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# Evaluation of Short Organic Food Supply Chains with Special Reference to Climate Smartness - The Case of Direct Farmers' Market, Kurunegala, Sri Lanka

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## ABSTRACT

***Purpose:*** *Good Agricultural Practices (GAP), Participatory Guarantee System (PGS), Climate Smart Agriculture (CSA) and direct organic farmers' markets (supply chains) with GAP and PGS for CSA are relatively new concepts and applications have not much studied. This study was carried out to evaluate the climate smartness of short organic food supply chains in a direct farmers' market in Kurunegala, Sri Lanka.*

***Research Method:*** *Data were collected from all farmer venders (50) of the direct organic farmers' market using a structured interview schedule and from two venders through in-depth interviews and observations. The economic, social and environmental sustainability aspects were assessed as the components of CSA.*

***Findings:*** *Results revealed that the income of farmer venders increased after joining the organic direct market and that was stable throughout the year achieving the economic sustainability. Involvement of small-scale farmers, adopting climate resilient production practices, access to information and markets, institutional support and collective actions were identified along the value chains as the elements of social sustainability. The average Green House Gas (GHG) emission along the two selected value chains of the direct market had reduced after joining the farmers market depicting the environmental sustainability. Therefore, the studied organic direct farmers' market was climate smart.*

***Research Limitations:*** *Only two value chains of the market was studied due to its' complexity and time and resource limitations. The calculations of GHG emission were based on default values as there were no country specific values. Therefore, the calculated GHG emission values are approximate.*

***Originality/Value:*** *The findings of the study are novel as most of the concepts studied are relatively new. Therefore, findings are important for understanding and future interventions.*

**Keywords:** *Climate Change, Climate Smart Agriculture, Direct Farmers' Markets, Organic Food Supply Chains*

## INTRODUCTION

Nearly within past two decades, the world is facing considerable changes in climate and these changes have affected lives of the people directly and indirectly at different scales and Sri Lanka is not an exception. Climate trends of Sri Lanka include increased mean annual temperature, daytime maximum temperatures, mean night-time minimum temperatures, decrease in island-wide mean annual precipitation, sea level rise and also the increased frequency and intensity of floods and droughts (USAID, 2018). Agriculture has a significant contribution for climate change and climate change has a significant negative effect on agriculture (Yohannes, 2016). Therefore, the scientists work on climate change and agriculture have identified the need of climate change adaptation and mitigation measures. The concept of Climate Smart Agriculture (CSA) was originated in order to ensure the sustainability of agriculture and food security within the

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context of climate change. "CSA is an approach for transforming and re-orienting agricultural systems to support food security under the new realities of climate change" (Lipper *et al.,* 2014). Developing sustainable and inclusive food value chains is an important aspect to achieve CSA objectives. In order to be climate smart, food supply chains should be i) economically, ii) socially and iii) environmentally sustainable (FAO,2013). In general, research on impact of climate change shocks on different types of food supply chains is still in its infancy (Reardon and Zilberman, 2018) and therefore, needs to pay more attention. Farmers' (direct) markets are a way to develop climate smart food supply chains. "Farmers' markets are food markets where farmers and producers bring their produce for sale directly to the public" (Bullock., 2000). Accordingly, the direct markets are not a new concept to the Sri Lanka. Historically, the direct sales of fruits and vegetables by farmers to the consumers were practiced as a marketing system and considered as a source of fresh fruits and vegetables (Vidanapathirana, Priyadarshana and Rambukwella, 2011). The traditional periodic rural market (*pola*) is one such system which can be considered as a direct market (Priyankara, 2016). However, there can be farmers as well as the intermediaries in these traditional markets. Mostly, the sellers are intermediaries. Also, at present, almost all of the fruits and vegetables sell at these markets are not organic and have not produced adhering to the Good Agricultural Practices (GAP). The newly established *Kurunegala Wayamba Isuru* Farmers' Market is a direct market which sells agricultural produce certified with Good Agricultural Practices (GAP) and Participatory Guarantee System (PGS) which helps to achieve CSA. GAP is a "collection of principles to apply for on-farm production and postproduction processes, resulting in safe and healthy food and non-food agricultural products, while taking into account economic, social and environmental sustainability" (FAO, 2003). The difference of this market from a traditional direct market is almost all the vendors who sell agricultural produce are rural farmers and they have agreed upon to follow GAP and PGS.

"PGS is a low-cost, locally based system of quality assurance with a strong emphasis on social control and knowledge building". This system is based on the active participation of farmers, consumers, rural advisors and local authorities: they come together in order to make decisions, visit farms, support each other and check that farmers are producing according to an organic standard". (Participatory Guarantee Systems | FAO, 2018).

Therefore, this market is certified as an organic market as it has GAP and PGS certification. The Provincial Department of Agriculture, North-Western Province was acting as the quality assurance body as it was in charge of technical support for the direct farmers' market.

The *Wayamba Isuru* farmers' market in Kurunegala district, Sri Lanka was implemented by the Provincial Department of Agriculture, North Western Province (PDOANWP) of Sri Lanka with the support of Climate Change Adaptation Project (CCAP) which was implemented by the United Nations Development Programme (UNDP) in collaboration with the Ministry of Disaster Management. This market was facilitated by Jana Thakshan which is a Non-Government Organization. The Provincial Department of Agriculture also served as the technical party in quality assurance. Major objective of this market was to increase the income of rural ecological producers who are trying to adapt eco-friendly agricultural practices as an adaptation practice for climate change.

