Agricultural Inputs & Harvest Among Fruit Producers in Rural Sri Lanka

Insights from a baseline survey of the Fruit and Vegetables for Sustainable Healthy Diets (FRESH) end-to-end evaluation

Research Brief #3 | September 2026

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Introduction

Repeated crises in Sri Lanka – the COVID-19 pandemic, economic crisis, and climate-related disruptions – have strained food systems and narrowed household access to nutritious foods, pushing many toward cheaper and more calorie-dense alternatives (1-5). These pressures have compounded an ongoing nutrition transition, in which rising consumption of ultra-processed foods coexists with persistent micronutrient deficiencies and increasing rates of overweight and obesity (6, 7).

Fruit and vegetables (F&V) are key sources of vitamins, minerals, dietary fiber, and phytochemicals, and adequate intake contributes to the reduction of both micronutrient deficiency and diet-related chronic diseases (8). However, intake of fruit and vegetables (F&V) falls well short of international and national recommendations: mean consumption in rural agricultural communities is approximately 118 (±117) grams of vegetables and 71 (±243) grams of fruit per person per day (9, 10), against the minimum of 400 grams per person per day according to the World Health Organization (WHO) and Sri Lanka's Food Based Dietary Guidelines (FBDG) (11). What farmers grow, their production practices, how much they harvest, and whether produce enters household consumption or local markets all shape the acceptability and availability of F&V at the household and community levels, making production data a necessary input for understanding and addressing low intake. This brief follows a companion brief on vegetable production and applies the same framing to fruit.

The CGIAR Science Program on Better Diets and Nutrition (BDN), previously the Fruit and Vegetables for Sustainable Healthy Diets (FRESH) initiative, integrates supply-side, demand-side, and food environment interventions across the food system. This brief presents baseline findings on fruit production from rural farming households enrolled in the FRESH end-to-end evaluation in Sri Lanka, documenting fruit crops grown, inputs used, pre-harvest losses, yields, and market orientation to inform supply-side intervention design and establish a benchmark for evaluation.

Methodology

Study design and participants

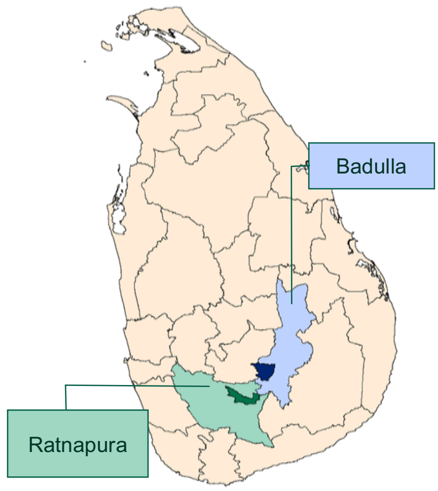
The FRESH Sri Lanka baseline study is a longitudinal cluster-matched and partially randomized controlled trial. Households were eligible for inclusion in the study if there was a woman of reproductive age (20-49 years) who consented to participate. The study was reviewed and approved by the Wayamba University of Sri Lanka Ethics Review Committee (No.: 202404H1) and the IFPRI Institutional Review Board (No.: NDH-24-0419MP); the full design is described in Research Brief #1 (12).

This brief is restricted to rural households that reported operating agricultural land. Of the 1,277 rural farming households in the study, 615 (48%) reported growing at least one fruit crop in the 12 months prior to the survey and form the analytic sample here. Households that farmed but did not produce fruit are excluded.

Study setting

Data were collected across two agroecologically distinct districts: Badulla (Uva Province), a highland area with cooler weather dominated by intensive commercial vegetable cultivation, and Ratnapura (Sabaragamuwa Province), a lowland district with warmer weather where rice-based farming systems predominate. Rural households were randomly selected from Grama Niladhari (GN) Divisions (smallest administrative sub-units) nested within specific Divisional Secretariat (DS) Divisions (third level administrative units) within each district. The sample is therefore not representative of either district or Sri Lanka as a whole.

