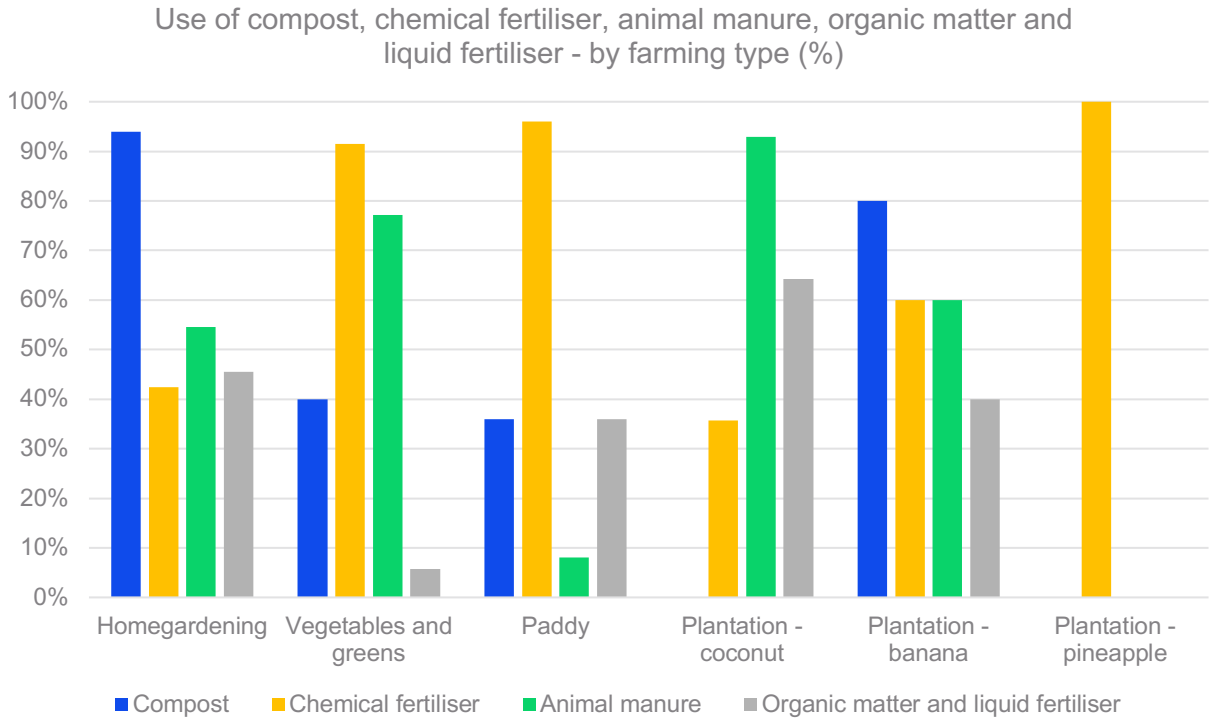


Figure 7: Use of compost, chemical fertiliser, animal manure, organic matter and liquid fertiliser – categorised by farming type (%)



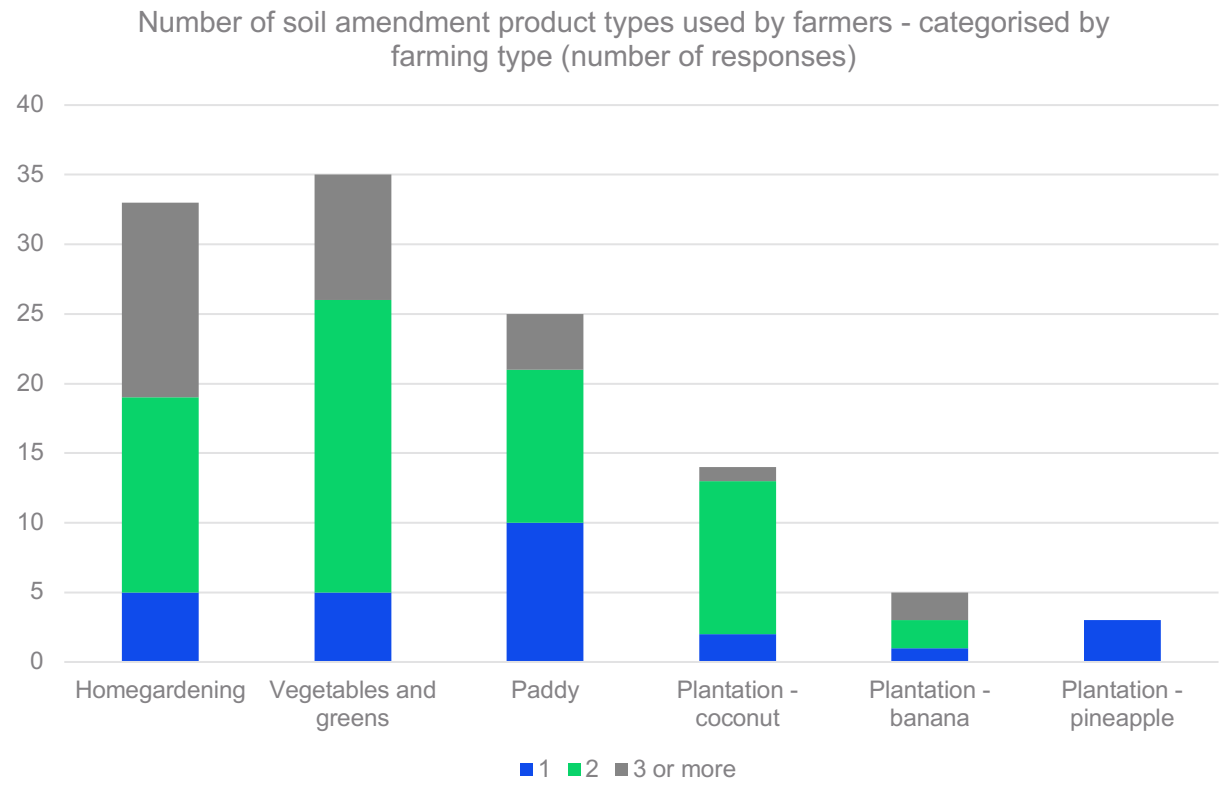
Number of soil amendment products used by farmers

Most farmers use a range of soil amendment products, on average using two product types (noting that farmers may use multiple forms of each type, such as different brands of chemical fertilisers or types of animal manure or organic matter).

Key findings include:

- Homegardeners and banana farmers used the largest number of product types, with more than 40% of farmers using three or more types of products. They typically used compost, along with one or two other types of products.
- Vegetables and greens farmers and coconut farmers typically use two types of products; vegetables and greens farmers typically used chemical fertiliser and animal manure and coconut farmers typically used animal manure in combination with either chemical fertiliser or organic matter.
- Around 40% of paddy farmers exclusively used one product (chemical fertiliser), and 44% used two products.

Figure 8: Number of soil amendment product types used by farmers - categorised by farming type (number of responses)



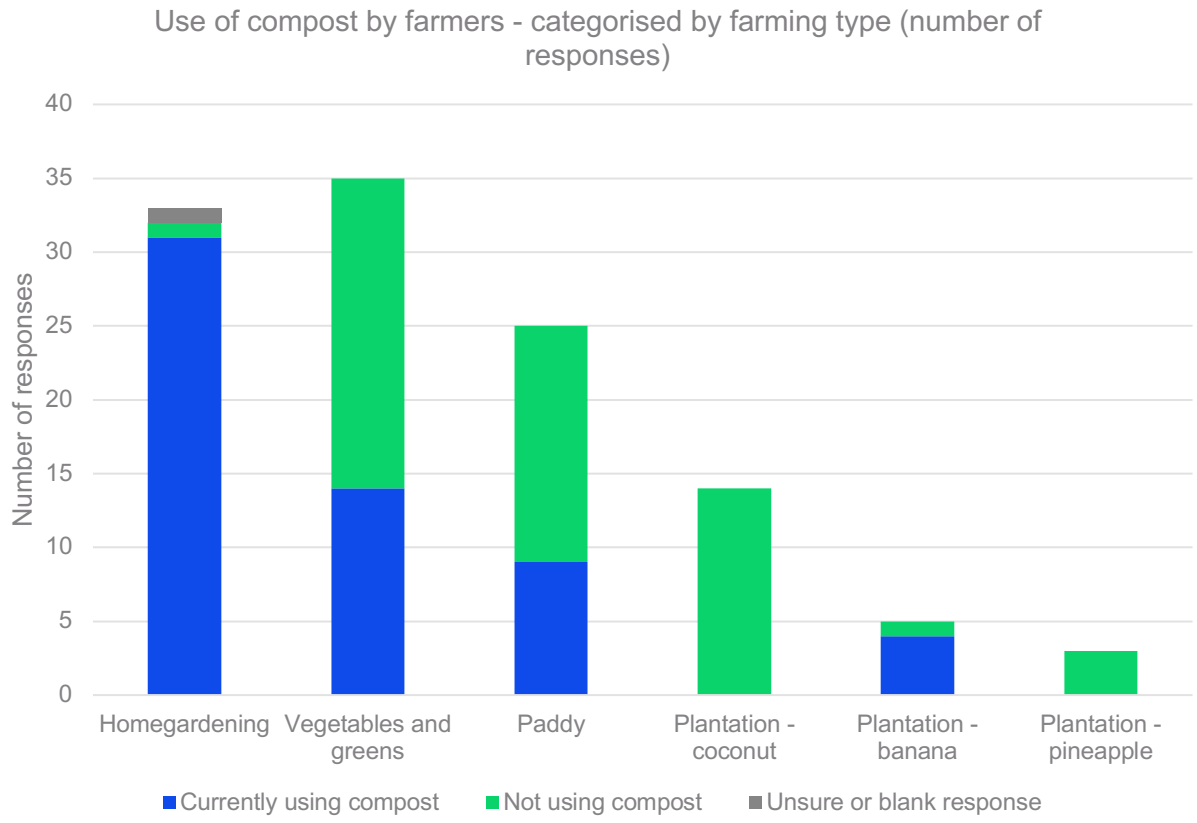
Number of farmers who use compost

Around half of all farmers in the study currently use compost (50%).

Number of farmers who use compost – categorised by farming type

- Homegardeners are the most likely to use compost (94% of 33 responses), followed by banana farmers (80% of 5 responses).
- Just over one-third of vegetable and greens farmers (40% of 35 responses) and paddy farmers (36% of 25 responses) reported using compost.
- No coconut farmers or pineapple farmers reported they are currently using compost.

Figure 9: Use of compost by farmers – categorised by farming type (number of responses)

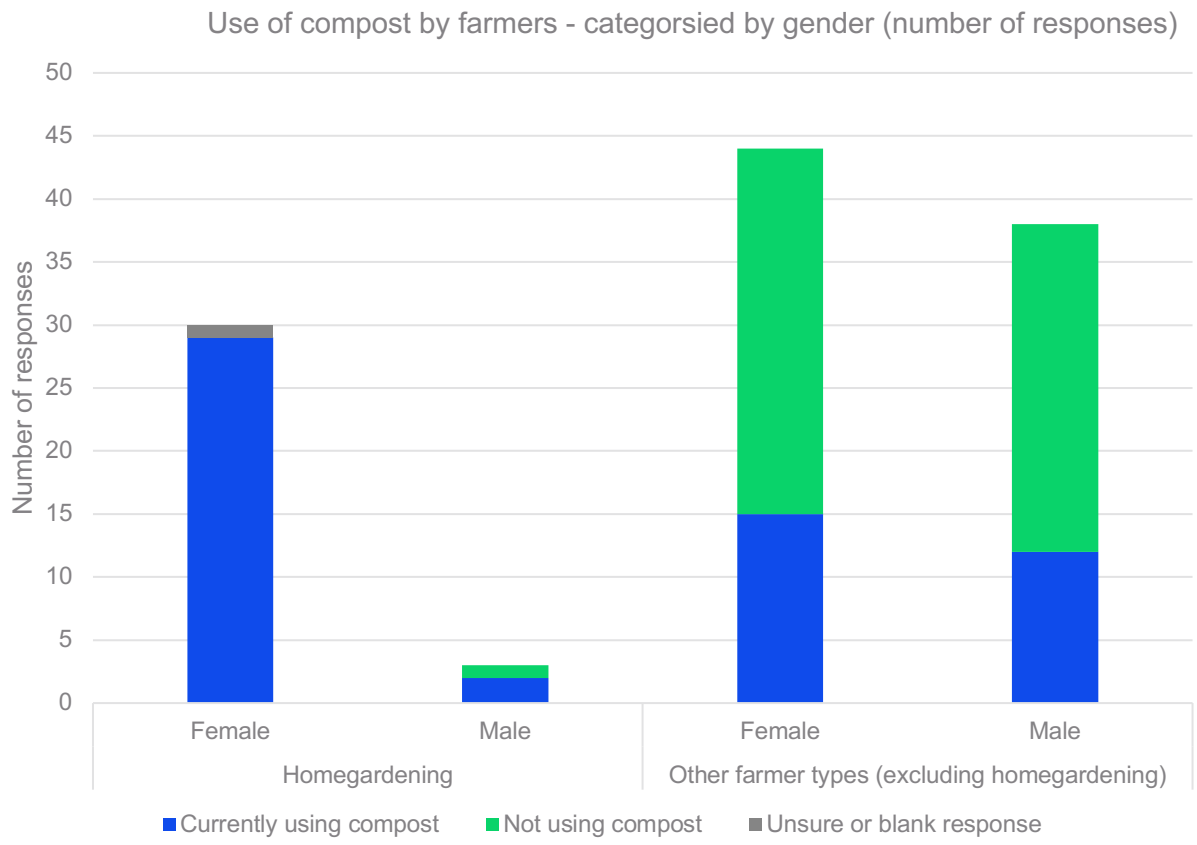


Number of farmers who use compost – categorised by gender

The number of farmers who use compost was analysed by gender, as shown in Figure 10. Key finding include:

- The majority of homegardeners in the study were female (30 out of 33 responses), and 97% are currently using compost. There were only three male homegardeners, 2 of which used compost and one which did not.
- Of the other farmer types (vegetables and greens, paddy and plantations), there was no difference in compost use linked to gender, as 34% of female respondents and 32% of male respondents reported that they used compost.
- Although overall female respondents are more likely to use compost (59% of 74 responses), compared to male (34% of 41 responses), this is because homegardeners have high rates of compost use, and more than 90% of homegardeners are female.