Another example for this kind of an organic food market in Sri Lanka is "Good Market" in Read Avenue, Colombo. Good Market operates as a not-for-profit, self-financing social enterprise. It does not have private owners and does not issue dividends. In 2012 December, the American Dr. Amanda Kiessel founded a small weekly market in the capital selling regional organic products and sustainable goods. Good Market offers its services as a marketing platform where organic farmers and the manufacturers of sustainable, environmentally friendly, fair trade products and natural cosmetics, etc. can make their goods available to consumers.

These types of markets have short supply chains. 'Short Food Supply Chains' are where the number of intermediaries is minimized, the

ideal being a direct contact between the producer and the consumer. (Kneafsey *et al.,* 2013). Accordingly, *Wayamba Isuru* farmers' organic market is consisted of short food supply chains since almost vendors were farmers who sell their own produce directly to the consumers.

Research evidence of evaluation and documentation of such markets in Sri Lanka with special reference to CSA is meagre. Thus, the objective of this study was to evaluate the climate smartness of short food supply chains of a newly established organic direct farmers' market in Kurunegala based on its' economic, social and environmental sustainability.

## MATERIALS AND METHODS

Mixed research methodology was adapted in this study enabling both quantitative and qualitative exploration. The Kurunegala *Wayamba Isuru* direct farmers' market which was located at the premises of Provincial Department of Agriculture, North Western Province of Sri Lanka was studied as a case. All active members (50) who were farmer vendors selling their organic products at the market were interviewed using a structured interview schedule. Data were collected under background information, income, farming information, producer group information, access to information, support from external institutes, access to market, practice of eco-friendly farming methods, level of satisfaction and attitudes. Two farmers (male and a female) were selected based on income earned from the market (highest and middle) for the in-depth exploration and supply chain analysis in the perspective of climate smartness. Economic sustainability was measured through income gain of the stakeholders in the direct farmers' market. Income records of the producer group were observed for cross tabulation. Social sustainability (resilience to climate change) was measured through the level of smallholder involvement, adopting sustainable and climate resilience production practices, access to information and knowledge, access to market and support from external institutes. Environmental sustainability of the selected two cases was measured by Green House Gas (GHG) emission along the supply chain. GHG emission calculation was done using IPCC Inventory Software (http://www.ipcc-nggip.iges.or.jp/software/index.html) using collected data from two selected venders at production level and transportation. The annual crop yield, amount of fertilizer applied, land extent, number of animals reared were collected as the field data at the production level in two selected cases. Distance from farm to market, transport mode, weight of the transported bulk was also considered in calculation of GHG emission.

Key informant discussions were held with different stakeholders of the direct farmers' market, Kurunegala. Former Provincial Director of the Provincial Department of Agriculture, North-Western Province, Co-coordinator from UNDP, Co-coordinator from *Jana Thakshan*, President of *Wayamba Isuru* Venders' Forum were interviewed as the key informants using a checklist. Three discontinued members (inactive) were telephone interviewed in order to identify the factors affected on discontinuation. Few (5) consumers were also interviewed. Interviews were audio recorded with the permission of the interviewee. Several visits (10 times) to the farmer market were made during the study period to observe and collect data. Compiled documents of the Farmers' Market by the Provincial Department of Agriculture, (NWP) were also used as the secondary sources.

Data were analyzed by the Statistical Package for Social Sciences (SPSS) software. Both descriptive and inferential statistics were used for the quantitative analysis. Climate smartness was measured on the basis of economic, social and environmental sustainability. Environmental sustainability was measured using GHG emission. IPCC Inventory Software was used to calculate GHG emission based on the data collected at producer level and transportation. Field data such as the annual crop yield, amount of fertilizer applied, land extent, number of animals reared were collected at the producer level. Qualitative analysis was employed through several steps. They were data reading, coding, displaying, reducing and interpretation according

to Creswell (2009). Wilcoxon signed-rank test was used to compare the monthly income of the farmer vendors before and after joining the farmers' market.

## RESULTS AND DISCUSSION

### *Background of the Organic Farmers' Direct Market*

The studied market (*Wayamba Isuru* direct farmers market) was established in the year of 2017. Altogether, there were 50 active farmer vendors of the direct farmer market in Kurunegala at the time of investigation. Among them, the majority (64%) was female and 36% was male. In terms of age, 52% was 31- 50 years, 46% was more than 50 years and only 2% was less than 30 years. Half of the respondents had studied up to GCE ordinary level and 24% up to GCE advanced level, 8% up to a bachelor's degree while the education level of the rest (18%) was less than GCE ordinary level. The majority of vendors (48) were farmers except 2 vendors who were selling value added agro based products at the farmers' market.

Farmers who wish to join the market are needed to sign an agreement with the Provincial Department of Agriculture, North Western Province, stating that they do not use agro-chemicals during the production process. They can bring their produce to the market once the Agricultural Instructor of the area certifies that the particular farmer is adhered to the agreement on organic production. Farmers who are registered in the farmers' market are also required to form village level producer groups together with neighboring farmers who like to produce according to the standards of the agreement. Members of such producer groups are allowed to bring their produce to the farmers' market. This market is held weekly on every Saturday.