Figure 1. Study locations



Note: Darker colors within districts indicate selected study areas

Data collection

Trained enumerators collected data from June and August 2024 in either Sinhala or Tamil languages based on respondent preference. Agricultural modules were completed by household heads and covered: plot characteristics (area and land type); seed variety (improved or hybrid vs local, traditional, or indigenous); fertilizer use (organic vs chemical); pesticide application (whether used and number of types); irrigation source (rainfall, river or stream, tube-well or agro-well, dam, reservoir, canal or lake, and pond, tank, spring, or anicut); fruit crops grown; quantities harvested; pre-harvest losses and their causes (birds, wild animals, insects, disease, and weather); and harvest utilization (household consumption, commercial sale, gifts, and other uses). Production data for the fruit crops covered the full 12-month recall period from June–August 2023 to June–August 2024, prior to the baseline survey, without seasonal disaggregation.

Analyses

All analyses were conducted at the household level and summarized by fruit crop type. Results are stratified by district, given that the two study areas were purposively selected to represent different farming systems and are not intended for direct statistical comparison.

Descriptive statistics such as counts, proportions, means, standard deviations (SD), medians and interquartile ranges (IQR) are reported throughout. Yields (tons per hectare) were compared to national averages published by the Department of Agriculture for 2023 and 2024 using data from the Department of Census and Statistics (13, 14). Market orientation was calculated as the ratio of total harvest sold to total harvest across all fruit crops, where 0 indicates fully subsistence-oriented production with no sales and 1 indicates fully commercial production with no self-consumption.

Results

Characteristics of fruit producing households

Of the 1,277 rural farming households in our sample, approximately half produced fruit crops, with similar representation across both Badulla and Ratnapura districts **(Table 1)**. Most fruit-producing households were male-headed. Household heads reported completing approximately 10 years of schooling; Ratnapura household heads were more likely to report farming as their primary livelihood than in Badulla (46% vs. 36%). Wealth distribution was broadly similar across districts; in fact, fruit producers were relatively wealthier than the average household in the sample.

Table 1. Characteristics of fruit farming households

Characteristics	Badulla	Ratnapura
Fruit producing households, n (%)	358 (47.7)	257 (48.8)
Male-headed households, n (%)	311 (86.9)	226 (87.9)
Household head is a farmer, n (%)	129 (36.0)	117 (45.5)
Years of schooling, mean (SD)	10.7 (2.7)	9.7 (3)
Age of household head, mean (SD)	51 (12.4)	50 (12.4)
Wealth index, n (%)		
Poorest	28 (7.8)	26 (10.1)
Below average	64 (17.9)	36 (14.0)
Average	78 (21.8)	57 (22.2)
Above average	90 (25.1)	62 (24.1)
Wealthiest	98 (27.4)	76 (29.6)
Agricultural inputs and outputs		
Any fertilizer use, n (%)	20 (5.6)	19 (7.5)
Inorganic fertilizer use, n (%)	11 (3.1)	15 (5.8)
Any pesticide use, n (%)	4 (1.1)	9 (3.5)
Land under fruit production (ha), median (IQR)	0.3 (0.1- 0.6)	0.5 (0.2-1.1)
Land under any agricultural production (ha), median (IQR)	0.4 (0.2-0.9)	0.6 (0.3-1.3)
Type of land, n (%)		
Homestead	260 (72.6)	232 (90.3)
Arable	94 (26.3)	44 (17.1)
Bush/forest	1 (0.3)	-
Other plot	6 (1.7)	1 (0.4)
Household produces only fruits, n (%)	84 (23.5)	63 (24.5)
Number of fruits produced, mean (SD)	3.5 (2.3)	4 (3.2)
Market orientation, median (IQR)	0 (0-0.4)	0.3 (0-0.7)

SD: standard deviation; IQR: interquartile range (25th percentile – 75th percentile); ha: hectare

Less than 10% of fruit producing households in either district applied any fertilizer, with inorganic fertilizer use reported by less than 1% of all fruit producing households. Pesticide application for fruit crops was also negligible (<5%). Production was concentrated on small homestead plots in both districts, though it was more pronounced in Ratnapura than in Badulla (90% vs. 73%). More than a quarter of Badulla fruit producers used arable land.