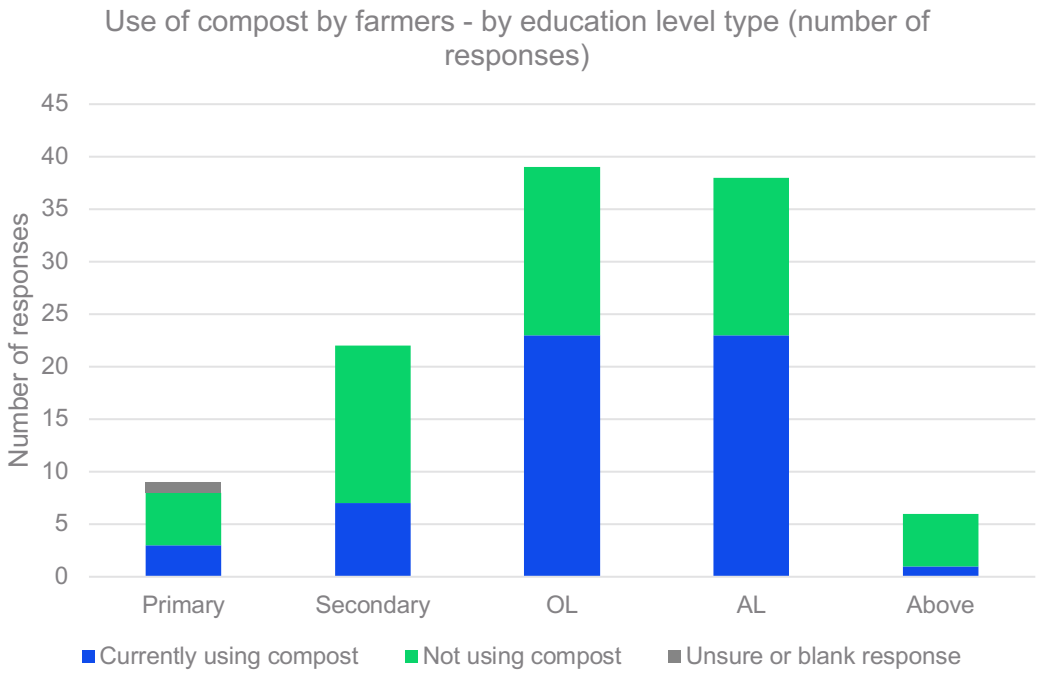
Figure 10: Use of compost by farmers – categorised by gender (number of responses)



Number of farmers who use compost – by education level

- Farmers with a higher education level are more likely to use compost. This is somewhat influenced by the high proportion of homegardeners who have O Levels or above (88%) compared to other farming types (66%).

Figure 11: Use of compost by farmers - by education level (number of responses)



4.2 Farmer perceptions on compost, chemical fertilisers and animal manure

Perceptions on chemical fertilisers and animal manure:

- Farmers tend to use chemical fertilisers because of a combination of experience and ease of use, and to a lesser extent price/availability and plant growth response.
- Farmers tend to use animal manure because of a combination of experience, advice and availability.

Perceptions on compost:

- Farmers tend to use compost because they see it as helping to produce healthy food that is free from chemicals, toxins and poisons. Many farmers also commented that compost leads to better quality plants and has benefits for plant growth and yield, particularly if used with chemical fertilisers or animal manure.
- Some farmers who use compost indicated that it can lead to damage from wild animals, worms and insects and had a tendency to spread diseases.
- Farmers who do not use compost commented that this is because of a lack of experience, lack of trust in the product and the high price and large quantities required.
- The price of compost was a common concern for those who do not use it, but of farmers who use it, price was only mentioned by coconut farmers.
- The low yield from compost if used alone (not in combination with chemical fertilisers or animal manure) was mentioned by both those compost users and non-users – highlighting lack of understanding that it is primarily a soil amendment rather than a fertiliser.
- Concerns about the quality of compost were mentioned more often by those who do not use it. Farmers who use compost were more concerned about the quality of chemical fertilisers.

Differences between farming types:

- Vegetable and greens farmers are mainly concerned about plant growth and yield (which was frequently suggested as a reason for using chemical fertilisers, and to a lesser extent manure and compost)
- Homegardeners were generally concerned about human health affects (commonly noted as a reason for using compost, and a reason for not using chemical fertilisers).
- Paddy farmers and coconut farmers are often concerned about price and availability (paddy farmers noted that they receive low priced or free chemical fertilisers and coconut farmers receive low priced or free poultry manure from neighbouring farms.

Farmers were asked to discuss the reasons they use the products that they are currently using. The following sections describe the key comments and a summary of all comments is presented in Annex 8.1.

Farmer perceptions on chemical fertilisers

Comments from farmers who use chemical fertilisers

Chemical fertilisers were used by a high number of vegetables and greens, paddy and pineapple farmers, and often used by homegardeners, banana and coconut farmers. Farmers who use chemical fertilisers tend

to do so because of a combination of **experience and ease of use**, and to a lesser extent **price/availability** and **plant growth**. Comments from specific farmer groups include:

- Vegetables and greens farmers frequently commented that they used chemical fertilisers because of **nutrient content, plant growth and yield**, and a small number of homegardeners made similar comments.
- **Past experience** with chemical fertilisers was frequently mentioned by vegetables and greens and paddy farmers. Paddy farmers also commented that chemical fertilisers was **recommended by the government**.
- Paddy farmers highlighted that they used chemical fertilisers because they received **free, low priced or subsidised fertiliser** from the government.
- Pineapple farmers felt that only chemical fertilisers were **proven effective** and they had no other option.
- **Ease of use** of chemical fertilisers was mentioned by vegetable and greens, paddy and banana farmers. Vegetables and greens and paddy farmers also suggested that the available varieties of **seeds were adapted for use with chemical fertilisers**.

Several farmers who use chemical fertilisers also commented that they use lesser amounts of chemical fertilisers for reasons including:

- Several coconut farmers mentioned that they had **supply issues and found it difficult to buy chemical fertilisers** (in contrast to paddy farmers).
- One paddy farmer commented they use it less because of **health effects**.
- One banana farmer commented that it decreases fruit **quality and taste**.

Comments from farmers who do not use chemical fertilisers

Farmers who do not use chemical fertilisers also provided their reasons for not using it, including:

- Many homegardeners felt that chemical fertilisers contains **toxin and poisons**, and using them is **harmful for human health**.
- One paddy farmer commented that they don't use it because it **promotes weed growth**.
- One banana farmer commented that if chemical fertiliser is **used excessively plants will rot and die**.

Farmer perceptions on animal manure

Comments from farmers who use animal manure

Animal manure was used at very high rates by coconut famers, and often by vegetables and greens, homegardeners and banana farmers. Farmers who use animal manure tend to do so because of a combination of **experience, advice and availability**. Comments from specific farmer groups include:

- **Price and supply** were the main reasons mentioned by coconut farmers for using animal manure, as they can easily obtain it for free or a low price including from nearby poultry farmers. Several vegetables and greens farmers also commented that it was **easy to find and purchase**.
- Many vegetables and greens farmers noted that they used animal manure because of **plant growth and nutrient content**, and that it was particularly important for rapid growth in the primary stage (with

chemical used for secondary growth). A small number of coconut farmers also mentioned its nutrient content and homegardeners its effectiveness on crops.

- **Past experience and trust** was mentioned by a small number of homegardeners, vegetable and greens, coconut and banana farmers. Some vegetables and greens farmers suggested that animal manure was **recommended by the government**, and coconut farmers that it was recommended by the coconut board or that they had heard about it or seen good results at a friend's farm.
- Homegardeners commented that they used it as it **doesn't contain anything toxic**.

Paddy and pineapple farmers did not make any comments and rarely used animal manure.

Farmers perceptions on compost

Farmers were asked to discuss why they use or don't use compost. The following sections describe the key comments and a summary of all comments is presented in Annex 8.1.

Comments from farmers who use compost

Farmers who use compost tend to use it because they feel it can be used for **producing healthy food, free from chemicals, toxins and poisons**. The second most common reason was that it **produces better quality plants** and jas **benefits for plant growth and yield**, particularly if used with chemical fertilisers or animal manure.

- Many homegardeners emphasised that compost is **natural**, that it **does not contain chemicals, toxins and poisons** and that they want to **produce healthy food**. Some also highlighted that they were trying to not use chemicals and adopt organic farming as much as possible as the **harvest is grown for household usage**. They felt that **chemical fertiliser contains toxins and poisons** and is harmful to human body. Several vegetables and greens and paddy farmers also had similar perceptions.
- Many homegardeners and several vegetables and greens, paddy and banana farmers commented that compost had positive **benefits for plant growth and yield**, and several mentioned that there was a **good harvest if compost and chemical fertilisers and/or poultry manure were used together.** Farmers across these same groups also felt that compost had a negative impact on plant growth and yield, commenting that it led to **low efficiency, growth rate and yield** if only compost was used.
- Several homegardeners and vegetables and greens farmers felt that compost led to a **better quality plant**. Homegardeners felt that the **harvest was good quality**, although lower than if grown with chemical fertilisers. One banana farmer commented that compost led to **better tasting fruit** than if chemical fertilisers were used.
- The price and supply of compost was mentioned by several paddy farmers, who suggested that it has a **high price because a larger volume is needed to get the required nutrients compared to chemical fertiliser** and it was **difficult to buy.**
- Many farmers noted that compost led to higher rates of **damage from wild animals, worms and insects** and had a **tendency to spread diseases.** Several also commented that compost **can be poisonous.**

Comments from farmers who do not use compost

The most common comments across farmers on why they didn't use compost related to **lack of experience, lack of trust in the product** and the **high price and quantities required**.

- Many paddy and coconut farmers emphasised that they didn't use compost because of a **lack of knowledge, awareness and experience**, as well as several vegetables and greens farmers. Vegetables and greens farmers commented that they **cannot take the risk of using compost** and they **trust chemical fertilisers**.
- Many vegetables and greens farmers and several paddy, coconut and pineapple farmers suggested that they don't use compost because the **large quantities needed will lead to a high final cost** of using compost. Vegetables and greens farmers also felt that compost was **difficult to find and labour intensive to use**.
- Paddy and coconut farmers noted that they felt there is a **low quality of compost available**, and one paddy farmer commented there are **issues with compost standards.** Paddy farmers mentioned that they **don't know what compounds it contains**.
- Several farmers felt that compost led to **low yield / harvest, slow growth** and **did not have enough nutrients**.
- The **difficulty in using compost** was also mentioned by farmers – including that it is difficult and takes time to make, that it has a bad smell, that farmers don't have the manpower to apply to land and that using chemical fertilisers is easier.
- Several farmers also felt that **compost was not suitable for their needs** – including that farmers have no requirement for compost (since using poultry manure, cow manure or leaf litter) and that it is not suitable for large scale farms.

4.3 Farmer willingness to purchase compost from MSW or made with septage

- More farmers are willing to purchase compost than currently use it, suggesting there is potential to increase compost demand.
- Farmers are more willing to purchase compost made from MSW than they are to purchase compost that contains septage, except for coconut farmers who prefer compost with septage.
- Around 70% of farmers are willing to purchase compost made from MSW, because they feel it has a good nutrient content and a reasonable price. Many commented that they are only willing to use it if it is of a high quality, meets the approval of government or a standard and that it is free from anything harmful.
- Just over half of farmers are willing to use compost that contains septage. Farmers gave similar reasons to why they would be willing to use compost made from MSW, but in addition noted that they are willing to use compost made with septage if it gives good results for plant growth and yield.
- Homegardeners and banana plantations have highest rates of compost use currently, but are less willing to purchase compost from MSW or septage compared to their current compost use.
- Farmers who are not willing to use compost from MSW commented that this is because they are uncertain about the contents and concerned that it could include plastics, chemicals, germs/diseases or other harmful substances. For compost with septage, many farmers felt it is unsuitable for use on foods for home consumption.

After the discussion on why farmers use the products they are current using, farmers were provided with information on compost products available in the market and shown a range of samples. This included 5 samples made from MSW, including 3 enhanced with septage. Farmers were then asked if they would be willing to purchase compost made with MSW or compost that contains septage, and explain why or why not. The following sections describe the key findings and a summary of all comments is presented in Annex 8.1. The following section (4.4) provides further details on the compost samples and the perceptions of farmers of these specific samples.

Willingness to purchase compost from MSW or made with septage

- Overall farmers are more willing to purchase compost made from MSW (70%) than they are to purchase compost that contains septage (56%).
- More farmers are willing to purchase compost than currently use it (50%).

Willingness to purchase compost from MSW or made with septage – categorised by farming type

- The farmer types who have higher rates of current compost use (homegardeners and banana plantations) are less willing to purchase compost from MSW or septage compared to their current compost use.
- All other farmer types indicated higher willingness than their current compost use.
- Most farmer types are more willing to purchase compost from MSW than they are to use septage; the exception to this is coconut farmers who were more willing to purchase compost with septage (86%) than compost made from MSW (79%).

Figure 12: Comparison of current compost use with willingness of farmers to purchase compost made with MSW or septage

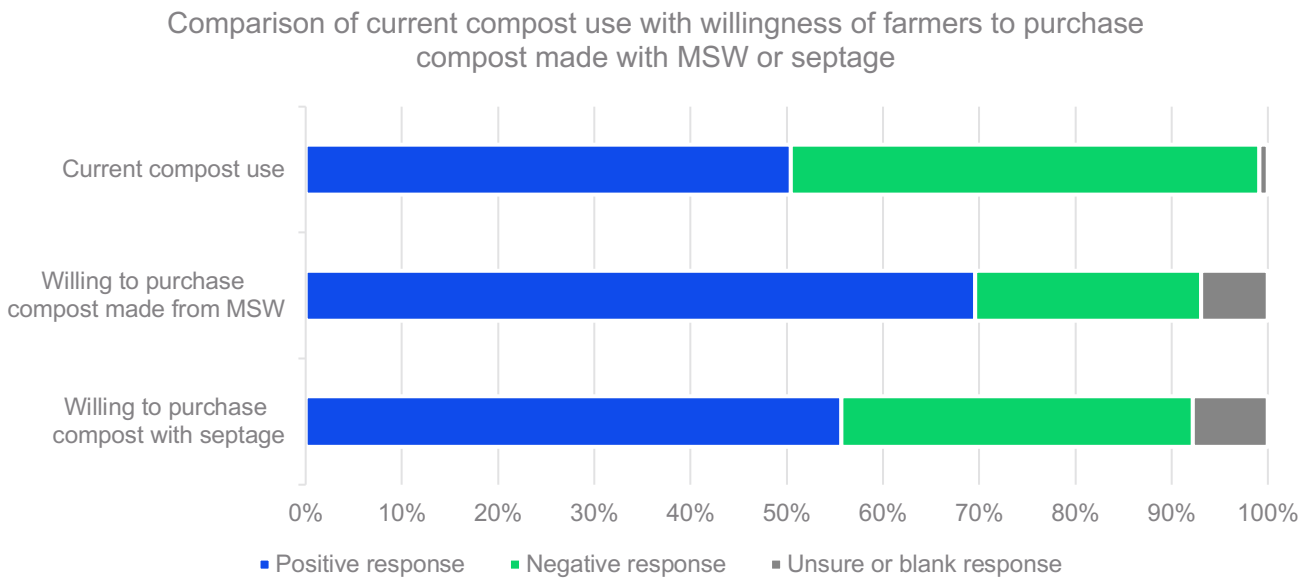
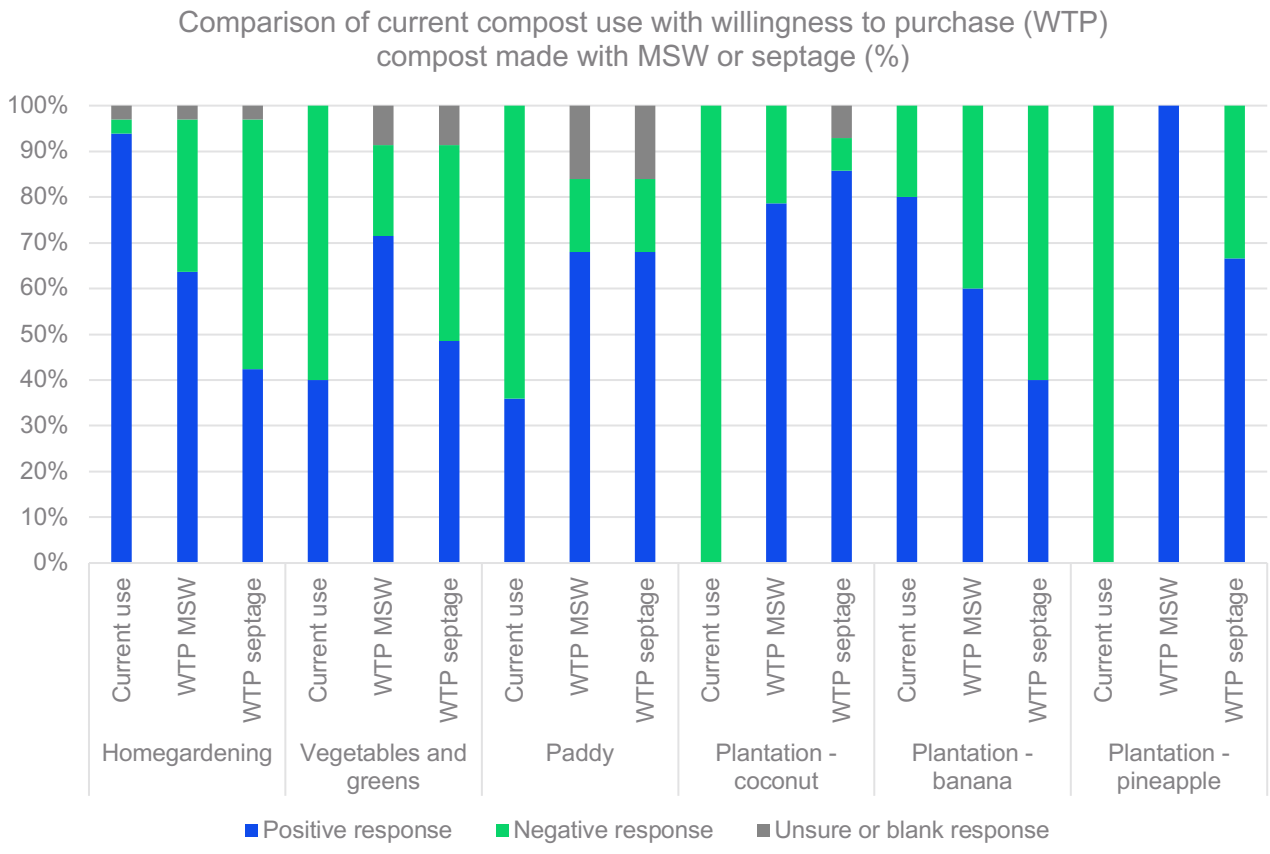