### *Does the Supply Chains of the Organic Farmers' Direct Market Climate Smart?*

"Value chains are also vulnerable to pests and diseases; environmental degradation; changes in supply or demand; price fluctuations; logistical and infrastructural risks; financial, monetary, fiscal and tax policies; political risks; and security-related risks" (Mwongera *et al.,* 2018) Therefore, value chain analysis is important for in-depth understanding of climate smartness at different phases which are vulnerable to climate change. Several factors should be considered when developing a climate smart food supply chain. Accordingly, the supply chain should be economically, socially and environmentally sustainable. Therefore, climate smartness at different phases of the supply chains in farmers' market is discussed based on economic, social and environmental sustainability criteria while linking to the in-depth analysis of the two selected cases where possible.

**Figure 01: Organic Farmers' Direct Market**

***Economic Sustainability***

Economic sustainability; refers to a value chain performance that provides equal or higher profits or incomes for each stakeholder. Economic sustainability was analyzed based on the income and profit gain among stakeholders at different phases of the supply chains. In the direct farmer market, mostly (98%), the producer and the retail seller was the same person because there were no intermediaries in the supply chain. Once their main source of income is secured, they can be considered as economically sustainable.

The approximate monthly income level of the 50 vendors was analyzed. The results of Wilcoxon signed-rank test revealed that, there was a significant difference ($Z = -5.717$, $p = 0.000$) between monthly income before and after joining the farmers' market. The Table 01 compares the income of vendors before and after joining the farmers' market.

According to the table 01, the mean value of monthly income from farming was higher than that of before joining the farmers' market. The reason might be the absence of intermediaries along the value chain and therefore, the ability of producers to gain the total income without sharing with the intermediaries. Studies show that a supply chain can be developed as a sustainable supply chain if farmers are the immediate suppliers for food businesses and there is an opportunity to incorporate higher-level sustainable agriculture criteria into supply contracts (Smith, 2008). Furthermore, the minimum value before joining the market is zero. That is especially because of the women who did not have any income from farming, had joined with the market to sell the organic produce from their home gardens and started receiving an income. Therefore, it can be stated that the direct farmers' market has contributed to the economic empowerment of rural women.

According to the key informant discussion which was held with the former Provincial Director of Agriculture, North Western Province, it was revealed that, at the beginning, (March, 2017), only few vendors had their own electronic balances for weighing. At the end of 2017, majority of the vendors had their own electronic balances. It can be considered as evidence that vendors have gained a higher income and they have invested their income for the success of their business. According to the observations made, all most all the vendors had electronic balances except few.

A Coordinator from UNDP at the key informant discussion revealed that at the beginning of the farmers' market, the venders were financially supported for their transport cost. At the end of 2017, the financial support for transport was discontinued but, the venders had continued their business at the farmers' market while bearing the transport cost by their own. It was another evidence for improvement of the vender's economic status and profits after joining with the farmers' market.

According to the above facts, it can be interpreted that, venders who were producers as well, were economically sustainable, at the market level of the supply chains in farmers' market as they have improved their income after joining the farmers' market.

**Table 01: Comparison of monthly income of the venders before and after joining the market**

| | Monthly Income from Farming (Rs.) after joining the direct market | Monthly income from farming before joining the direct market (Rs.) |
|---|---|---|
| Mean | 37977.77 (215.42 USD) | 22622.22 (128.32 USD) |
| Median | 20000.00 (113.44 USD) | 10000.00 (56.72 USD) |
| Minimum | 8000.00 (45.38 USD) | 0.00 (0 USD) |
| Maximum | 200000.00 (1134.43 USD) | 150000.00 (850.82 USD) |

***Economic Sustainability of the Two Selected Cases for in-depth Analysis***

Two farmers (male and a female) were selected based on the income earned from the market (highest and middle) for the in-depth interviews and supply chain analysis in the perspective of climate smartness.

***Case 1: Background***

According to the structured interviews and secondary data collected from Provincial Department of Agriculture, the farmer vendor who had an income which was fluctuated around the mean of the monthly income was a woman vendor in the farmers' market. She had received GAP and PGS certificates to produce and sell organic produce at the market. She was 55 years old and a mother of three daughters. She had nearly 40 years of experience in farming from her childhood and educated up to the Advanced Level of the primary education. Before the woman vendor joining the farmers' market, her husband was engaged in selling agricultural produce collected from the village in weekly fairs other than farming. Even though she had a fairly good educational background, she had not applied for other jobs. As she mentioned, that was mainly because of the gender stereotyping within her family and the community. She was happy that she could contribute to the family income and her economic empowerment and gained social recognition by joining the farmers' market.

***Income from farming***

Before the woman vendor joining the farmers' market, the monthly income of the family from farming was approximately around Rs. 20,000. She had not involved in selling their agricultural produce before joining with the farmers' market although she joined her husband in the production process. She was able to double the family income after joining the organic farmers' direct market. The table 02 shows the monthly income of the woman in a selected month. (October 2017). That was the last month at the time of conducting the research. The woman was able to maintain that income throughout the year. She revealed that her profit also increased as the income increased and she could earn a stable income throughout the year. Therefore, the organic farmers' direct market had helped the farmers to increase their income leading to economic sustainability.