Commonly produced fruits

A variety of fruit crops were produced by rural households in our study during the past year (June 2023 to August 2024). The most commonly produced fruits across both districts included ripe banana, mango, avocado, guava, orange, fresh coconut, jack fruit, pomegranate, custard apple and papaya (or pawpaw).


Ripe banana


Mango


Avocado


Guava


Orange


King coconut


Jack fruit

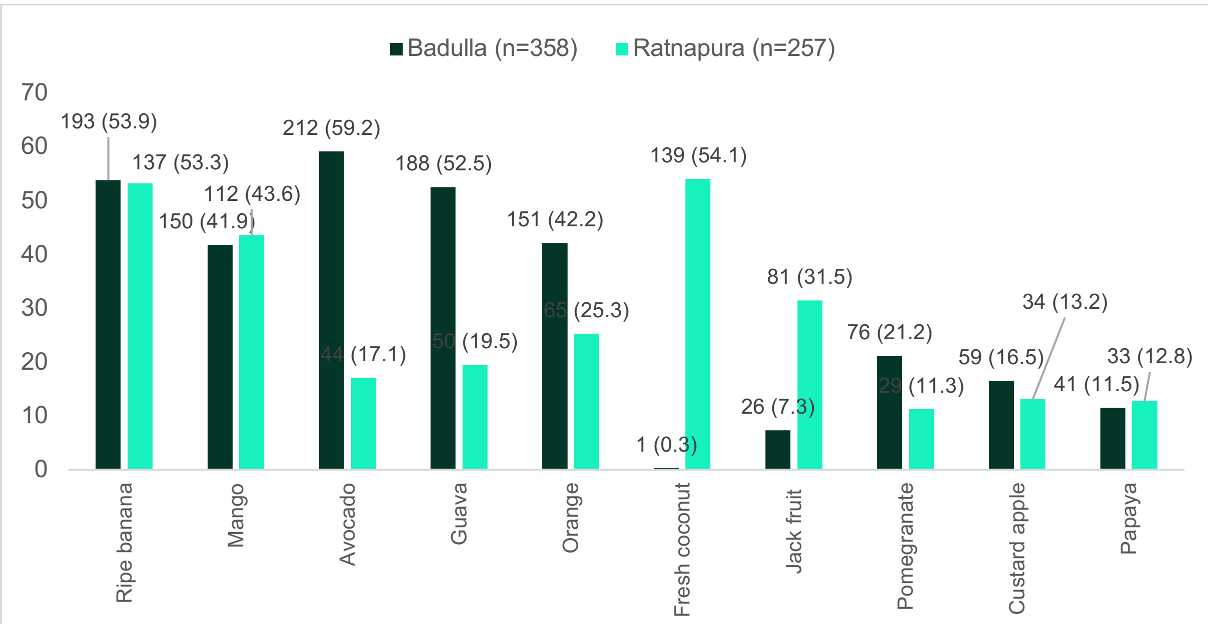

Pomegranate


Custard apple


Papaya

Ripe banana (~54%) and mango (~42%) were the most widely produced fruits across both districts, cultivated by roughly half of the fruit-producing households **(Figure 2)**. Beyond these two fruit crops, the two districts diverged considerably. For example, avocado was the most commonly produced fruit (59%), followed by guava (53%) and orange (42%) in Badulla; these fruit crops were substantially less prevalent in Ratnapura (17%, 20%, and 25%, respectively). Conversely, fresh coconut was produced by 54% of Ratnapura households but was virtually absent in Badulla (<1%). Similarly, jackfruit was more common in Ratnapura than in Badulla (32% vs. 7% of households). Pomegranate, custard apple, and papaya were produced by a minority of households in both districts.