Figure 13: Comparison of current compost use with willingness to purchase (WTP) compost made with MSW or septage - by farming type



Farmers perceptions on compost made from MSW

Comments from farmers who are willing to use compost made from MSW

- Farmers were who are willing to use compost made from MSW frequently commented that it has **a good nutrient content** and a **low / reasonable price**. Many commented that their willingness to use it was dependent on it being of a **high quality that met the approval of government or a standard** and that it was **free from anything harmful**. Specific comments include:
  - Farmers who don't currently use compost (in particular vegetables and greens, paddy and coconut plantation farmers) commented that they would be willing to use compost made from MSW after **trying it or having more information** on it and because it has **good nutrient content and a low / reasonable price**. Some farmers noted that they would be willing to use it on certain conditions, including if it was **approved by the government, produced to the standards** or **free from polythene and plastic, chemicals and/or side affects.**
  - Farmers who currently use compost (in particular homegardeners, vegetables and greens, paddy and banana plantation farmers) commented that they were willing to use compost made from MSW for similar reasons as those who don't currently use it, in particular as it had **good nutrient content and a low / reasonable price**. Others noted that their willingness was dependent on certain conditions, including that the **quality is high and it does not contain any harmful waste**.

Comments from farmers who are not willing to use compost made from MSW

- Many homegardeners, as well as some vegetables and greens, paddy and banana plantation farmers, are not willing to use compost made from MSW even though they currently use compost. These farmers commented that they were **uncertain about the contents**. Specifically they were concerned that it could include **polythene and plastic, chemicals, germs or other harmful substances**.

Farmers perceptions on compost made with septage

Comments from farmers who are willing to use compost made with septage

- Farmers were who are willing to use compost made with septage frequently commented that it has **a good nutrient content** and they would be **willing to use it if it gives good results**. Specific comments include:
  - Farmers who don't currently use compost (in particular vegetables and greens and coconut plantation farmers) commented that they would be willing to use compost made with septage as it has **good nutrient content**. Some farmers noted that they would be willing to use it on certain conditions, including if it was **gives good results.**
  - Farmers who currently use compost (in particular homegardeners, vegetables and greens, paddy and banana plantation farmers) also shared these reasons. Others noted that their willingness was dependent on certain conditions, including **it does not contain anything harmful or toxic**.
  - Many farmers who both use and don't use compost currently commented that they **have no problems with using it**, with some commenting it is similar to using animal manure.

Comments from farmers who are not willing to use compost made with septage

- Many homegardeners, as well as some vegetables and greens, paddy and banana plantation farmers, are not willing to use compost made with septage even though they currently use compost. These farmers commented that they were concerned it could contain **germs and diseases**, it could **affect the crops or damage plants** and that is **unpleasant**. Many noted that it is it is **unsuitable for their use** and they would **not use on foods for home consumption**. Those who don't currently use compost had similar concerns.

4.4 Farmer perceptions on compost samples

- Within the farming groups there was a wide range of preferences, with almost all the samples selected as the top preference by at least one farmer within the group.
- Some most highly preferred samples were contentious, with many farmers holding opposing views.
- Since the farmers in this study have a wide variety of views and preferences for the samples, this highlights the need for targeting various different products to each farming group.

During the focus group discussion, farmers were shown a range of physical compost samples and given basic information about the ingredients, process, typical analysis and cost. A summary of the samples is shown in Table 10 and further details in Annex 8.3. Farmers were asked what they liked or didn't like about the samples, and which would be their top preference. See Annex 8.1 for detailed comments from farming groups.

Table 10: List of compost samples

Sample	Description	Price
Sample 1	Compost from municipal solid waste (MSW)	30 LKR / kg
Sample 2	Compost from MSW enhanced with faecal sludge	10 LKR / kg
Sample 3	Compost from MSW enhanced with faecal sludge and urea	25 LKR / kg
Sample 4	Compost from MSW enhanced with faecal sludge and NPK fertiliser	25 LKR / kg
Sample 5	Pellet	37.50 LKR / kg
Sample 6	Compost from cow/goat manure, green leaves, paddy husk, bone meal, dolomite, wood ash	19 LKR / kg
Sample 7	Compost from fruit waste, cow manure, ash, coco-peat and bark	85 LKR / kg
Sample 8	Liquid bio fertiliser made from MSW (from bio-digesters)	-
Sample 9	Liquid bio fertiliser made from MSW (from bio-digesters) and enhanced with neem / garlic	120 LKR / 100 ml

Compost sample preferences

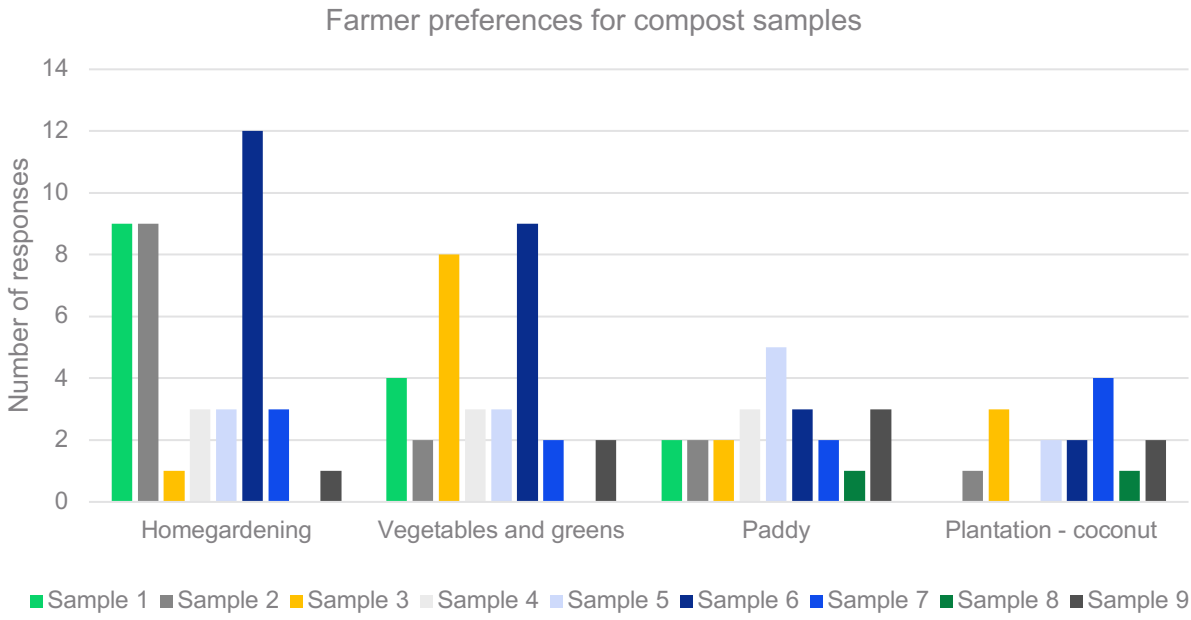
- Within the farming groups there was a wide range of preferences, with almost all the samples selected as the top preference by at least one farmer within the group (see Figure 14).
  - Some most highly preferred samples were contentious, with many farmers holding opposing views. For example, although around half of farmers who commented on Samples 1 – 4 noted that they liked their contents, a similar number commented that they disliked the contents – in particular that they **didn't like that these samples were made from MSW**, or disliked that they **contain faecel sludge** (Samples 2, 3, 4) or **chemical fertilisers** (3, 4).
  - Sample 5 also had a high number of both positive and negatitve comments. Many farmers commented that they liked that the compost stays in the soil for a long timebut others felt the slow release was a negative. Overall many farmers commented that they were **unfamiliar with the pelletised form**.

  - Sample 8 had many farmers comment that they were **unfamiliar with the form of compost**, with some liking that it was a liquid form because it is easy to apply, while others felt that it would be difficult to use and unsuccessful.
  - Samples 6, 7 and 9 had mostly positive comments. Farmers generally **like the contents** of Samples 6 and 7, and felt they have **good nutrient content**. For Sample 9, many liked that it **contains a natural pest / insect repellant**.

- Homegardeners and vegetables and greens farmers both had the highest number of farmers preference for Sample 6, a compost mix made from cow/goat manure, green leaves, paddy husk, bone meal, dolomite, wood ash (not made from MSW). Reasons given for this are that they **like the contents (including that it contains dolomite and goat manure)**, it has **good nutrient content** and they **like the texture and dark colour**.
- Homegardeners also frequently preferenced Samples 1 (compost from MSW) and 2 (compost from MSW enhanced with faecal sludge). The main reasons given are that they **like the contents** and that it is **free from chemicals**. Farmers also liked that Sample 1 is **free from faecal sludge**, a **reasonable price**, that it is **similar to homemade compost** and they **like the texture**. However, many farmers also commented that they wouldn't use these two samples because they **don't like that it is made from MSW** and **they are uncertain about the contents (e.g. could be toxic or contain chemicals)**. Some farmers also commented that on Sample 2 that they **don't like that it contains faecal sludge**.
- Vegetables and greens farmers also had a high preference for Sample 3 (compost from MSW enhanced with faecal sludge and urea). Farmers commented that they **like that it contains urea**, they **like the texture** and it has a **good nutrient content**. Other farmers commented that they don't like that it contains urea or faecal sludge, and many homegardeners made similar comments.
- Paddy farmers had very mixed views on the compost samples. The most common preference was for Sample 5 (a pelletised version of Samples 1-3). Famers commented that pellets are **easy to apply and use in paddy cultivation**, and some commented that they **have experience with it**.
- Coconut farmers also had mixed views, and the most common preference was for Sample 7 (compost from fruit waste, cow manure, ash, coco-peat and bark), because they **like the contents** and feel it is **good for soil moisture**, followed by Sample 3.

Since the farmers in this study have a wide variety of views and preferences for the samples, this highlights the need for targeting various different products to each farming group.

Figure 14: Farmer preferences for compost samples[5]



[5] Note: Banana and pineapple farmer responses are not included because of the low number of responses

4.5 Practices and perceptions relating to cost of compost

Compost cost:

- There was a wide range in the price that farmers were willing to pay for compost.
- The average price farmers are willing to pay is higher than the current minimum price of compost made from MSW.
- Most farmers (with the exception of vegetables and greens and pinapple farmers) are also willing to pay above the minimum price of compost from plant matter and animal manure.
- The prices farmers are willing to pay are typically lower than the more premium compost products.
- Although farmers show a willingness to pay in line with samples from the market, they also expressed that they are expecting a high quality product for these prices, which may not currently be met.

Travel to buy cost:

- There was a wide range in the distance that farmers were willing to travel for compost.

Farmers were asked to nominate how much they would likely be willing to pay for compost and the distance they would be willing to travel.

Willingness of farmers to pay for compost

The price farmers are willing to pay for compost is presented in Table 11 and compared with the price of compost samples in Figure 15.

- There was a wide range in the price that farmers were willing to pay for compost, from 4.3 rupees to 85 rupees per kg, with an average of approximately 23 rupees per kg.
- Coconut and banana farmers were willing to pay much higher prices than other farmer types on average.
- The average price farmers are willing to pay is higher than the current minimum price of compost made from MSW in the compost samples shared with farmers in this study (10 LKR / kg for Samples 2 – 4). However, not all farmers were willing to use this type of compost.
- Most farmers (with the exception of vegetables and greens and pinapple farmers) are also willing to pay above the minimum price of compost from plant matter and animal manure (19 LKR / kg for Sample 6).
- The prices farmers are willing to pay are typically lower than the more premium compost products, including pelletised compost (Sample 5) and the higher-priced compost from plant matter and animal manure (Sample 7). Sample 5 was the most preferred sample for paddy farmers and Sample 7 was the most preferred for coconut farmers, but their average current willingness to pay is below these prices.
- Although farmers show a willingness to pay in line with samples from the market, they also expressed that they are expecting a high quality product for these prices, which may not currently be met.
- Some farmers commented that the price needs to be low because of the quantities required, while others commented that they have no issues with the price.