**Table 02: Income of the woman vendor for the month of October 2017**

| Week | Income (Rs.) |
|---|---|
| 1st week | 9500.00 (53.89 USD) |
| 2nd week | 12000.00 (68.07 USD) |
| 3rd week | 12000.00 (68.07 USD) |
| 4th week | 15000.00 (85.08 USD) |
| Total | 48500.00 (275.10 USD) |

**Table 03: Income of the farmer vender from the direct market for the month of October 2017**

| Week | Income (Rs.) |
|---|---|
| 1st week | 55000.00 (311.97 USD) |
| 2nd week | 65000.00 (368.69 USD) |
| 3rd week | 63000.00 (357.35 USD) |
| 4th week | 52000.00 (294.95 USD) |
| Total | 235000.00 (1332.96 USD) |

***Case 2: Background***

The farmer vendor who had earned the highest income from farmers' market was a male at the age of 48. He was a member of the producer group having GAP and PGS certificates. He owned a comparatively large land extent (5acers) for cultivation. Other than selling his own produce at the market he also collected the produce from his producer group who had the GAP and PGS certificates for producing organic food for selling. That was another reason for him to earn the highest income at the market.

The farmer was able to double the income after joining the farmers' market. He stated that his profit was also satisfactorily increased as the income increased. According to both cases studied, the farmer vendors were able to receive a fair amount of income throughout the 04 weeks of study. They also mentioned that they were able to receive a good income throughout the year. Therefore, both cases provided an evidence for economic sustainability of the farmers' direct market.

***Social Sustainability (Resilience to Climate Change)***

Social sustainability; refers to resilience to climate change and value chain performance where additional value is created (additional profits and wage incomes) that benefits a large number of poor households, which is equitably distributed along the value chain and has no impact that would be socially unacceptable, including no socially objectionable practices like unhealthy work conditions, child labour, violation of strong cultural traditions, etc. (FAO 2013). In the present study, social sustainability was analyzed at different phases of the supply chains. It was analyzed using several variables namely, smallholder involvement, adopting sustainable and climate resilient production practices, access to information and knowledge, access to market and support from external institutes. The selected two cases were also studied in the perspective of social sustainability.

***Smallholder Involvement***

According to, Hussain & Thapa (2012), "smallholder farmer" is defined as farmers those who depend on small-scale subsistence farming as their primary source of income. Smallholders use mainly family labour for production. The average size of actual area cultivated is only 0.8 – 2 hectares or less. In *Wayamba Isuru* Farmers' market, 84% of the vendors were smallholder farmers who owned a total land extent less than 2 acres.

Usually, smallholders are highly vulnerable to climate change. Therefore, vulnerability of the smallholders should be reduced to protect them from climate change impacts. Higher the smallholder involvement in a supply chain, higher the resilience to climate change. The smallholder involvement was higher in the supply chains of the farmers' market. Therefore, the resilience to climate change of the stakeholders of the supply chains of farmers' market at the producer (small holder) level was high.

Focusing on the case 1 of the in-depth interview, she (the vendor) was a smallholder farmer as she owned only 2 acres of land. From that, 0.5 acres were allocated for a rain water harvesting tank (*Pathaha*) where she used to irrigate her crops cultivated. In case 2, the farmer cannot be considered as a small-scale farmer. He had a land area of 5 Acres. However, he helps the small-scale farmers in his producer group who produce in small scales by acting as an intermediary for them without unreasonable profit margins.

***Adopting Sustainable and Climate Resilient Production Practices***

Adapting sustainable and climate resilient production practices is important for climate resilient in agriculture. Cropping calendar of Sri Lanka (*yala* and *maha*) is based on the two main rainfall seasons. Therefore, rainfall plays an important role in Sri Lankan agriculture. Any excess or shortage of rainfall has higher influence on agricultural production. Adaptation

of sustainable and climate resilient production practices is the best solution to face the climate change challenges in agriculture than the mitigation.

Food safety certification guarantees the customers that the produce they are buying has been grown, harvested, and handled in a manner that minimizes the risk of contamination. Certification communicates that the farm or farmer has made a commitment to provide food that is safe. (Vaughan, *et al.,* 2014). In *Wayamba Isuru* direct Farmers' Market, there was an agreement among the farmers, namely the "promise for organic production". It was basically a set of promises to practice Good Agricultural Practices (GAP) such as crop rotation, mixed cropping, planting insect repellant crops in the field, use of pheromone traps, use of light traps, use of bio control agents, integrated farming, rainwater conservation, use of traditional/indigenous methods (*Kem*) and practice of new organic methods and to bring only quality organic products to the farmers' market. The awareness of the producers on GAP is an important aspect of implementation. According to a study conducted by Karalliyadda and Kazunari, 2018 in Sri Lanka, the majority of farmers were unaware of the considered quality standards in agricultural production. However, the awareness level of the vendors of the studied direct farmers market on the agreement was high (Table 04).

The table 05 shows the level of practice of the agreed practices by the respondents. Accordingly, the majority (67%) adhered to the all agreed practices. However, 33% had not practiced few GAP in the agreement due to some limitations. Therefore, the necessary actions such as proper monitoring and regulation should be implemented in advance.

The figure 02 shows the level of practice of some GAP by the respondents.

In general, higher proportion of vendors practiced eco-friendly farming methods. The major reason might be training programmes conducted by the Provincial Department of Agriculture, and other external institutions to impart knowledge on eco-friendly farming methods. Another reason may be their requirement to use the market opportunity at the farmers' market. Adaptation of eco-friendly farming methods, increases the resilience of the vulnerable communities to climate change.