Figure 2. Fruits produced by district between June 2023 and August 2024



Agricultural inputs

Production of the 10 fruits in both districts was characterized by low agricultural input use. Plots used for these 10 common fruit crops were small (mean = 0.1–0.2 ha), predominantly homestead-based, and largely rainfed (70–100%). Improved or hybrid variety adoption was minimal, with the highest uptake for orange in Badulla (27%), mango in Ratnapura (27%), and pomegranate in both districts (~21%). Fertilizer use and pesticide application were reported by less than 10% of fruit producing households.

LAND SIZE

0.1–0.2 ha

Smallholder plots, mostly homestead

Badulla: 73% homestead

Ratnapura: 90% homestead

IMPROVED/ HYBRID VARIETY

5–27%

of producers reported using improved or hybrid varieties; highest for orange in **Badulla** (27%), mango in **Ratnapura** (27%) and pomegranate in both districts (~21%)

FERTILIZER USE

≦ 8%

of producers reported fertilizer use for most fruits, except papaya in **Ratnapura** (24% of producers, 19% inorganic)

PESTICIDE APPLICATION

≦ 3.5%

of producers reported pesticide application to any of the 10 fruit crops across both districts

Two fruit-district combinations deviated from this general pattern of low agricultural input use. For instance, papaya producing households in Ratnapura showed relatively higher fertilizer use (24% of producers used any fertilizer; 19% of producers used inorganic fertilizers) and more diversified irrigation sources compared to other fruit producing households in that district (15% wells, 6% dam, reservoir, canal or lake). In Badulla, orange and pomegranate farmers showed modest supplementary irrigation via wells and ponds (17–20%) alongside limited fertilizer use for orange (7%); both were also more likely to be produced from improved varieties in the district.

70–100%
rain-fed

WATER SOURCE

Rainfall was the primary water source across both districts for fruit crop cultivation. **Ratnapura** was almost entirely rain-dependent (100% for 8 of 10 fruits). **Badulla** showed more diversification: wells and tanks supplemented rainfall for orange (18% wells, 20% tanks), pomegranate (17% wells, 18% tanks), and papaya (22% wells) cultivation.

Pre-harvest loss

The proportion of fruit producers who reported pre-harvest losses in fruit crops varied by fruit type and district **(Table 2)**. In Badulla, mango had the highest prevalence (33%) and severity of pre-harvest loss (24% mean loss), followed by papaya (27% producers; 20% mean loss). In Ratnapura, fresh coconut (67% producers; 37% mean loss), ripe banana (52% producers; 28% mean loss) and mango (48% producers; 33% mean loss) were the most affected fruits. Additionally, the proportion of households reporting pre-harvest losses was two to three times higher in Ratnapura than in Badulla for most fruit crops.

Table 2. Pre-harvest loss among fruit producing households

Pre-harvest loss	Households, n (%)		Proportion lost (%), mean (SD)	
	Badulla	Ratnapura	Badulla	Ratnapura
Ripe banana	48 (24.9)	71 (51.8)	13.9 (27.6)	27.8 (32.4)
Mango	50 (33.3)	54 (48.2)	24.3 (38.6)	32.8 (39.1)
Avocado	37 (17.5)	16 (36.4)	12 (30)	25.2 (38.2)
Guava	40 (21.3)	14 (28)	14.3 (30.8)	19.2 (34.2)
Orange	11 (7.3)	12 (18.5)	5.2 (20.4)	14 (32.2)
Fresh coconut	0 (0)	93 (66.9)	-	37.2 (33.9)
Jack fruit	3 (11.5)	37 (45.7)	8.1 (27.1)	26 (32.9)
Pomegranate	10 (13.2)	3 (10.3)	10.8 (29)	7.4 (23.9)
Custard apple	11 (18.6)	6 (17.6)	16.1 (36.1)	9.6 (24.2)
Papaya	11 (26.8)	15 (45.5)	20.2 (37.2)	19.1 (25.9)

-Implies no data because the crop was not grown or household did not experience loss.