Table 11: Price farmers are willing to pay for compost (Sri Lankan Rupees / kg)

	All farmers	Home-gardeners	Vegetables and greens	Paddy	Coconut plantation	Banana plantation	Pineapple plantation
Maximum	85.0	50.0	44.5	40.0	85.0	85.0	20.0
Minimum	4.3	5.0	4.3	10.0	5.5	10.0	15.0
Average	23.3	22.1	18.6	23.3	31.2	46.9	18.3

Figure 15: Price farmers are willing to pay for compost

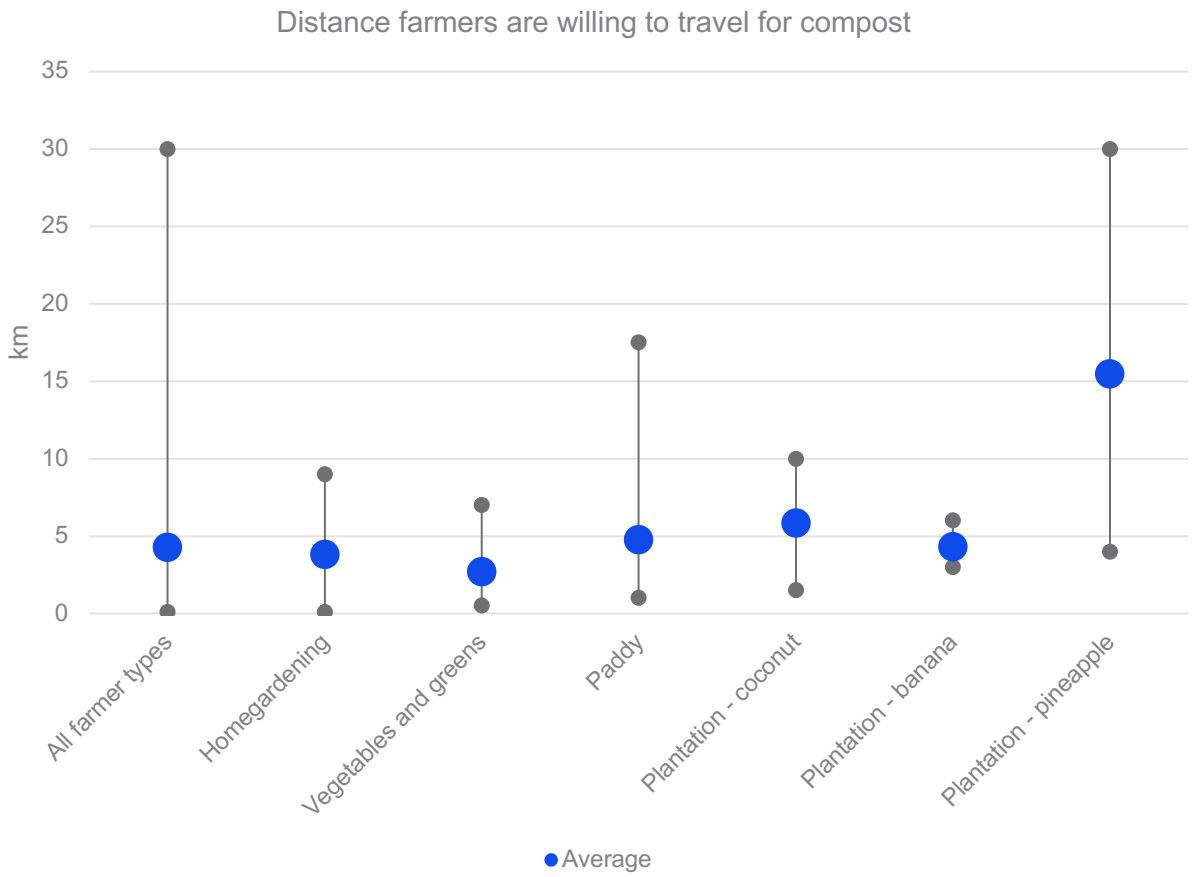
Willingness of farmers to travel for compost

- There was a wide range in the distance that farmers were willing to travel for compost, from around 0.1 to 30 km, with an average of approximately 4.3 km.
- Some farmers commented that it needs to be close to the farm, and others that the distance did not matter. Other farmers mentioned that they would only travel a certain distance or the transport costs would be too high.
- Pineapple farmers were willing to travel further than other farmer types on average, and homegardeners and vegetables and greens farmers were willing to travel the shortest distance. This indicates that the distance farmers are willing to travel increases with the quantity of compost, as the cost of transportation is distributed over a larger quantity.

Table 12: Distance farmers are willing to travel for compost (km)

	All farmers	Home-gardeners	Vegetables and greens	Paddy	Coconut plantation	Banana plantation	Pineapple plantation
Maximum	30.0	9.0	7.0	17.5	10.0	6.0	30.0
Minimum	0.1	0.1	0.5	1.0	1.5	3.0	4.0
Average	4.3	3.8	2.7	4.8	5.9	4.3	15.5

Figure 16: Distance farmers are willing to travel for compost



4.6 Enablers and barriers to using compost

Farmers were asked what helps them to use compost (enablers) and what they perceive to be the barriers or challenges to using compost. The most common themes mentioned by farmers were around the **price of compost**, the **need for increased awareness** and the **need for improved quality and standards**. Specific comments included:

- Farmers frequently commented that compost **needs to be available at a reasonable price**.
  - Vegetables and greens and paddy farmers both commented that it is **currently more expensive than chemical fertilisers**, and pineapple farmers felt that the **price would need to be equivalent**.
  - Paddy farmers also commented that compost **could be given for free instead of chemical fertilisers** (which they receive for subsidised or free).
  - Homegardeners and paddy farmers frequently commented on the **high costs of transport and delivery**. Homegardeners, paddy and coconut farmers suggested that **transport options could be improved** and **compost could be transported to the farm** rather than farmers needing to transport it.
  - Paddy farmers freqently commented on **high labour costs**, however labour needs and costs were not a high concern for other farmer groups.
- Farmers frequently commented that **compost in the market is currently poor quality** and **needs to be produced to a standard**.
- Farmers frequently commented that **there was a need for increased awareness about compost** and **needs to be produced to a standard**.
  - Paddy and coconut farmers suggested that **a trial of compost on a farm could show results to farmers**
  - Vegetables and greens farmers commented that **farmers could be given samples to test out.**
- The **need for good government support** was commented on by homegardeners, vegetables and greens and paddy farmers.
  - Vegetables and greens farmers commented that **government officers don't have good knowledge about farming**
- Coconut and banana farmers both frequently suggested that specific **tailor made compost products could be developed** that meet their needs.
- Vegetables and greens farmers frequently commented that **seeds that do not require chemical fertilisers need to be available**

5. Findings from gross margin analysis

A 'gross margin' is the gross income from a farm enterprise less the variable costs incurred in achieving it. Variable costs are those costs which can be quite clearly attributed to a certain enterprise and which increase as the scale of the enterprise increases (e.g. sowing costs, seed, fertiliser, herbiside, direct labour). Gross margin analysis provides a guide to the relative profitability of different improvement options. It can help to decide whether a potential improvement is worth implementing, or whether one option is better than another option. It is a useful basic planning tool in farm planning to determine how much money different enterprises are capable of generating per unit of a resource (usually per unit of land area).

A subset of the farmers who participated in the focus groups undertook a questionnaire to collect data on farm variable input costs. From this we used gross margins analysis to understand how much of the total costs of farm inputs was made up of fertilisers. This allowed us to make a simple comparison of the sensitivity of a range of farm enterprises to input costs such as fertilisers.

The following section presents the cost distribution and futher details of the gross margin analysis are provided in Annex 8.2.

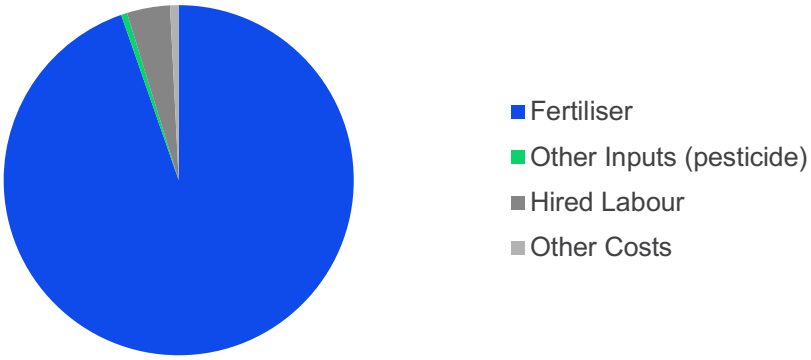
Implications of gross margin analysis for compost use

The key implications of the gross margin analysis for the use of compost are provided below.

Homegardeners

Fertilisers are the major cost component for homegardening, representing 95% of the cost of production. This, along with the high variety of soil amendment products used by farmers (as found in Section 4.1), suggests that homegardeners are searching for ‘value’ in the products they purchase to reduce costs. The majority of home gardeners also use compost to complement chemical fertiliser. Provided that the compost is of a high quality and rich in nutrients, there is a window of opportunity to encourage them to further substitute chemical fertilisers with compost and thereby reduce the cost of production.

Figure 17: Cost distribution for homegardeners

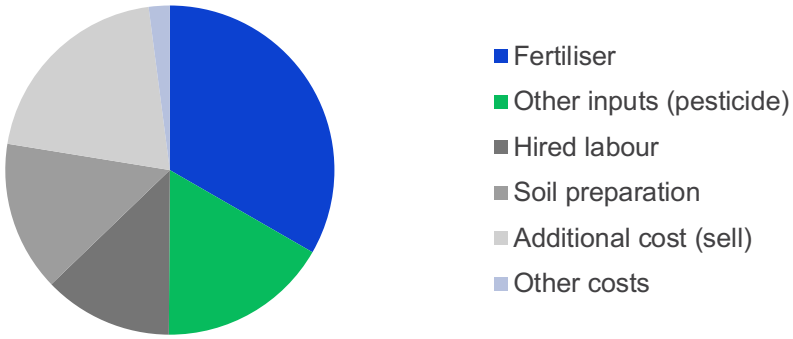


Notes: n=9; all use compost. Crops include: leeks, brinjol, snake gourd, malabar spinach (Basella alba), sessile joyweed (Alternanthera sessilis), kankun (Ipomoea aquatica), bird chili, lemon, radish, ladies finger, luffa, bitter gourd, cabbage, green leaves, tomato, wing bean, cucumber, okra.

Vegetables and greens farmers

Fertiliser costs is a significant share of the input cost for vegetables and greens farmers, approximately one third of cost of production. This suggests that these farmers are likely to be very sensitive to price increases in fertiliers, and substitution with compost could help to reduce the cost of production. The prerequisite to encourage compost use would be to enhance the short-term responsiveness of compost to vegetable crops as the majority of vegetable farmers are commercial operators with seasonal crops and short-term profits.

Figure 18: Cost distribution for vegetables and greens farmers

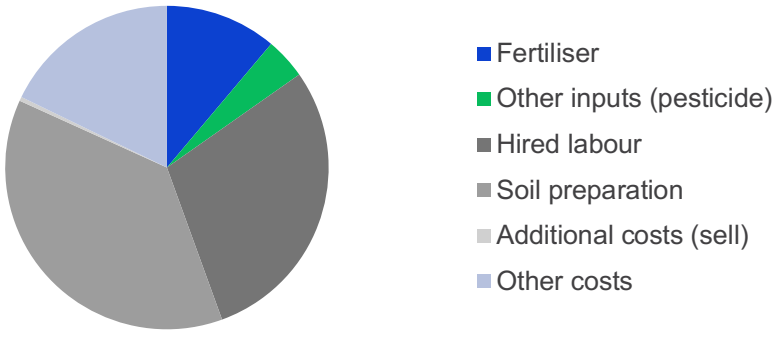


Notes: n=11; 3 farmers use compost; one season is considered as 6 months. Crops include: long beans, luffa, brinjals, snake gourd, bitter gourd, higurala, ledantha ala, cucumber, okra and ginger.

Paddy farmers

The overall gross margin is negative for paddy farmers, as a considerable amount of produce is used for home consumption. Since chemical fertilisers are subsidised for paddy farming, the fertiliser cost is not a significant portion of the cost of production. This means that paddy farmers are not sensitive to the price of fertilisers in the same way as other farmer types and may have less requirements for nutrient content from compost. Soil preparation is the main cost as farmers use machinery for land preparation. Farmers also already use significant amount of hired labour, implying that farmers will be reluctant to use compost products that could further increase labour cost. A feasible option would be to encourage farmers to incorporate compost to soil at the time of soil preparation, which would require a specially formulated compost suitable for this purpose.

Figure 19: Cost distribution for paddy farmers

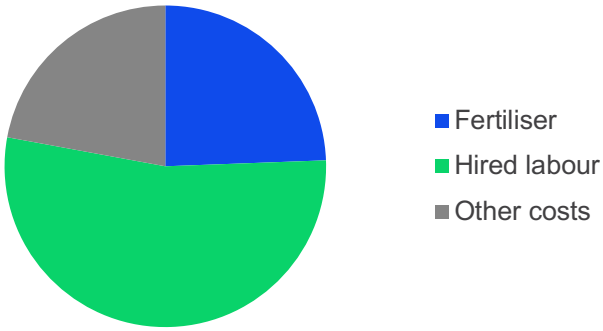


Notes: n=7; 3 farmers use compost. Price of paddy Rs. 50/kg.

Coconut farmers

Hired labour is more than 50% of the variable input cost for coconut farmers. The labour intensive nature of compost could be the reason why coconut planters do not prefer to use compost (along with the supply of free and low cost poultry manure, as discussed in Section 4.2). If the compost could be made less bulky or the nutrient content per unit of compost could be enhanced, it may be possible to encourage them to use compost. Further as coconut is a perennial crop, the advantage of compost for enhancing long term soil properties could be leveraged to encourage coconut planters to use compost.

Figure 20: Cost distribution for coconut farmers



Notes: n=6; none use compost; other cost includes pesticide and transport cost; average nuts = 819/ac/season

6. Findings from compost retailer and producer interviews

The following chapter presents the findings from interviews undertaken with compost and fertiliser retailers and compost producers. The list of interviewees is presented in Table 13.

6.1 Retailers

Background and experience

Interviews were undertaken with 5 retailers, comprising of one urban council, one agrarian service center outlet and three private entities. These retailers are all located within or close to the Kaduwela MC area, with two within the area, two situated 45 km from Kaduwela and the urban council 76km from Kaduwela. Four of the retailers had 10 years or more of experience in compost retailing, and one retailer had three years of experience.

Types of products and ingredients

The retailers sell nine types of compost sold in their outlets, out of which eight were in powder form and one in pellet form. The difference among the powder form compost products sold by different retailers was the ingredients they used. For example, the urban council outlet was selling a hybrid product which is produced by using MSW, feacal sludge and rock phosphate, while one of the private sector retailers was selling powder which is produced by using cattle manure, green manure, goat manure, paddy husk, bone meal, dolomite and ash. Three of the retailers sell both compost and fertiliser, and two of the retailers only sell compost. For more details on the products, see Table 13.

Most of the retailers were not aware of the origin of the ingredients of compost products they sell. Out of nine products only four products were made from MSW and retailers didn't know the origins of the ingredients of the other products.

Out of these four products made from MSW, two were sold in the outlet managed by the urban council who sell compost they produce using MSW they collect from the area. They use feacal sludge for one product to uplift the quality and the nitrogen level and collect it from government institutes.

Pricing and sales quantities

There were three compost products which are sold for between 10 to 20 rupees per kg, and 4 products that sell from 21 to 30 rupees. The prices are higher for these products compared to others because of the compost production process.

The pelletised product is sold for 37.50 rupees for 1kg, while the vermicompost product sells for 175 rupees. There was only one compost product that contains feacal sludge which is sold by the urban council outlet for 25 rupees per kg.