**Table 04: Level of awareness on *Kabanika Govi Poronduwa***

| Level of Awareness | Percentage (%) |
|---|---|
| Completely aware | 71% |
| To a some extent | 20% |
| Aware | 9% |
| Not aware | 0% |

**Table 05: Level of practice of *Kabanika Govi Poronduwa***

| Level of practice | Percentage of the venders |
|---|---|
| All practices | 67% |
| Almost all, except few | 33% |
| Not any practice | 0% |

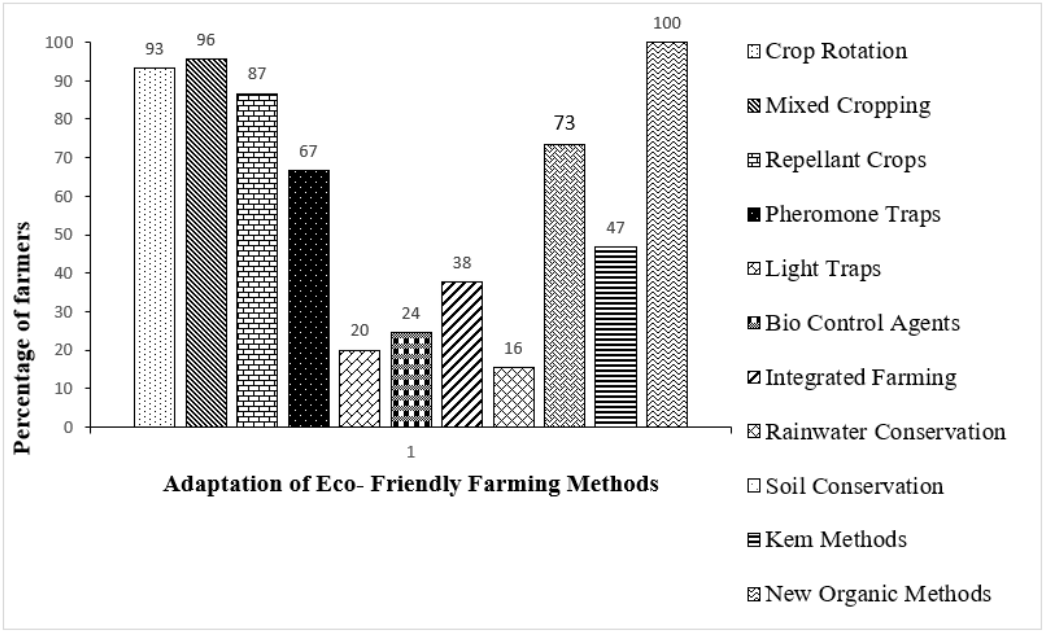


**Figure 02: Level of practice of some Good Agricultural Practices by the respondents**

Crop rotation and mixed cropping are considered as eco-friendly farming practices since that avoid some pest and disease attacks for food crops consequently minimizing or with no use of agro chemicals. In Case 1 from selected two cases; the vendor woman was practicing crop rotation in every cultivation season. She was also practicing mixed cropping. She had cultivated around 15 crop varieties belonging to different species. Crop diversification is also a best practice to reduce vulnerability to climate change. Cultivation of underutilized crops like *Alanga, kiri Handa, Anguna, Ratala and* Anona are important since those species are less susceptible to pest and diseases and can be cultivated under minimum soil and water conditions while reducing the vulnerability to climate change. Another benefit is that the farmer can have a continuous income throughout the year as different crops give their harvest at different times.

The crop livestock integration is another good practice. The woman in case 1was rearing goats in her home garden and she uses goat manure as organic fertilizer for her cultivation. She also makes compost by her own. Therefore, she does not need to buy any other organic fertilizers from outside for food crops as she applies them together with crop residues. Maho area which she lives receives less rainfall during some seasons (especially in *yala*) since it belongs to the Dry Zone. Therefore, the main problem of farmers in that area is lack of irrigation water for their cultivation. The woman had decided to have a rain water harvesting tank in her own land with her experience of prolong droughts. At present, it is the source of irrigation water for her cultivation. It is also considered as an adaptation to climate change, since farmers can conserve rainwater for a longer period. Furthermore, it contributes to increase the water levels in drinking water wells by recharging the ground water level in the particular land area. Furthermore, she was practicing new organic methods such as preparing vermi-compost as a liquid fertilizer, and traditional method of preparing some leaf extracts as insecticides and pesticides depicting the adherence to eco- friendly and GAP leading to climate resilient.

Focusing on Case 2; the farmer vendor was practising several climate resilient production practices. As observed, he was practicing crop rotation and mixed cropping (cowpea, maize, rice, tomato, bitter gourd, coconut, banana, lime and Annona) leading to sustainable agriculture and therefore, contributing to resilience to climate change. He was able to have a continuous income due to this crop diversification.

**Figure 03:** ***Suwandel*** **paddy cultivation with coconut as an intercropping**

As observed, another factor of success of the vendor (farmer) was having an agro-well in his own land as the source of irrigation. Agro-wells are important in extracting ground water for agriculture. The farmer had adapted some organic practices, such as using Neem extraction and preparation of vermi-compost. Furthermore, he had grown repellent plants and adapted soil conservation methods as GAP leading to climate smart agriculture. However, he was not practicing compost production in his own farm. He stated that the time is a limiting factor for him since he also acts as an intermediary in collecting other farmers' produce.

***Access to Information***

Access to information and knowledge of the vendors at the producer level in the supply chains was also another factor that affects social sustainability of the supply chain with reference to climate smart agriculture. If the access to information is high, that will help people to get adequate knowledge on how to overcome climate change related issues and how to manage their farming and other practices in a more climate resilient way.