The primary cause of pre-harvest losses did not differ significantly by fruit types or districts. Indeed, wild animals were reported as the main cause of pre-harvest losses for most fruits across Badulla and Ratnapura. It is also interesting to note that Badulla fruit producers reported higher concerns related to birds, disease and weather for pre-harvest losses than Ratnapura fruit producers, whose concern was almost exclusively wild animals. Common wild animals causing damage in the district include elephants, peacocks, Toque macaque (*Macaca sinica*), giant squirrel (*Ratufa macroura*), wild boar (*Sus scrofa*), and porcupines (*Hystrix indica*).

BADULLA

- 64% - 91% of households reported animals as the primary cause of pre-harvest losses across all fruit crops
- Birds affected 18–55% of most fruit crops at pre-harvest, with orange producing households most affected (55%)
- Disease was a concern for papaya (36%) and jack fruit (33%) producers
- Weather-related losses affected banana (25%), avocado (27%), and mango (14%) producers

RATNAPURA

- 80–100% of households reported animals as the primary cause of pre-harvest losses across all fruit crops
- Secondary causes of pre-harvest losses were minimal, with birds affecting papaya (27%) and mango (19%) producers, and disease affecting pomegranate (33%) and papaya (13%) producers
- Weather and other causes were negligible in this district

Harvest and utilization

Mean fruit harvests varied by fruit type and district **(Table 3)**. Ripe banana had the highest mean harvest in Badulla (12.5 t/ha), followed by avocado (7.9 t/ha). Jackfruit had the highest mean harvest in Ratnapura (9.7 t/ha), followed by papaya (6.4 t/ha). Mango, orange, guava, pomegranate, and custard apple harvests were low in both districts (≤5 t/ha). Where benchmarks were available, the fruit harvests generally fell below the national average yield. Avocado in Badulla was the exception with harvest being twice as high as the national average yields reported in both 2023 and 2024 (7.9 t/ha vs ~3.5t/ha)

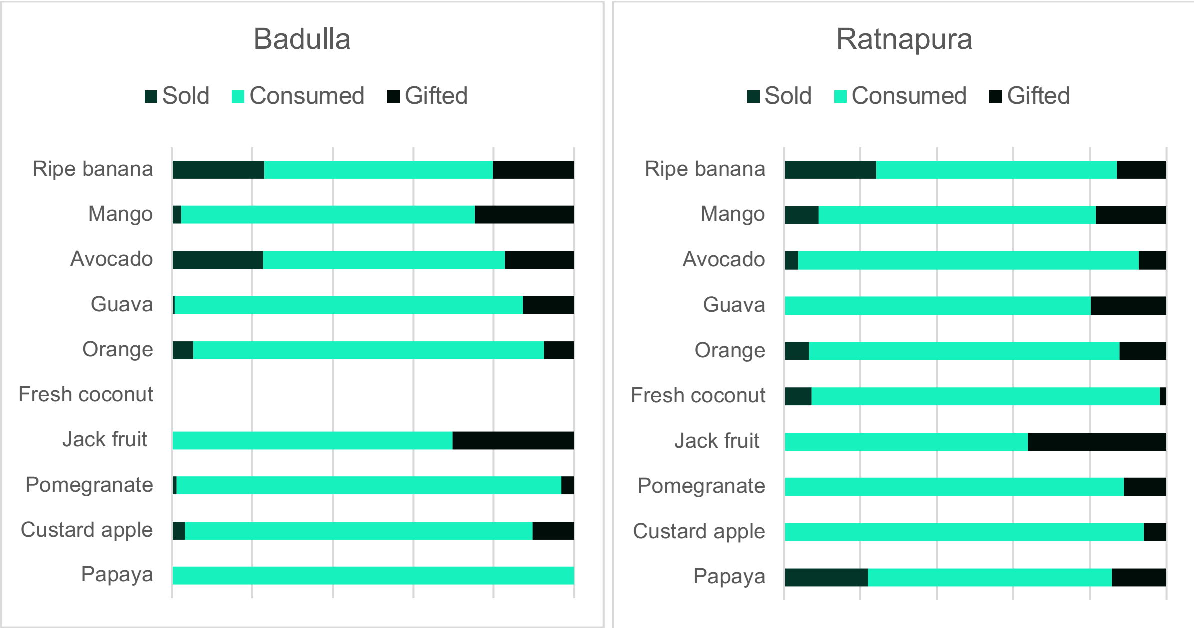
Table 3. Pesticide use among fruit producing households