The urban council retailer sells 25 tonnes per month, including both the regular MSW compost and the compost with added feacal sludge. Of the other two other products which are produced using MSW, one retailer noted that they sell around 200kg per month and the other around 1000kg per month. The retailer who sells the pellet form product noted that they can sell around 100kg per month.

All the retailers said there is sufficient demand for compost and they can meet this demand. However, the urban council outlet noted that on occasion they are not able to immediately meet demand, but that when this happens, they agree to supply the volume of compost wanted by the customer at a future date.

Table 13: List of retailers and producers

	Type	Location	Compost products sold	Sample no.
Retailers				
1	Urban council (sell only compost)	Kuliyapitiya (76 Kms from Kaduwela)	**Hybrid compost** (MSW, Faecal sludge,NPK) – 25 rupees/kg	Sample 4
			Normal Compost (MSW, Fish waste, vegetable waste, Cow dung, leaves) feacal sludge optional– 10 rupees/kg	Sample 2
2	Private retailer (sell both compost and fertiliser)	Padukka (23 Kms from Kaduwela)	**Mihisaru compost** (MSW, Vegetable waste) – 28 rupees/Kg municipal solid waste (kitchen waste, animal waste, wood husk, banana leaves, straw, tree leaves)	Sample 1
3	Agrarian service center outlet (sell both compost and fertiliser)	Padukka (23 Kms from Kaduwela)	**Sanstha Organic (Pellet)** (Oil cake, paddy husk, Eppavala rock phosphate) – 37.5 rupees /Kg	Sample 5
			ERP compost (dust) (MSW,Vegetable waste) – 27.5 rupees/Kg	N/A
4	Private retailer (sell only compost)	Diyatha uyana (10 Kms from Kaduwela)	**Vermi Compost** – 175 rupees/Kg	N/A
			Laksaru Compost (Cow dung, Poultry Manure, Dolomite, Eppawala phosphate, Coco peat [Kohubath]) – 30 rupees /Kg	N/A
5	Private retailer (sell both compost and fertiliser)	Diyatha uyana (10 Kms from Kaduwela)	**Nature fert** (cattle manure, green manure, goat manure, paddy husk, bone meal, dolomite, ash) – 19 rupees /Kg	Sample 6
			Sarupala Organic fertilizer (cattle manure, green manure, paddy straw) – 20 rupees /Kg	N/A
Producers				
1	Urban council	Kuliyapitiya (76 Kms from Kaduwela)	**Hybrid compost** (MSW, Fecal sludge,NPK) – 25 rupees/Kg	Sample 4
			Normal compost MSW (Fish waste, vegetable waste, cow dung, leaves) Feacal sludge optional – 10 rupees/Kg	Sample 2
2	Government Institute under the Ministry of Agriculture	Government Institute	**HS organic pellet** fertilizer (Lak pohora) – 37.5 rupees/Kg (Oil cake, paddy husk, Eppavala rock phosphate)	Sample 5
3	Municipal council	Kaduwela MC	**KMC Saru pohora** (MSW (Food waste, leaves)) – 10 rupees/Kg	N/A
4	Private producer	Batticoloa (303 Kms from Kaduwela)	**Granular compost** (green leaves, animal manure) – 12 rupees/Kg	N/A
5	Private producer	Rajanganaya, Anuradhapura (180 Kms from Kaduwela)	**Regular compost** (green leaves, Manure, animal bones) – 10 Rupees/Kg	N/A
			Powder compst (green leaves, Manure, animal bones) – 12 rupees/Kg	Sample 7
			Hybrid compost (green leaves, Manure, animal bones, chemical nutrients) – 20 rupees/Kg	N/A

Perceptions on farmer demand for compost

Home gardeners and vegetable farmers were the main customer base for all retailers. Only one retailer noted that customers are concerned about the ingredients when they purchase compost, and others felt that they don't worry about the ingredients. The retailers noted that most of the farmers are focused on price and their previous experience with the particular product.

The retailers noted that most of the farmers felt that they got a good harvest after applying compost. The urban council noted that they have large customer base and new customers typically come to them because of feedback from another customer. These new customers have seen results at neighbouring farmes and they have decided to use those products.

All retailers felt that demand for compost from farmers will increase in future, especially from small scale farmers, because they don't like to use chemical fertilisers as they concerned that they are harmful for human health.

Perceptions on compost from MSW and faecal sludge

Of the retailers who sell compost made from MSW, they commented that there is a high demand for compost made by MSW compared to other products. These retailers had no reservations in selling compost produced by using MSW.

Of the retailers who didn't sell compost produced using MSW, they mentioned that they have low knowledge about compost made from MSW. The majority also responded that they don't like the idea of selling compost with added feacal sludge, as they assume there won't be demand for consumers and think it will have a bad odor.

Enablers and barriers to increasing compost uptake

Based on their experience, the retailers suggested to increase the future demand for the compost, that the price should decrease, as the current cost of compost is higher than using chemical fertilisers. They noted that many farmers are using chemical fertiliser even though they feel that it is harmful because of the high price of compost. The retailers noted that there should be promotions, awareness campaigns and marketing tools, as people have been familiar with using to chemical fertilisers for a long time.

All retailers' noted there should be government intervention to promote the compost usage among farmers and their suggestions were:

i. Government could give a subsidy to producers to reduce the cost of compost production

ii. Government should involve with certification process (as farmers have trust on government products than private products).

6.2 Compost producers

Background and experience

Of the five compost producers, two were from the private sector and the from the government sector (one municipal council, one urban council and one government institute under the Ministry of Agriculture). (Note that the compost producer interviewee from the urban council is from the same council as the retailer interviewee, however different people were interviewed.) Two of the producers have 12 years of experience in compost production, while the others have 11 years, 8 years and 7 years experience.

Product types and ingredients

The producers manufacture eight compost products, which includes four products in powder form, three in a bulk form (before straining) and one pelletised product.

The products made from MSW were produced by two government producers, two products by the urban council (one regular compost and one with added faecal sludge) and one by Kaduwela municipal council. Both of these producers are the government agency who collect MSW in their area.

The other government agency and two private sector companies were not using MSW. The other government institute produces a pelletised form of compost made from organic matter. The two private sector producers are manufacturing compost from animal waste and organic matter, one who who was producing three products, while the other private company produces one compost product.

Only the urban council were using feacal sludge, using it for one product specially formulated for use on low harvest farming fields. They didn't use feacal sludge for their other product because according to the report of the Coconut Research Institute, in their normal compost, the nitrogen content is nearly 1.67%. They stated that typically the nitrogen content should be 1%, so there is no point of adding feacal sludge for the normal compost because it already has the required nitrogen content.

Pricing and sales quantities

The pelletised compost producer was producing 1,500 tonnes per month and selling this for 37.50 rupees for per kg. They commented that they are able sell the quantities that they produce and they can't meet all the demand for their product, so they are in the position to increase their capacity.

One of the private sector producers was producing a hybrid compost product which includes chemical fertilisers. The monthly production for this product was 80 Kgs and they could sell 60 to 80 kgs per month, for 20 rupees per kg. They were also selling two other separate products (made from animal manure and organic matter) for 10 and 12 rupees per kg.

The urban council noted that they produced 25 tonnes of regular compost per month, which is sold for 10 rupees. The compost with added feacal sludge has a monthly production of 1 tonne and they were able to sell all of what they produced each month for 25 rupees per kg. Municipal Council has a capacity of producing 20 tons monthly.

Two of the government producers sell their products at their own outlets. Two of the private sector producers sell their products at their yard, and one also distributes to other retailer outlets. The government producer who produces pellets distributes their products to agrarian service centres. All of the producers noted that they were satisfied with the profitability of their operations, except the pellet producer. The pellet producer began plans to export their products in 2009 due to lack of demand from local farmers and now they annually export 200 metric tons.

Perceptions on farmer demand

The urban council noted that their regular compost from MSW had a higher demand than the feacal sludge added compost. The council noted that this is because the normal compost already has the required nitrogen content. Farmers are familiar with the regular compost product, but if their plant growth is very low then they buy the compost with added feacal sludge as a special product.

Individual home gardeners and vegetable farmers were the main customers of all government sector producers, and most were repeat customers. The private sector sell their products to plantations such as coconut and banana and for landscaping. Government institutes and private companies, including CIC, Uni power and Elite, are typical customers of the private sector producers.

The experience of the compost producers of how farmers select products, is that some farmers base their decision on price and nutrient content, while others consider mainly the form of the compost product. The

experience of the pellet producer was that most customers use their product because of the easiness to use, and that some customers prefer granular form as their land is degraded.

Producers also noted that most of the home gardeners and small-scale farmers prefer compost in a powder form, because they have a perception that good quality compost comes in a powder form. The main criteria used by farmers to measure a god compost was the smell, and color.

All the producers felt that demand for compost will increase in the future, as the many farmers like the idea of eco-farming and they believe that chemical fertiliser doesn't work as well on land that is degraded.

Perception on MSW and fecal sludge

The two government agencies who are producing compost from MSW noted that they have no reservation for producing or selling the compost with MSW and they use their own materials collected locally in their areas. However, the other government agency and two private sector companies who were not using MSW noted that they felt it would be a low quality, and some believe that MSW contains heavy metals.

The one government agency who was using feacal sludge collected locally also had no reservations in selling this product. Some of the other producers who do not use faecal sludge felt it would not be of a good enough quality to use for their products.

Enablers and barriers to increasing compost uptake

Supply of ingredients

The two government producers who use MSW in their products noted that even though they have enough supply of materials, there are problems with the quality of solid waste because of inpromper segregation which sometimes leads to non-degradable materials mixed in with bio-degradable waste. This is a large problem for them in terms of ensuring a supply of quality ingredients.

One private sector producer mentioned that their plant is far from the local authority and municipal council, and because of that it's difficult to source MSW for their production. This producer had tried using MSW in the past, but was not satisfied with the quality.

In terms of the supply of septage, the urban council noted that they have no issue getting feacal sludge for their products. The municipal council has not added faecal sludge to their products, but noted they could obtain supply if they wanted to. The other producers felt that they would not be able to have have enough supply.

Quality of the compost and labelling

All the producers test the nutrient content (NPK level) of the product they produce through government institutes, such as the Coconut Research iIstitute in Lunuvila, Industrial Technology Institute (ITT) or Solid Waste Management Authority, Gannoruwa. Although all producers tested the quality, only 3 producers were displaying the NPK level for their products.

Only the private producers were able to provide the percentage of ingredients in their products. Some of government producers preferred not to share this information, while others were unsure about the percentage of ingredients as they use the collected bio-degradable MSW for their products. Only the private producers mention the ingredient contents on their packaging.

Increasing the uptake of compost

To increase demand for compost, the producers suggested various practical strategies, such as:

- Conducting a promotion campaign on compost, including through cultivating a model cultivation field using compost and promoting the sale of value added compost (compost mixed with chemical fertiliser)

- Providing support for compost producers, including by introducing new technologies and machinery for compost production, improving waste segregation is compost yards and linking the large scale chemical producers logistic facilities to the compost distribution network
- Promoting eco-farming by reducing the subsidy for chemical fertiliser and creating a subsidy for more eco friendly products including compost.

All producers felt that the government should be involved in the process to increase demand for compost.

Future plan of the compost production business

All the producers had plans to increase their compost business, however, only one government and one private producer was doing advertised marketing of their products. The government producer which produces pellets commented that they wanted to develop a liquid fertilizer, while the municipal council compost producer noted they want to increase their capacity from 20 to 35 tonnes per month.

All the compost producers had faced challenges in their manufacturing and for their plans for expansion. Private sector producers have faced difficulties such as insufficient land to expand their compost yards at a satisfactory price, high delivery costs and finding low cost machinery.

As noted above, the government producers who produce compost from MSW were facing the problem of improper segregation of waste, with non-degradable waste mixed with the bio-degradable waste, which is creating problems for expansion. As a mitigation action, they have informed to their collectors to increase household awareness and not to collect from households who are not properly segregating their waste. They also face the challenged that people living nearby the compost year have complained about the odour.

7. Implications for future organic waste value chains

Market segmentation:

The focus group discussions and gross margin analysis revealed that the values and needs differ between farmer groups (potential market segments). It is unlikely that a single compost product could meet the needs of all potential users. The idea of specialised products was also directly mentioned by paddy and banana farmers in the focus groups.

- **Homegardeners** could be a potential market for a range of products, including:
  - high-quality compost made from MSW,
  - high-quality compost made from MSW enhanced faecal sludge, and
  - compost made from plant matter and animal manure (not MSW).

This group of farmers is very willing to use compost, and the most common reason for this is to avoid perceived health impacts of chemical fertiliser. Because of their interest in health, some have concerns about the quality of compost from MSW and septage, particularly about contamination with plastics, chemicals, diseases and other harmful contents. Many commented that they would not consider using compost with septage for use on crops grown for home consumption. For this reason, a compost made from plant matter and animal manure was the most preferred option for this group, however a high proportion are interested in compost from MSW, including enhanced with faecal sludge. Fertiliser is 95% of the cost of production for homegardeners (as they don't have labour costs), which highlights that increased compost use could substitute for other fertiliser/amendment use and reduce their cost of production.

- **Vegetables and greens farmers** could be a potential additional market for products targeting homegardeners, however they had a stronger preference for compost with added urea. They could be a potential market for:
  - high-quality compost made from MSW enhanced with faecal sludge and urea, and
  - compost made from plant matter and animal manure (not MSW).

Vegetables and greens farmers are particularly interested in rapid plant growth and high yields, commonly mentioned the nutrient content as a key reason for using soil amendments. This group of farmers is the most vulnerable to climatic conditions, such as flooding, so they prefer short production seasons where the yield is important. Adding faecal sludge and urea to a compost mix could help to meet this need. However, there is also a high proportion who are not willing to use compost with added faecal sludge, and would be interested in a compost made from plant matter and animal manure which also has a high nutrient content.

Vegetables and greens farmers are very price sensitive as their produce is highly vulnerable to price conditions, and many commented that they don't use compost because the large quantities needed will lead to a high final cost of using compost. The gross margin analysis found that fertiliser is one-third of the cost of production. This indicates that they are more likely to be interested in a lower-priced compost option, and that increased compost use could substitute for some of the fertiliser input and reduce cost of production.

- **Banana and pineapple farmers** could also have an interest in various compost products similar to homegardeners and vegetables and greens farmers, however more market research would need to be done with these groups given the small number of participants in this study.

- **Paddy farmers** have currently quite low levels of compost use, but nearly 70% showed interest in using compost. Given that they receive subsidised or free chemical fertilisers, many commented that the price of compost was the main barrier to use. These farmers could be a market for:
  - tailor-made high-quality compost made from MSW, which could be integrated with their current fertiliser provision / integrated with soil preparation.

Paddy farmers most commonly preferred a pelletised form of compost when discussing the samples, however, they generally had mixed views on the benefits of each compost type, so determining the best compost products for this market requires further investigation.

Soil preparation is the main cost as farmers use machinery for land preparation. Farmers already use a significant amount of hired labour implying that farmers will be reluctant to use bulky compost because it will further increase labour cost. A feasible option would be to encourage farmers to incorporate compost to soil at the time of mechanized land preparation – a pelletised product facilitates application by machinery. This would require a specially formulated compost product suitable for application at the time land preparation.