In the farmers' market, farmer vendors had adequate sources of information to receive necessary information on GAP, PGS and marketing. Individual direct contacts with the officers, visits by extension officers, group discussions with the extension officers and farmer meetings at the extension office were the most popular sources of the farmers to meet their information and training needs. Figure 03.5 shows the use of different information sources by the farmer vendors of the market.

According to Figure 04, individual direct contacts with the officers (96%), visits by extension officers (96%), group discussions with the extension officers (92%), farmer meetings at the extension office (92%) were the most popular sources of information for the respondents. These results revealed that there was a rigorous project intervention to fulfil the information and training needs of the farmers. However, adequate and continuous support will be helpful to sustain the direct farmers' market even after the project intervention. A less percentage of farmers used hotlines (8%), web sites (8%) and listened radio programmes (30%). The reasons for less use of websites and hotlines might be the less accessibility, affordability and less ICT literacy of the farmers.

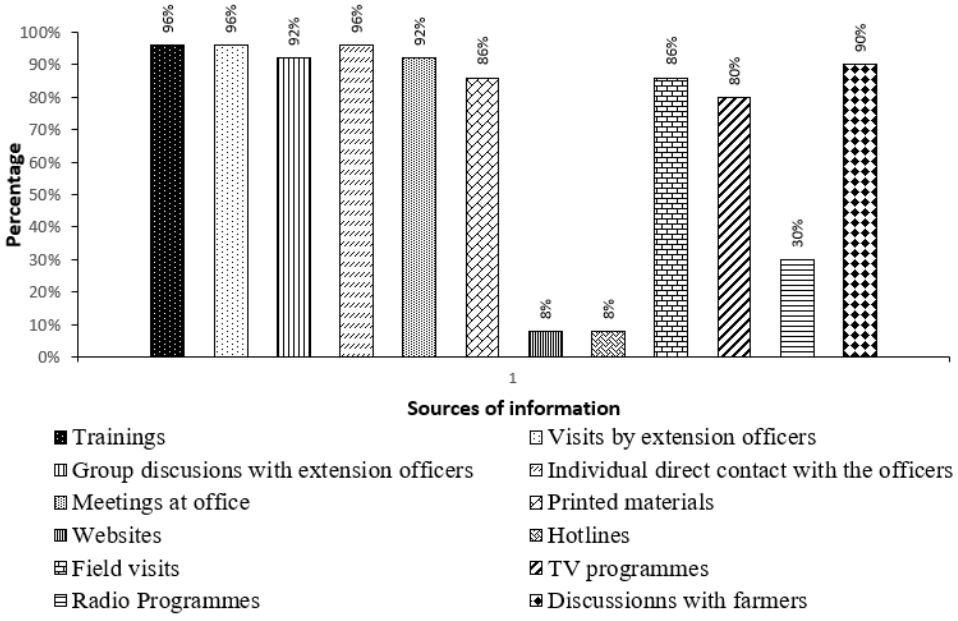


**Figure 04: Different information sources used by the farmer vendors**

When considering the studied case 1 from selected two cases for in-depth analysis, the respondent had received a number of opportunities for training programmes to acquire necessary knowledge, skills and attitudes for her production according to GAP and PGS. Being a member of the women's society, the respondent had received necessary exposure. She had participated in several residential workshops and field visits. Those trainings had supported her to develop her knowledge, skills and attitudes. Furthermore, she was very curious about acquiring knowledge on new agricultural techniques. She had frequently contacted the Agricultural Instructor (AI) of the area whenever she faced a problem. She also had participated continuously in monthly meetings of her producer group. She also mentioned that these meetings were helpful to discuss things with fellow farmers. Furthermore, she had collected relevant information from agricultural magazines, leaflets and newspaper articles.

When focusing on Case 2; the farmer vendor had participated in a number of trainings which were organized by the Department of Agriculture and Department of Agrarian Development. When there is a problem related to his farming, he had contacted the AI and had discussed with him. As he revealed, he had a close relationship with AI that he could call him on telephone whenever he needed a support from the AI. He also had participated in several field visits and stated that it was a great opportunity for him to participate in field visits, as he could learn by observations of success cases and experience sharing. The farmer also had attempted to learn from collected agricultural magazines, leaflets, newspaper articles etc. He had used electronic media such as television and radio to improve his knowledge on agriculture. According to these facts, the respondent had adequate sources of information and was satisfied with access to information.

### *Access to Market*

Sufficient access to market is important to have a secured income while ensuring the social sustainability. In addition, risk and uncertainty of marketing is high when the farmers depend only on one market channel in selling their produce. In the studied direct farmers market, only 32% of the venders sell their produce solely at the farmers' market. All other venders (68%) had other methods of selling their produce reducing the risk and uncertainty. (Figure 05)