Quantity harvested (t/ha)	FRESH Harvest, mean (SD)		Sri Lanka national production, mean	
	Badulla	Ratnapura	2023[1]	2024[2]
Ripe banana	12.5 (32.9)	6 (7.4)	17.5	18.3
Mango	4.6 (12.4)	2.6 (4.6)	6.9	6.1
Avocado	7.9 (14.8)	1.4 (1.5)	3.4	3.6
Guava	0.7 (1.9)	0.4 (0.6)	3.9	4.1
Orange	0.4 (0.5)	1.9 (3.8)	1.4	1.2
Fresh coconut	0 (0)	9.3 (12.2)	-	-
Jack fruit	1.1 (0.9)	9.7 (11.1)	-	-
Pomegranate	0.3 (0.6)	0.2 (0.2)	-	-
Custard apple	2.3 (8.2)	0.8 (1.4)	-	-
Papaya	0.7 (0.9)	6.4 (18.4)	18.4	17.6

[1] Agricultural Statistics 2024 (Vol XXI). Socio Economics and Planning Centre, Department of Agriculture.
[2] Agricultural Statistics 2025 (Vol XXII). Socio Economics and Planning Centre, Department of Agriculture.

Across both districts, fruit harvest was predominantly kept for household consumption rather than sold or gifted **(Figure 3)**. Commercial sales were concentrated in a small number of fruit-district combinations, e.g. ripe banana was the most consistently commercialized crop, with approximately 25% sold in both Badulla and Ratnapura. Avocado sales were substantial in Badulla (23%) but negligible in Ratnapura (4%), despite being the most widely grown fruit there. Conversely, papaya was sold by 22% of Ratnapura producers but not at all in Badulla. Jackfruit had the highest gifting share of any fruit, accounting for about a third of each district's harvest (30% Badulla, 36% Ratnapura). Pomegranate, custard apple, guava, and orange were almost entirely consumed at home, with sale shares below 7% across both districts.

Figure 3. Proportion of harvested fruits sold, consumed and gifted



Discussion

The baseline data reveals a fruit production system characterized by small homestead plots, minimal external inputs, near-total rainfall dependence, and low market orientation. Fertilizer use was at or below 8% and pesticide application was negligible (≤3.5%) across both districts. Market orientation was low in both districts, with Badulla producers at the median selling none of their fruit harvest (median = 0) and Ratnapura producers selling a small share (median = 0.3). These features held despite considerable differences in fruit mix: avocado, guava, and orange leading in Badulla, while fresh coconut and jackfruit were more prevalent in Ratnapura. Differences in land type between districts, with arable land more common in Badulla and homestead plots almost universal in Ratnapura, likely reflect underlying variations in land availability, tenure arrangements, and farming-system orientation, each of which carries implications for how supply-side support can be structured. Within this low-input pattern, orange and pomegranate were notable exceptions: among households that grew these fruits, improved or hybrid varieties were substantially higher than for any other fruit, particularly in Badulla. This suggests that commercial hybrid variety systems exist for at least a subset of fruit crops and could be a lever for supply-side engagement, where agronomic conditions support it.

Pre-harvest losses were high and more prevalent in Ratnapura than in Badulla across most fruit crops. Wild animals were the dominant cause in both districts, but Badulla producers reported a more varied pre-harvest loss profile, including birds, disease, and weather, each affecting specific fruits, while Ratnapura losses were almost exclusively driven by local wild animals. These fruit- and district-specific patterns should inform the targeting of loss-reduction strategies rather than a uniform approach across the program areas.