There are ongoing political discussions in regard to the fertiliser subsidy for paddy farmers, including the idea that the subsidised fertiliser could be complemented with subsidised compost. Paddy farmers also suggested in the focus groups that this would be a way to enable them to use compost. As of December 2020, the chemical fertiliser subsidy has been reduced, but compost has yet to be provided to paddy farmers. AIs have also been asked to observe the levels of compost use by paddy farmers, with the idea that in future chemical fertiliser may only be provided to farmers if they take steps to use compost.

- **Coconut farmers** could be a potential market for:
  - tailor-made compost product made from MSW and faecal sludge,
  - compost made from plant matter and animal manure (not MSW).

Coconut farmers had very high willingness to use compost, even though none currently use compost. Many commented that they would have no problem with using compost with faecal sludge as they felt it would have a good nutrient content. They are likely to be less concerned about faecal sludge compared to other farming types because the harvested coconut crops would have no direct contact with the compost, unlike crops which are grown in the soil.

A significant barrier to compost use is that coconut farmers mostly use poultry manure as it is easily available from neighbouring farms for free or a very low price (similar to paddy farmers and subsidised chemical fertiliser). Coconut farmers also commented on the need for improved transport options to make it easy to obtain compost. Labour costs are also high for coconut farmers (partly because of the low cost of poultry manure), so a compost product that is less labour intensive or high a high nutrient content could encourage them to use compost. Small scale spreading equipment could also be developed to help minimise the labour costs.

Education of the use, benefits and application of compost:

The concern that the use of compost alone would lead to low yield (i.e. not in combination with chemical fertilisers or animal manure) was mentioned by famers who currently use and don't use compost. This highlights a lack of understanding of the use and benefits of compost, and that it is not a direct replacement for fertiliser.

Many farmers who have lower rates of compost use but potential interest in using it, particularly vegetables and greens, paddy and coconut farmers, commented that their lack of awareness and experience using compost was a barrier to use.

Specific opportunities for education could include:

- **On-farm compost trials or demonstrations** could be undertaken to demonstrate compost use and benefits to farmers specific to their farming systems, and data could be collected to share more broadly among farmers. Paddy and coconut farmers both suggested that on farm trials would be helpful for them in the focus groups, as some paddy farmers also noted that they were willing to have trials take place on their farms. Some vegetables and greens farms suggested that they could be given free samples to trial. Some retailers also mentioned in the interviews that farmers tend to learn from each other, which would support this strategy.
- **Development of recommendations on compost application** could also help farmers by providing them with information on how compost can be used. At the moment farmers receive information on fertiliser use from various sources, including retailers, government extension officers (particularly mentioned by paddy farmers) and the coconut cultivation board.
- **Capacity building of technical farming knowledge for extension officers** who provide information on compost and fertilisers to farmers was highlighted as important by vegetables and greens farmers. As evidenced from the reseach focus group discusssions, in many cases, farmers don't trust the extension officers and instead rely on the recommendations of retailers, which is a risk as retailers may make recommendations based on their sale margins. Agricultural inspectors (AIs) require more knowledge on compost products, many don't like to promote compost usage as they don't trust the standards of compost available in the market.
- **Education of retailers** is particularly important for homegardeners and vegetables and greens farmers who typically purchase from retailers, whereas plantations usually buy directly from compost producers. The interviews with retailers indicated that many did not know details of the origin of ingredients in the compost products that they sell.
- **Improved labelling** of compost products would give farmers, retailers and extension officers certainty of what they are purchasing. Labelling could include information such as the ingredients, nutrient composition (NPK), adherence to any standards and details on application and storage.
- **Improved understanding of contamination and health risks** of compost made from MSW and faecal sludge is needed for farmers, retailers and extension officers. Many farmers and retailers commented on the risks of contamination with plastics, germs and diseases, however, these risks need to be balanced with an understanding of the comparative risks of contamination in other fertiliser products (chemical fertilisers and animal manure).

High quality production and adherence to standards:

Farmers from all groups frequently commented that compost in the market is currently poor quality and needs to be produced to a standard. Many commented that they would be willing to use compost made from MSW if it could be guaranteed to be free from contamination. This feedback can be shared with compost producers so that they are informed that there would likely be a higher demand for compost if issues with contamination could be improved.

Sri Lanka has a compost standard in development.

Pricing:

The need for compost to be available at a low / reasonable price was commonly mentioned as a barrier to use by farmers. Compost retailers also noted that most farmers are focused on price (as well as their previous experience with the particular product), and many didn't want to be using chemical fertilisers but were doing so because the price is cheaper than compost.

This suggests the need for market intervention to scale up production and usage of compost to reduce the production costs. Some options of how pricing could become less of a barrier to use include increasing the nutrient content so that farmers feel the price is more in line with the prices paid for fertilisers and allocating a portion of the fertiliser subsidy budget towards compost subsidies. There could also be grants or tax exemptions for compost producers to invest in capital costs of compost production. One compost producer also suggested that the price of compost could be reduced if compost producers could use the existing storage and distribution infrastructure for chemical fertilisers.

It should also be noted that the average price stated by farmers that they are wiling to pay per kilo is higher than the current minimum market prices for compost from MSW. However, farmers also expressed that they are expecting a high quality product for these prices. Paddy farmers preferred Sample 5 (pelletised form of MSW compost) and coconut farmers preferred Sample 7 (made from plant matter and animal manure) but their average current willingness to pay is below the prices for these samples.

Improved transport and purchasing options:

Difficulties in purchasing and the high cost of transport were mentioned frequently as barriers by farmers, particularly in comparison to chemical fertilisers or animal manure which is more easily available. Farmers indicated they were willing to travel an average of just over 4 km to purchase compost, with many commenting they would travel a similar distance to what they would travel to purchase fertilisers.

There is a need for a deeper investigation into transport options or alternatives. For example, bulk purchasing by farmer groups or collectives could reduce transport costs (and overall product costs). A variety of packaging sizes and wholesale options could also increase the potential number of outlets which could retail compost.

This highlights the potential for new business models that meet the compost demand of the different farming types.

Government support:

Some farmers indicated that they trusted the government in terms of advice on compost and fertiliser use. For example, some coconut famers use poultry manure on the recommendation of the coconut cultivation board and paddy farmers mentioned that their fertiliser use was based on government recommendations (as well as subsidies).

This highlights that an increased involvement of the government could help to promote compost use, including support for options highlighted above such as developing recommendations on compost use, on-farm trials or demonstrations, increasing the technical knowledge of extension officers and supporting standards development and certification.

In addition, government can help to promote the compost market development through financial and technical support to compost producers. This could include grants or tax exemptions, consideration of the fertiliser subsidy for compost or subsidised leases, as the availability of land was noted as an issue by some producers.

Local governments also have an important role in improving the quality of MSW and septage collection, which can in turn make it easier for compost producers to produce a high-quality compost produce free from contamination. This could include improving waste management infrastructure, and programs to improve the levels of source segregation of organic waste.

Promote indigenous seed varieties:

A small number of farmers mentioned that traditional varieties of seeds respond better to orgnic inputs. Most hybrid seeds are imported and need high doses of chmical fertiliers. There is potential to increase the

availability of traditional seeds and promote their use. This is particularly for home gardeners, as they do not require very high yields. Further research on the benefits of traditional seed varieties would also be useful.

Limitations

There are several limitations which mean that care should be applied when looking at the results of this study in relation to the potential for organic waste value chains in Sri Lanka more broadly. These include:

- **Case study area:** The case study area and types of farmers have specific characteristics that influence farmer demand for compost. In particular, this is a peri-urban area, with a high share of farmers growning crops for their own consumption, a large number of part time farmers and close proximity to poultry farmers providing free or low cost manure.
- **Recruitment of participants:** Farmers were recruited through the support of local AIs and ARPAs, based on the sampling strategy designed by the research team. This support was invaluable to the research, but also means that the research team did not have direct control over the participants who were selected.
- **Translation:** The research and data collection process was conducted in Sinhala while the data collation, analysis and write-up was conducted in English, which creates potential for mistranslations.
- **COVID-19:** Whilst this research was carried out in Sri Lanka during a time when there was limited cases and free movement of citizens, the impact of earlier COVID-19 lockdowns in 2020 and also future uncertainty may have impacted research findings.

8. Annexes

8.1 Additional data from questionnaire and focus groups

Table 14: Number of farmers who use compost, chemical fertilizer, animal manure and organic matter – categorised by farming type

		All farmers	Home-gardeners	Vegetables and greens	Paddy	Coconut plantation	Banana plantation	Pineapple plantation
Total farmers	Number	115	33	35	25	14	5	3
Compost	Number	58	31	14	9	0	4	0
	% of total	50%	94%	40%	36%	0%	80%	0%
Chemical fertiliser	Number	81	14	32	24	5	3	3
	% of total	70%	42%	91%	96%	36%	60%	100%
Animal manure	Number	63	18	27	2	13	3	0
	% of total	54%	55%	77%	8%	93%	60%	0%
Organic matter	Number	34	15	2	9	6	2	0
	% of total	29%	45%	6%	36%	43%	40%	0%

Table 15: Number of products used by farmers – categorised by farming type

		All farmers	Home-gardeners	Vegetables and greens	Paddy	Coconut plantation	Banana plantation	Pineapple plantation
Total farmers	Number	115	33	35	25	14	5	3
1 product	Number	28	5	5	10	4	1	3
	% of total	25%	15%	14%	40%	29%	20%	100%
2 products	Number	58	14	21	11	10	2	0
	% of total	50%	42%	60%	44%	71%	40%	0%
3 or more products	Number	29	14	9	4	0	2	0
	% of total	25%	42%	26%	16%	0%	40%	0%
Average	Responses	2.0	2.4	2.1	1.8	1.7	2.4	1.0

Table 16: Number of farmers who use compost – by gender

		All farmers			Homegardeners			Other farmer types		
		All	**Female**	**Male**	**All**	**Female**	**Male**	**All**	**Female**	**Male**
Total farmers	Number	115	74	41	33	30	3	82	44	38
Using compost	Number	59	44	14	31	29	2	27	15	12
	% of total	50%	59%	34%	94%	97%	67%	33%	34%	32%
	Number	56	29	27	1	0	1	55	29	26

Not using compost	% of total	49%	39%	66%	3%	0%	33%	67%	66%	68%
Unsure or blank	Number	1	1	0	1	1	0	0	0	0
	% of total	1%	1%	0%	3%	3%	0%	0%	0%	0%

Table 17: Number of farmers who use compost – categorised by education level

		All farmers	**Primary**	**Secondary**	**OL**	**AL**	**Above**
Total farmers	Number	115	9	22	39	38	6
Using compost	Number	58	3	7	23	23	1
	% of total	50%	33%	32%	59%	61%	17%
Not using compost	Number	56	5	15	16	15	5
	% of total	48%	56%	68%	41%	39%	83%
Unsure / blank	Number	1	1	0	0	0	0
	% of total	1%	3%	0%	0%	0%	0%

Table 18: Willingness to purchase compost from MSW – categorised by farming type

		All farmers	**Home-gardeners**	**Vegetables and greens**	**Paddy**	**Coconut plantation**	**Banana plantation**	**Pineapple plantation**
Total farmers	Number	115	33	35	25	14	5	3
Willing to purchase	Number	80	21	25	17	11	3	3
	% of total	70%	64%	71%	68%	79%	60%	100%
Not willing to purchase	Number	27	11	7	4	3	2	0
	% of total	23%	33%	20%	16%	21%	40%	0%
Unsure / blank	Number	8	1	3	4	0	0	0
	% of total	7%	3%	9%	16%	0%	0%	0%

Table 19: Willingness to purchase compost with septage – categorised by farming type

		All farmers	**Home-gardeners**	**Vegetables and greens**	**Paddy**	**Coconut plantation**	**Banana plantation**	**Pineapple plantation**
Total farmers	Number	115	33	35	25	14	5	3
Willing to purchase	Number	64	14	17	17	12	2	2
	% of total	56%	42%	49%	68%	86%	40%	67%
Not willing to purchase	Number	42	18	15	4	1	3	1
	% of total	37%	55%	43%	16%	7%	60%	33%
Unsure / blank	Number	9	1	3	4	1	0	0
	% of total	8%	3%	9%	16%	7%	0%	0%

Farmer perceptions on chemical fertilizers

	Homegardeners	Vegetables and greens	Paddy	Plantation - coconut	Plantation - banana	Plantation - pineapple
Comments from farmers who use chemical fertilisers						
Comments on nutrient content, plant growth and yield	A small number of farmers commented: • can increase harvest and fruit size • used to increase plant growth • used when the yield is reduced • soil has poor nutrition, so needs both chemical and compost	Many farmers commented: • used to increase plant growth and yield, or when yield is reduced • has good nutrient content / contains all nutrients needed for growth • used to get a good harvest • used for flowering • needed for secondary growth (animal manure used for primary)				A small number of farmers commented: • using it is profitable
Comments on past experience and trust		Many farmers commented: • used because of past experience • have experienced good results in the past • have trust in it	Many farmers commented: • used because of past experience • have always used it • recommended by the government		One farmer commented: • used out of habit	
Comments on price and supply		A small number of farmers commented: • low price	Many farmers commented: • received subsidies from the government • given free by the government • low price	A small number of farmers commented: • difficult to buy (vs poultry manure) • supply issues		
Other comments		Other comments: • easy to use • seeds are made for chemical fertilizer	Other comments: • easy to use • seeds are made for chemical fertilizer • works very fast		Other comments: • easy to use on large cultivated area	Many farmers commented: • Only chemical fertilizer is

		• soil has adapted to chemical fertilizer • reduces insect damage	• use it less because of health effects		• decreases fruit quality and taste	• proven effective • no other option
Comments from farmers who do not use chemical fertilisers						
Other comments	Many farmers who do not use it commented: • contains toxins & poisons • harmful to human body		One farmer commented: • weeds grow quicker		One farmer commented: • if used excessively plants will rot and die	

Farmer perceptions on animal manure

Animal manure	Homegardeners	Vegetables and greens	Plantation - coconut	Plantation - banana
Comments on nutrient content, plant growth and yield	A small number of farmers commented: • used as some chemical fertilizers are not effective on crops • preserves the fertility of the crop	Many farmers commented: • used to increase plant growth • has good nutrient content • needed for rapid growth in primary stage (chemical used for secondary)	A small number of farmers commented: • has good nutrient content (poultry and fish)	
Comments on past experience and trust	A small number of farmers commented: • recommended by the government	A small number of farmers commented: • used because of past experience	A small number of farmers commented: • recommended by the coconut board • saw good yield at a friend's farm • Heard about it from others and had good results in the past	One farmer commented: • used out of habit
Comments on price and supply		Several farmers commented: • easy to find / purchase	Many farmers commented: • low price • can get free for nearby farmers • very easy to find / common • has no supply issues compared to chemical • does not have high transport cost like other coconut fertilizers	
Other comments	Other comments: • doesn't contain anything toxic	Other comments: • used to for land preparation	Other comments:	

		• remains in soil for a long time • avoids leaf yellowing	• chemical fertilizers need to be used at a specific time or harvest will decrease, poultry manure does not have this issue	