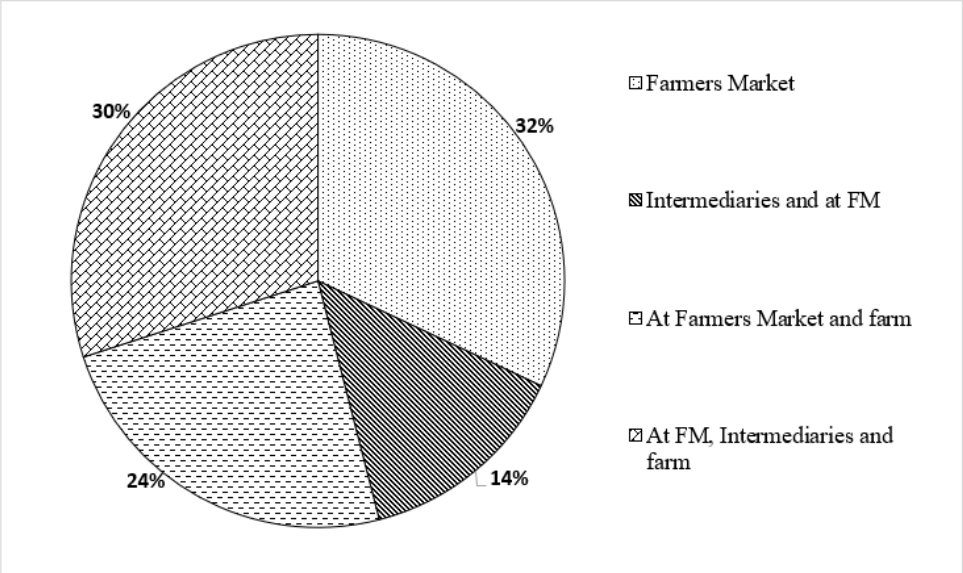


**Figure 05: Different market types available**

Majority of the farmers (65%) had not completely converted their inorganic cultivation into organic cultivation. Therefore, they usually cultivate their land using both inorganic and organic methods separately. The harvest from inorganic farming was not allowed to sell at the farmers' market. They sell that produce to intermediaries at the farm itself. Therefore, farmers' market had opened up an additional market opportunity for farmers while keeping their traditional market channels.

Focusing on Case 1; the farmer woman vendor had access to the direct farmers' market while her spouse was selling the produce for other market channels. In the studied case 2 also, the farmer had direct access to both farmers' market and other markets as well.

### *Support from External Institutes*

Support received from external institutes is an important aspect of social sustainability. Trainings, financial and coordination support received by the vender farmers were considered as the external support. The Department of Agriculture (DOA), Department of Agrarian Development (DAD), United Nations Development Programme (UNDP) and Jana Thakshan (NGO) were identified as the external supportive institutes. Figure 06 shows the percentages of different support received from different external institutes as stated by the respondents. Accordingly, the Department of Agriculture supported the vendors by providing trainings, relevant printed materials and support in coordination with relevant institutes and services. The Department of Agrarian Development also supported specially in providing trainings and related printed materials. UNDP and Jana Thakshan also contributed in providing trainings and coordination support to the farmer vendors while providing financial assistance.

When considering in-depth interviews, in case 1; the farmer woman and the farmer in case 2 received support from different institutes. They had received financial assistance to establish a rainwater harvesting tank, trainings, technical instructions, some materials such as plastic crates, and co-ordination support from these organizations. She was very satisfied with the support she received. Therefore, the external support received by farmer vendors contributed them to improve their farming sustainably.

According to the factors discussed above, (small holder involvement, adapting sustainable production practices, access to information, access to market, external support) it can be stated that the short supply chains of the studied organic farmers' direct market are socially sustainable.

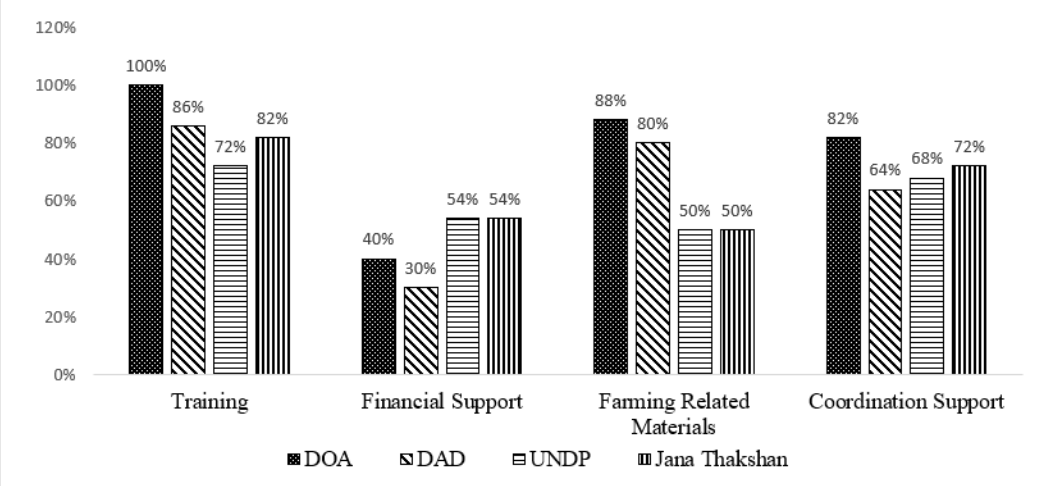


**Figure 06: Support from external institutes**

### *Environmental Sustainability*

In this study, environmental sustainability was assessed by estimating, approximate GHG emission along the supply chain in selected two cases. According to Smith *et al.,* 2014, agriculture contributes ~5.0 to 5.8 GtCO2e/yr or ~11% of total anthropogenic GHG emissions. Agricultural net emissions are considered as methane ($CH_4$) and nitrous oxide ($N_2O$) emissions and carbon sequestration resulting from the production of crops, livestock and agro forestry on farms (Wollenberg *et al.,* 2016). Furthermore, according to Wollenberg *et al.,* 2016, agriculture-related emissions and opportunities for mitigation also occur in the supply chain (transport, processing, fertilizer production, post-harvest loss), and due to land use change and consumption patterns (diet and food waste).