Reported harvests fell below national benchmarks for most fruits where comparisons were available, though standard deviations exceeded means throughout, indicating that a small number of higher-yielding farms pulled averages up. Mean yields are therefore unlikely to represent typical fruit producers. The yield gaps are likely compounded by several intersecting factors: the predominantly subsistence orientation of fruit production in both districts reduces incentive for input intensification; farm plots are small, limiting the scale at which productivity-enhancing practices can translate into marketable surplus; and pre-harvest losses further reduce harvestable outputs before any agronomic gains can be realized. The district-level pattern of harvests also points to fruit-specific priorities: fruits with the largest yield gaps relative to national benchmarks, and with sufficient producer prevalence, represent the most tractable targets for supply-side productivity support in each area. Whether agronomic constraints or market access limitations are independently binding cannot be determined from this baseline alone and warrants further investigation.

Conclusion

Fruit production among rural households in Badulla and Ratnapura was small-scale, low-input, and oriented primarily toward household consumption at baseline. Pre-harvest losses, predominantly driven by local wild animals, were high across both districts, and harvests fell below national benchmarks for most fruits, where comparisons were available. These findings establish a baseline against which the effects of FRESH supply-side interventions can be assessed and provide an initial basis for targeting support toward the fruit-district combinations where production constraints are most pronounced.

Key messages

This brief presents baseline findings on fruit production from 615 rural farming households in Badulla and Ratnapura districts to inform supply-side intervention design and evaluation within the FRESH initiative. Findings are neither nationally nor regionally representative of Sri Lanka.

Production Patterns:

- Ripe banana and mango were the most widely grown fruit crops in both districts. Beyond these, fruit portfolios diverged sharply by agroecology: avocado, guava, and orange were more common in Badulla, while coconut and jackfruit were more prevalent in Ratnapura.
- Fruit production was small-scale and homestead-based, with low market orientation in both districts.

Agricultural Inputs:

- Fruit production operated largely outside formal input systems, with fertilizer use (≤8%) and pesticide application (≤3.5%) negligible across both districts, and near-total dependence on rainfall for irrigation.
- Improved or hybrid variety adoption was low across most fruits, with the exception of orange in Badulla (27%), mango in Ratnapura (27%), and pomegranate in both districts (~21%), suggesting that commercial seed systems exist.

Harvest and Utilization:

- Pre-harvest losses were high across both districts and predominantly driven by wild animal damage, with losses more prevalent in Ratnapura than Badulla for most fruit crops. Identifying feasible loss-reduction strategies for the most affected fruit-district combinations needs to be a priority for supply-side implementation.
- Harvests fell below district and national benchmarks for most crops where comparisons were available, though high within-sample variability limits interpretation. Whether yield gaps reflect agronomic constraints, pre-harvest losses, or smallholder scale warrants further investigation.
- Fruit harvest was primarily used for self-consumption rather than sale, gifts or other uses; Ripe banana was the most sold fruit (~25%) while jackfruit was the most gifted fruit (~33%) in both districts.

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ACKNOWLEDGEMENT

We gratefully acknowledge all respondents for their time and willingness to participate in this study, as well as the field team from Kandy Consulting Group for their efforts in data collection. We also acknowledge Prof. Renuka Silva from Wayamba University of Sri Lanka for his role as country lead, Quinn Marshall from the International Food Policy Research Institute for his role as co-Principal Investigator and Sonja Hess from University of California Davis for her role as co-Investigator in this study.

We would like to thank all funders who support this research through their contributions to the CGIAR Trust Fund: www.cgiar.org/funders

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Cover & Page 5: Duleesha Nisansala and Mohamed Aheeyar, International Water Management Institute, Sri Lanka.
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CGIAR BETTER DIETS AND NUTRITION

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We would like to thank all funders who support this research through their contributions to the CGIAR Trust Fund: www.cgiar.org/funders.