Farmer perceptions on compost – from farmers who use compost

Animal manure	Homegardeners	Vegetables and greens	Paddy	Plantation - banana
Comments on nutrient content, plant growth and yield	Many farmers commented: • Harvest increases if mixed with chemical fertilizers • Compost is necessary for growth • Has high nutrients • Better plant growth • Increased yield • When it includes septage it has good quality and efficiency • No significant change in yield Many farmers commented: • Low efficiency & yield • Fruit is smaller • Reduced quality and firmness of the fruit • Takes more time to get a good harvest • Lower yield when only compost is used	Several farmers commented: • Good for plants and plant growth • Can get more harvest than chemical fertilizer • Plants are more efficient • Need to use both compost and chemical and/or poultry manure Many farmers commented: • Lower yield / growth rate	Several farmers commented: • Lack of nutrients in chemical fertilizers • High harvest Several farmers commented: • Most of the seeds that available in the market are lab-engineered and chemical fertilizer is essential for them • Low efficiency & yield • Takes time to show positive results	
Comments on crop quality and health	Several farmers commented: • Better quality plant • Gives a good quality harvest (but lower than chemical fertilizer)	Several farmers commented: • Better quality plant		One farmer commented: • Fruit has a good taste (compared to chemical)
Comments on human health	Many farmers commented: • It is natural • Does not contain chemicals, toxins and poisons • Want to produce healthy food without poison • Chemical fertilizer contains toxins & poisons & is harmful to human body. • Trying to not use chemical and be organic as much as possible because the harvest is grown for household usage.	Several farmers commented: • Want to consume food without chemicals • Chemical fertilizer is not good for health • Don't want to use chemical when growing for home consumption	Several farmers commented: • Trying to be chemical free • Want to produce food without poisons	
Comments on price and supply		One farmer commented: • Unable to produce compost	Several farmers commented: • High cost in buying compost	

			• Difficulties in finding / producing compost • Requires higher amounts compared to chemical	
Other comments	Other comments: • Need some training about compost • Damages from wild animals / predators is higher with compost use • Worms damage the plants • High tendency to spread diseases	Other comments: • Used in soil preparation • Homemade compost is higher quality than chemical fertilizers • Need some training about compost • Do not use compost available in the market • Sometimes compost can be poisonous	Other comments: • Reduces weed density • Mainly cultivate indigenous paddy variety • Excessive weed growth • Damages from animals higher with compost use	Other comments: • By experience • Homemade compost is better quality than other fertilizers • Increased insect damages

Farmer perceptions on compost – from farmers who don't use compost

	Homegardeners	**Vegetables and greens**	**Paddy**	**Plantation - coconut**	**Plantation - banana**	**Plantation - pineapple**
Comments on nutrient content, plant growth and yield	One farmer commented: • Can't get good harvest, plants are not successful and soil has adapted to chemical fertilizers	Several farmers commented: • Low harvest • Plants become yellowish	Several farmers commented: • Low yield • Takes a long time to grow	One farmer commented: • Not enough nutrients for coconut trees		One farmer commented: • Gives low quality harvest
Comments on past experience and trust		Several farmers commented: • Have never used it / no experience • Cannot take the risk • Trust chemical fertilizers	Many farmers commented: • They don't use it because of a lack of knowledge • They don't know what compounds it contains	Many farmers commented: • They don't use it because of a lack of knowledge / awareness • They are not used to it		
Comments on price and supply		Many farmers commented: • High price • Need large quantities • Difficult to find • Labour intensive	Several farmers commented: • Expensive • Need large quantities	Several farmers commented: • High price		One farmer commented: • Need large quantities

Other comments		Other comments: • Difficult to make • There is no need (since using poultry manure, cow manure or leaf litter) • Not suitable for large scale farms • Making compost takes time	Other comments: • Difficult to make • Low quality of compost available • Would like to use compost but using chemical fertilizer is much easier	Other comments: • Difficult to make • Low quality of compost available • There is no need (since using poultry manure) • Issue with standards - some samples had high sand content • Has a bad smell	Other comments: • Don't have manpower	Other comments: • No profit from organic farming with current prices

Willingness to use compost made from MSW

Note comments in bold were frequently mentioned by farmers

	Homegardeners	Vegetables and greens	Paddy	Plantation - coconut	Plantation - banana	Plantation - pineapple
Reasons willing to use – by farmers who currently use compost	• **Low/reasonable price** • **Good for harvest** • **Already using it** • Willing to try after doing some research • Has a good texture • Good for vegetables • Good organic matter content • Have no problems with it	• **Willing to use if the quality is high** • **Have no problems with it** • Willing to use if it does not contain any harmful waste • Good nutrient content • Prefer to chemical fertiliser	• **Good nutrient content** • Willing to use if have more information • Have no problems with it		• **Good nutrient content**	
Reasons willing to use – by farmers who don't use compost	• Good for soil	• **Willing to use after trying** • **Good nutrient content** • Willing to use if have more information • Willing to use if approved by the government	• **Have no problems with it** • Willing to use if it doesn't have any side affects • Low/reasonable price • Good nutrient content	• **Have no problems with it** • **Willing to use if free from polythene and plastic** • **Good nutrient content**	• Good nutrient content	• Willing to try after doing some research

		• Willing to use if produced to the standards • Low/reasonable price • Good for soil • Low levels of toxic ingredients	• Would like to take up organic farming	• Willing to use if free from chemicals		
Reasons not willing to use – by farmers who currently use compost	• **Uncertain about the contents** • It could include chemicals • It could include polythene and plastic • It could contain harmful substances • The contents could be unsuitable for plants and humans • It could contain germs • Would buy if it included animal manure • It is poor in nutrients • It does not ensure it meets a standard • It is unpleasant	• Uncertain about the contents • It could include polythene and plastic • Needs a large quantity	• **Uncertain about the contents** • It could be toxic		• It could be toxic • Already make compost at home so don't need to purchase	
Reasons not willing to use – by farmers who don't use compost		• It could be toxic • Don't have enough information about it		• It is poor in nutrients • Do not like to touch it		

Willingness to use compost made with septage

Note comments in bold were frequently mentioned by farmers

	Homegardeners	Vegetables and greens	Paddy	Plantation - coconut	Plantation - banana	Plantation - pineapple
Reasons willing to use – by farmers who currently use compost	• **Good nutrient content** • **No problems with it as similar to using animal manure** • Good for flowering • Gives good results • Willing to use if it does not contain anything harmful or toxic	• Does not contain chemicals • Have no problems with it • Free from artificial materials • Willing to use if it does not contain anything harmful or toxic	• Willing to use if not harmful for health • Willing to use if have more information • Good nutrient content • Have no problems with it • In the past only these types of fertilisers were used		• Have no problems with it	
Reasons willing to use – by farmers who don't use compost	• Willing to use if gives good results • Chemical fertiliser is more toxic	• **Good nutrient content** • Willing to use if effective for plant growth (but will not use for homegardening) • Willing to try / test using it • Willing to use if have more information • Can reduce the cost of chemical fertilisers • Have no problems with it		• **Good nutrient content** • **Have no problems with it** • Willing to use as it is processed • Good for drip irrigation not for plantation • Willing to use as free from germs and not unpleasant • It's natural • Has good structure		• Have no problems with it • Willing to use it if it's made to a good standard
Reasons not willing to use – by farmers who currently use compost	• **It could contain germs and diseases** • **It is unpleasant** • **Would not use on foods for home consumption**	• **It is unpleasant** • It is disgusting • Would only use poultry manure	• It could contain diseases • It could be toxic		• It is unpleasant • Already make compost at home so don't need to purchase	

	• **It could affect the crops / damage plants** • **It is unsuitable for use** • It is disgusting • Children from the household could come in contact with it • It is poor in nutrients • It has a bad odour • Have not used before • Would buy if it included animal manure					
Reasons not willing to use – by farmers who don't use compost		• **It is unpleasant** • It has a bad odour • It could be harmful to crops • It could contain germs • It could be toxic • Do not want to use for leafy vegetables	• It is unpleasant	• Do not like the idea of using septage	• It is unpleasant	• It is unpleasant • It is disgusting

Barriers and enablers to using compost

Note comments in bold were frequently mentioned by farmers

	Homegardeners	Vegetables and greens	Paddy	Plantation - coconut	Plantation - banana	Plantation - pineapple
Comments on overall price	• **Needs to be available at a reasonable price**	• **Needs to be available at a reasonable price** • Compost is more expensive than chemical fertiliser	• **Needs to be available at a reasonable price** • **Could be given for free (instead of chemical fertiliser)**	• **Needs to be available at a reasonable price**	• **Needs to be available at a reasonable price**	• **Price needs to be equivalent to chemical fertiliser**

			• Compost is more expensive than chemical fertiliser			
Comments on labour requirements and costs	• High labour costs	• High labour needs	• **High labour costs**	• High labour needs		
Comments on transport / delivery requirements and costs	• **High transport / delivery costs** • **Fertiliser is delivered to the farm [J clarify is this fert only or also compost? – comment made in Kaduwela]** • Compost can be transported to farmers		• **High transport / delivery costs** • Transport options need to be improved • Fertiliser is delivered to the farm	• **A system could be developed to deliver compost to the farm** • Lack of transport options		
Comments related to quality	• **Currently poor quality compost in the market** • **Need to improve quality** • **Needs to be produced to a standard** • Don't have trust in the ingredients	• **Currently poor quality compost in the market** • **Need to improve quality** • **Needs to be produced to a standard** • **Don't have trust in the ingredients** • Don't trust compost produced by the government	• **Currently poor quality compost in the market** • **Need to improve quality** • **Needs to be produced to a standard** • Don't have trust in the ingredients	• **Currently poor quality compost in the market** • Don't trust compost produced by private producers		• **Needs to be produced to a standard**
Comments related to awareness and information	• **Need for awareness about compost**	• **Need for awareness about compost** • **Lack of experience** • **Farmers could be given samples to test**	• **Lack of experience** • **A farm trial could show results to farmers**	• **Need for awareness about compost** • **A farm trial could show results to farmers** • Need for an extension program for farmers		

Comments related to government support	• Need for good government support	• **Government officers don't have good knowledge about farming** • Need for good government support	• **Need for good government support**			
Other comments	• Difficult to find / purchase	• **Difficult to find / purchase** • **Seeds that do not require chemical fertilisers need to be available**	• **Would prefer to make at home** • Difficult to find / purchase • Difficult to store	• **A special compost tailored for coconut plantations could be developed** • Difficult to find / purchase • Need information from the manufacturing company on compost packaging	• **A high nutrient content compost could be developed** • Would prefer to make at home	

Farmer perceptions on compost samples

	Homegardeners	Vegetables and greens	Paddy	Plantation - coconut
Sample 1: Compost from MSW	• **Like that it is free from chemicals** • **Like that it is free from faecal sludge** • **Reasonable price** • **Like that it is similar to homemade compost** • **Like the texture** • Good nutrient content • Like the colour • Like the contents • Like that it contains kitchen waste • **Don't like that it is made from MSW** • Uncertain about the contents • Can't ensure waste separation • High price	• **Like the texture** • **Like the contents** • **Good for aeration of the soil** • Like the colour • Good nutrient content • **Could contain toxic contents because it is made from MSW** • Don't like that it doesn't contain chemicals	• Like that it is free from chemicals • Good nutrient content • Difficult to use, will be removed by running water • Don't like the appearance • Don't like that it has high moisture content • Think it is not good for paddy (good for homegardening)	• Like the contents • Don't like that it is made from MSW • Low quality
Sample 2: Compost from MSW enhanced with faecal sludge	• **Like that it is free from chemicals** • **Like the contents** • Like the colour • Like that it is natural • Like that it is similar to homemade compost • Reasonable price • **Don't like that it contains faecal sludge** • Don't like that it is made from MSW • Uncertain about the contents • Don't like the appearance • Feels poor quality	• **Good nutrient content** • **Don't like that it contains faecal sludge** • Could contain toxic contents • Don't like that it doesn't contain chemicals • Unpleasant	• **Like that it is free from chemicals** • **Like the texture** • Like the contents • Like the moisture content • Don't mind that it contains faecal sludge it if it is good quality • Difficult to use, will be removed by running water • Don't like the appearance • Don't like that it has high moisture content	• Like that it is free from chemicals • Have experience with it from homegardening
Sample 3: Compost from MSW enhanced with	• **Like that it contains chemical fertiliser / urea** • **Like the colour (black)** • Like the high moisture content	• **Like that it contains urea** • **Good nutrient content** • **Like the texture** • Like that it contains faecal sludge	• **Like that it contains urea** • Have experience using it • Like the texture • Like the colour	• **Like that it contains urea** • Like the texture

faecal sludge and urea	• **Don't like that it contains faecal sludge** • **Don't like that it contains chemicals / urea** • Urea good for plant growth but does not induce fruit production • Don't like that it is made from MSW • Uncertain about the contents • Don't like the appearance • Feels poor quality	• Like the appearance (dusty form helps it to mix with soil and can be easily absorbed by plants) • Smell is good • **Don't like that it contains faecal sludge** • **Don't like that it contains chemicals / urea** • Could contain toxic contents • Unpleasant	• Don't mind that it contains faecal sludge it if it is good quality • **Don't like that it contains chemicals / urea** • Difficult to use, will be removed by running water • Dislike the appearance • Don't like that it has high moisture content	• Have experience with it from homegardening • Don't like that it contains chemicals / urea •
Sample 4: Compost from MSW enhanced with faecal sludge and NPK fertiliser	• **Like that it contains N, P, K** • **Good nutrient content** • Like that it is natural • **Don't like that it contains faecal sludge** • **Don't like that it contains chemicals / N, P, K** • Don't like that it is made from MSW • Uncertain about the contents • Don't like the low moisture content	• **Like that it contains N, P, K** • Good nutrient content • Like the high moisture content • **Don't like that it contains faecal sludge** • **Don't like that it contains chemicals / N, P, K** • Could contain toxic contents • Unpleasant	• **Like that it contains N, P, K** • Like that it looks dry • Don't mind that it contains faecal sludge it if it is good quality • **Don't like that it contains chemicals (N, P, K)** • Difficult to use, will be removed by running water • Dislike the appearance	• Like the contents • Like that it contains N, P, K • Good quality
Sample 5: Pelletised form of samples 1-3	• **Like that it is free from chemicals** • **Like that it stays a long time in the soil** • Like that it is free from faecal sludge • Good for plant health • **Unfamiliar / have no experience with it** • **Don't like that it is late to melt (?)** • Don't like that it contains chemicals • Don't like that it is made from MSW	• **Helps to reduce soil compaction** • Like the contents • Good for plant growth • Like that it stays a long time in the soil • Like that it is slowly absorbed into the plant • **Unfamiliar / have no experience with it** • **Don't like that it is late to melt (?)**	• **Pellets are easy to apply / easy to use in paddy cultivation** • **Have experience with it** • Like the contents • Like that it is free from chemicals • Like that it absorbs nutrition regularly • In pellet form, damage from wild animals can be minimised • Nutrients will absorb into roots much quicker • Like that it stays a long time in the soil	• **Easy to use** • Like that it stays a long time in the soil • The supplier (government) is reliable, even though the price is high • Unfamiliar / have no experience with it • Don't like that it is late to melt (?)

		• **Don't like that it takes a long time to mix with soil** • Takes a long time to give results • Could lead to fungus growth	• Good nutrient content • Like that it is late to melt (?) • Good price • Can see even distribution when applied • No dust appears when using it • **Don't like that it takes a long time to mix with soil** • Unfamiliar / have no experience with it • Dislike the form • Form is not suitable for paddy cultivation / difficult to use • Low distribution when adding to soil	
Sample 6: Compost from cow/goat manure, green leaves, paddy husk, bone meal, dolomite, wood ash	• **Like the contents** • **Good nutrient content** • **Like that it contains goat manure** • Like that it is free from chemicals • Like that it contains paddy husk • Promotes quick growth	• **Like the contents** • **Like the colour (dark)** • **Like the texture** • **Good nutrient content** • **Like that it contains dolomite** • **Like that it contains goat manure** • Like that it contains leaf litter • Like the high moisture content • Good for leaf vegetables • Know it is good from experience • Helps to reduce soil compaction	• **Like that it contains dolomite** • **The price is reasonable** • Like that it is free from chemicals • Have heard it is good • Difficult to use, will be removed by running water	• **Like the contents** • Like that it contains dolomite • Like that it contains animal manure and wood ash
Sample 7: Compost from fruit waste, cow manure, ash, coco-peat and bark	• **Like the contents** • **Like the colour (black)** • **Like the texture** • Like that it contains ash • Like the high moisture content	• Like the contents • Like that it includes cow manure • Like that it is natural • Like that it contains plant matter • Poor nutrient content • High price	• **Like the colour** • **Good nutrient content** • Like that it is natural • Like the texture • Difficult to use, will be removed by running water • Poor contents	• **Like the ingredients e.g. cow dung, gliricidia** • **Like that is absorbs water quickly / good for soil moisture** • Like that it is free from chemicals

				• Like the texture • Like the colour (dark)
Sample 8: Liquid bio fertiliser made from MSW (from bio-digesters)	• Like that it is free from chemicals and faecal sludge • Like the colour • Easy to apply • Liquid fertilisers are not successful • No time to use liquid fertiliser • Unfamiliar / have no experience with it	• Like that it is in a liquid form • Liquid form is easy to use • **Unfamiliar / have no experience with it** • Don't trust liquid fertiliser • Liquid fertiliser will evaporate and need to be used rapidly	• Like that it is free from chemicals • Like that it is in a liquid form • **Unfamiliar / have no experience with it** • Difficult to use, will be removed by running water • Think it will take a lot of labour • Don't like that it needs a large quantity	• Have experience with it from homegardening
Sample 9: Liquid bio fertiliser made from MSW (from bio-digesters) and enhanced with neem / garlic	• **Like that it contains a pest repellent** • Easy to apply • Like it from experience • Liquid fertilisers are not successful • No time to use liquid fertiliser	• **Like the contents** • **Like that it contains a pest repellent** • Like that it is in a liquid form • Liquid form is easy to use • Like the contents • **Unfamiliar / have no experience with it** • Don't trust liquid fertiliser • Liquid fertiliser will evaporate and need to be used rapidly	• **Like that it contains a pest repellent** • **Like that it is natural** • Easy to use • Like that it is free from chemicals • Like that it is in a liquid form • Difficult to use, will be removed by running water • Unfamiliar / have no experience with it • Think it will take a lot of labour • Don't like that it needs a large quantity	• **Like that it contains a pest repellent** • Like that it is in a liquid form • Have experience with it from homegardening

8.2 Gross margin analysis

Home Gardening

Income	kg per season per 10 perches(kg)	Price of a kg	Total income from 10 perches
			18647.72
Expenditure	Rs per season per 10 perches		
Fertilizer	4364.22		
Other Inputs(pesticide)	25.68		
Hired Labour	182.48		
Other Cost	36.69		
Total variable cost			4609.07
Gross margin (rupees)			14038.65

Coconut Cultivation

Income	Nuts per season per acre (Nuts)	Price of coconut	Total income from acre
	819	-	40769.23
Expenditure (Per season per acre)			
Fertilizer	945.10		
Hired Labour	2071.01		
Other Cost	856.01		
Total Variable costs			3872.12
Gross margin (rupees)			36897.11

Pineapple Cultivation

Income	kg per season in an acre(kg)	Price of a kg	Total income from acre
			6636.36
Expenditure	Rs per season per acre		
Soil Preparation	436.36		
Fertilizer	527.27		
Other Inputs(pesticide)	5909.00		
Additional cost(sell)	0		
Other Cost	272.72		
Total variable costs			7145.45
Gross margin (rupees)			-509.09

Vegetable Cultivation

Income	kg per season in an acre(kg)	Price of a kg	Total income from acre
	2077.36		179621.40
Expenditure	Rs per season per acre		
Soil Preparation	6584.36		
Fertilizer	14857.61		
Other Inputs(pesticide)	7485.10		
Hired Labour	5662.55		
Additional cost(sell)	9086.42		
Other Cost	921.81		
Total variable costs			44597.85
Gross margin (rupees)			135023.55

Paddy Cultivation (With accounting for home consumption)

Income		kg per season per acre(kg)	Price of a kg	Total income from acre
		1008.94		59923.01
Expenditure per season per acre				
Soil Preparation	15827.95			
Fertilizer	4731.18			
Other Inputs(pesticide)	1737.63			
Hired Labour	12387.09			
Additional cost(sell)	172.04			
Other Cost	7556.98			
Total Variable cost				42412.87
Gross margin (rupees)				17510.14

8.3 Compost menu used in focus groups

Sample	Process	Typical analysis	Cost
Sample 1: Compost from municipal solid waste Made from municipal solid waste (kitchen waste, animal waste, wood husk, banana leaves, straw, tree leaves)	Open windrow composting. Organic fraction of the MSW is used but can contain up to around 5% other items such as yogurt cups, polythene wraps), These items gets removed during the final stages of compost preparation	PH 8.1 Moisture 27.2% Total N 1.1, Total P - 0.9, Total K – 1.5 C: N – 29.2	30 LKR per kg
Sample 2: Co-Compost (Super Compost) Made from municipal solid waste (kitchen waste, animal waste, wood husk, banana leaves, straw, tree leaves) faecal sludge optional	Open windrow composting (Faecal Sludge 600g and Compost 1400g) these are produced by Private parties after obtaining MSW, or using their own agriculture by products.	No information on NPK levels PH 7 Moisture 15%	10 LKR per kg
Sample 3: Hybrid compost 1 Made from municipal solid waste, faecal sludge and urea	Open windrow composting amended with Urea Urea 200g Compost 1200g Faecal sludge 60g (added just before bagging?)	No information on NPK levels PH 7 Moisture 15%	25 LKR per kg
Sample 4: Hybrid Compost 2 Made from municipal solid waste, faecal sludge and NPK fertilizer	Open windrow composting amended with mix of NPK 200g Compost 1200g Faecal sludge 60g (added just before bagging?)	No information on NPK levels PH 7 Moisture 15%	25 LKR per kg
Sample 5: Palletes Oil cake, paddy husk, Eppavala rock phosphate	Open windrow composting then pelletising	No information	37.50 LKR per kg
Sample 6: Other types of compost. Made from Cow dung, green leaves, goat manure, paddy husk, bone meals, dolomite, wood ash	Open windrow composting amended with animal waste, rock phosphate, dolomite, husk	No Information	19 LKR per kg
Sample 7: Pot mixture Made from fruit waste, cow dung, ash, coco-peat and bark	Open windrow composting, using crushers initially.	No information	85 LKR per kg
Sample 8: Liquid bio fertilizer Made from municipal solid waste	Bio slurry from bio-digesters	N, P, K (416, 49.5, 458 mg/L) BoD – 1488 mg/L B,Mn,Zn, – (0.6, 1.6, 2.1 mg/L) Mg,Ca – (67, 354 mg/L)	At the moment given free
Sample 9: Enhanced liquid bio fertilizer Made from municipal solid waste mixed with neem extract, garlic or other organic material	Enhanced bio slurry from bio digesters mixed with neem extract, garlic or other organic material.	No information	120 LKR per 100 ml

8.4 Questionnaires and focus group guide

Farmer questionnaire and focus group guide - Overview

Begin with welcome from lead facilitator

Informed consent

- Provide and explain information sheet
- Gain informed consent
- Note on consent form

COVID check

Ask each farmer:

- *To the best of your knowledge, have you been in contact with a confirmed COVID-19 case in the last 14 days?*

  YES – NO [If yes – please request the participant to leave and note that due to health advice you are not able to include them in the research]

- *Are you experiencing today, or have you experienced in last two weeks flu like symptoms?*

  YES - NO [If yes – please request the participant to leave and note that due to health advice you are not able to include them in the research]

Questionnaire (see Part 1)

Allocate a researcher to each farmer in the group to fill out the questionnaire with the farmer

Focus Group (see Part 2)

Once the interview has been completed invite the farmer to move into location for the focus group.
Ensure all farmers are present before starting the focus group
Ensure that all farmers are seated comfortably with appropriate social distance

Optional financial information (see Part 3)

Allocate a researcher to the farmer in the group to fill out the table

Part 1: Individual Farmer questionnaire

Focus group number: *Date:* *Interviewer name:*

DS division: *GN Division:* *ASC:*

APRA division: *GPS code:*

Farmer name: *Research Identifier:*

Age: *Gender:* *Contact Details:*

Education Level: Primary /Secondary / OL/ AL / Above *No of Family members:*

Do you receive Samurdhi or any government benefit: YES/NO *Any family members with a disability (note number):*

Farmer type (circle which applies to focus group): Home gardening Vegetables Paddy Plantation (coconut, banana, pineapple)

Note: answers to below table are only for the crop type circled above

Question	***Instruction***	**Options**		
Approximately what size is your farm?	*Add area under cultivation (in Perch)*			
Do you farm full time, or do you also have another job?	*Choose which applies*	Full time farming	Part time farming	
How long have you been farming?	*Choose which applies*	1 – 5 years	6 – 10 years	More than 10 years
Do you own the land or are you renting?	*Tick which apply*	Own the land	Renting the land	
Do you farm for your own consumption or to sell?	*Add details where they apply*	Which crops do you sell? (add specific crops or note “all”)	Where do you sell the crops?	Which crops do consume yourself? (add specific crops or note “all”)
How much do you sell your crop for?	*Add details*	Overall sale price of all crops per year (rupees)	How much do you consume yourself? (percentage)	
How much fertilizer do you use?	*Add details where they apply*	Total kg of fertilizer used per year (kg)	Distance travelled to purchase fertilizer (km)	
How much do you spend on fertilizer?	*Add details where they apply*	Yearly cost of fertilizers (rupees)	*If possible:* Average price per kg for fertilizer (rupees)	*If possible:* Average price for delivery (rupees)
How much compost do you use?	*Add details where they apply*	Total kg of compost used per year (kg)	Distance travelled to purchase compost (km)	
How much do you spend on compost?	*Add details where they apply*	Yearly cost of compost (rupees)	*If possible:* Average price per kg for compost (rupees)	*If possible:* Average price for delivery (rupees)

Part 2: Focus group discussion

Note for facilitators:

- This section attempts to understand the current fertilizer and soil conditioner usage practices of farmers w.r.t a specific focus area (eg: paddy, home garden, vegetable, Plantation – banana, pine apple, coconut). Hence when asking questions draw focus to the specific production/ crop type.
- Encourage everyone to respond / participate
- Encourage conversation about why farmers provide same or different responses to each of the questions

Facilitator script: We are now going to have a group discussion and invite everyone to share their experience and views. We are interested in your experience and views based on your practice of farming {SPECIFIC CROP}. In the case your grow other crops, please think only about {SPECIFIC CROP} when responding to our questions. We will be encouraging everyone to share, so please feel free to share your experience and views.

Current fertilizer use

1. Normally what type of fertilizers/ soil conditioners do you use for farming? What is the form you prefer to buy? (Chemical, compost and animal waste)

Note: if they use chemical fertilizers or animal waste, this should be the focus of Question 2. The views on compost will be discussed in next section.

2. Why do you use these forms of fertilizer? [Note type of fertilizer being discussed _____]

   The following prompts can be used: brand, form, price, nutrient content, ease of purchase / use, recommendations.

   Note: if they use chemical fertilizers or animal waste, this should be the focus of this next question. If they only use compost then they can skip to next section.

Farmer perception on compost

Note for facilitators: The next section attempts to understand the perception of farmers w.r.t usage of compost even if they are not using it now if they were to use or if they we reusing and not now what are the reasons etc. different farmers can have different perceptions hence its important to get the opinion of all participants in the group. Even if farmers have conflicting opinions those should be allowed to be expressed.

Facilitator script: We are interested to learn about your experience and views on compost.

3. Do you use compost for your farming?
4. If no, Why not?
5. If you use compost, what is your compost made of?
6. Why do you use it?

   The following prompts can be used: brand, form, price, nutrient content, ease of purchase / use, recommendations.

7. Do you see any difference in your farming (harvest, soil health) by using compost?

Farmer perception on waste-derived compost samples

Note for facilitators: introduce the compost samples and allow farmers to look at the samples for a few minutes before asking the questions in this section.

Facilitator script: We have brought here different types of compost available in the market, each sample is demonstrated here with the packaging that is sold and loose samples are available for you to have an idea of the colour, odour and the texture, please have a look for your selves as if you would go to a sales outlet to buy compost for your land and tell us which products you like and dislike and the reasons for your decision.

Do follow safety guidelines when checking the samples before you take samples use sanitizers to clean your hands and after checking samples again clean your hands with sanitisers.

8. What do you like or dislike about these samples?

The following prompts can be used: form, nutrient content, ease of use, contains septage or not, colour, odor.

a. Would you purchase compost made from municipal solid waste? If yes, why? If no, why not?

b. Would you purchase compost that includes septage? If yes, why? If no, why not?

9. Which is your preferred type of compost? (everyone choose one) Why?
The following prompts can be used: form, nutrient content, ease of use, contains septage or not, colour, odor.

10. How much would you pay for compost? (note if per bag / kg) Why?

11. How far would you travel for compost? Why?

Perceived impacts of compost on farming and sources of information

The next section tries to understand barriers farmers face when using compost and what actions are required to increase the use of waste derived compost the over all idea is to assess the factors that affects the demand for Waste derived compost.

12. What helps you to use waste-derived compost?

13. What are barriers or challenges for you to use waste-derived compost?

The following can be used as prompts:

- Do you think using WDSA would affect your ability to sell your crops? If yes how, if not why not?
- Have you been encouraged to use compost (e.g. by government, AIs)? If yes how?

14. Do you think you can get enough fertilizers when you want (Chemical, compost and animal waste)?if yes, why? If not why not?

15. What are your future plans for your farm? Do you plan to continue farming? *(two reasons to ask this – future demand, and if they are concerned about soil health)*

COVID-19 impacts

16. Has there been any impact to your household's food security or your farming practices from COVID-19? If yes, how? If not, why not?

17. Have your farming practices changed because of COVID-19? If yes, how? If not, why not?

18. Are there any changes you would like to do in future based on experiences from COVID-19 to ensure your food security?

Part 3: Optional financial information

Date: _____ Interviewer name: _____ Farmer type: _____

Farmer name: _____ Research identifier: _____

Thanks for taking the time to answer a few extra questions, we would like to know in relation to your {SPECIFIC} crop

Crop type	Area cultivated	Cost of soil preparation	Cost of fertilizers (for the season)	Cost of other inputs (insecticides/ pesticides)	Cost of hired labour	Estimated harvest (per season)	Total sales value (per season)	What additional costs do you incur when selling (eg: transport)	Other information /costs
1									
2									
3									