IPCC (International Panel on Climate Change) inventory software was used for the emission calculation, and some of the calculations were done according to GHG Emissions Calculation Methodology and GHG Audit (2015). The exact values were unable to calculate as there were no defined country specific values for emission factors for the Sri Lankan context. Therefore, the calculations were based on default values and can be considered only as an approximate estimation of GHG emission along the supply chains. In the calculation, market level was not considered as in both cases there were no surplus remained at the market as waste. Table 06 shows the approximate GHG emission along the value chain before and after joining the farmers' market.

According to the results, the GHG emission along the value chain in both analyzed cases has reduced after joining the farmers' market. The reasons might be the reduced distance from farm to market and reduction of use of agrochemicals. Accordingly, it can be considered that the value chains of short organic food supply chains of the studied direct market are environmentally sustainable.

**Table 06: Approximate GHG emission along the supply chain after joining the farmers' market**

| | Producer Level ($kgCO_2/kg$) | | Transportation ($kgCO_2/kg$) | | Total ($kgCO_2/kg$) | |
|---|---|---|---|---|---|---|
| | Before | After | Before | After | Before | After |
| Case 1 | 1.5671 | 1.0333 | 0.3121 | 0.0088 | 1.9092 | 1.0419 |
| Case 2 | 0.3421 | 0.2756 | 0.1972 | 0.2073 | 0.5093 | 0.4829 |

***Attitudes of the farmer vendors toward the Farmers' Market***

The majority (68%) of the farmer vendors strongly agreed (36%) and agreed (32%) that selling their produce at the farmers' market without intermediaries is profitable. They also strongly agreed (52%) and agreed (24%) that the consumers are willing to pay more for organic produce. According to the discussions made with few customers, they were willing to pay a fair amount of money for authentic organic produce.

The farmer woman in the case study also believed that farmers' market is a good opportunity to smallholder farmers like her. Furthermore, she firmly believed that, this concept should be implemented in other areas of the country to help rural farmers/farm women to improve their income consequently improving the living standards. Usually, in Sri Lankan society, there is not much social recognition towards a woman who sells vegetables in a traditional fair and it is fairly difficult for them to compete and survive with male sellers. However, according to the woman in the case study, being a vendor at the farmers' market is not difficult compared to a traditional fair. She also believed that she could sell produce at the farmers' market with dignity as a woman vendor. Therefore, it can be considered that the market opened up new opportunities for farm women.

The farmer vender of the case study 2 also believed that farmers' market is a better opportunity for farmers to have a higher profit rather than selling their produce to intermediaries. According to his experience, it was very difficult to sell produce to intermediaries with a considerable profit. At present, there is a very high demand for his organic produce at the farmer' market and does not need to put much effort to attract customers as they regularly come in adequate numbers.

All farmer vendors agreed that it was important to follow the good practices in the agreement of the organic production. Furthermore, they all recommended implementing GAP, PGS and organic farmers' direct markets in other areas of the country.

According the telephone interviews with the discontinued members, distance from farm to the market has affected the sustainability of the direct farmers' market. Some of the farmer vendors had discontinued because of the longer distance and thereby the higher transportation cost and time. Some of their production quantities were not sufficient to achieve profits. Therefore, these factors should be considered in future implementation of the direct farmers' markets.

## CONCLUSION

There was a statistically significant ($Z= - 5.717$, $p<0.05$) improvement of monthly income of the venders after joining the direct farmers' market. According to the 2 cases studied, the farmer vendors were able to receive a fair amount of income throughout the studied 04 weeks. They also mentioned that they were able to receive a stable income throughout the year which was proved by the income records of the producer group. Therefore, it can be concluded that, the farmer vendors have achieved economic sustainability. The majority of the farmer vendors of the direct farmers' market was smallholder farmers who owned total organic lands less than 2 acres and they practiced climate resilient Good Agricultural Practices(GAP) such as crop rotation, mixed cropping, planting repellent plants, use of pheromone traps, soil conservation methods and new organic farming methods. The majority of the farmer vendors had the access to information through several methods, such as; trainings, visits by extension officers, group discussions with extension officers, reading printed materials, field visits, related television programmes and discussions with other farmers leading to social sustainability. However, use of Information and Communication Technologies (ICT) such as hot lines, websites and social media was at a very low level. The majority of the farmer vendors had access to other markets such as selling their products to intermediaries and at the farm itself other than in the Direct Farmers' Market, Kurunegala. Therefore, it can be concluded that they are less vulnerable for market failures since they had several options.

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supported the farmer vendors by proving trainings, financial support, printed agricultural materials and coordination support. Vendors were satisfied with the support provided by these external organizations. A majority (95%) of the farmer vendors were members of village level producer groups and most of their decisions were identified along the value chain. Group actions were at a satisfactory level. Development of social capital was observed. Therefore, it can be concluded that the market (supply chains) was socially sustainable. However, continuous monitoring and evaluation will be important even after the project period to sustain the project.

In selected two cases, average Green House Gas Emission (GHG) along the supply chain was, 0.7624 kg$CO_2$/kg which was lower than 1.2093 kg$CO_2$/kg before joining the farmers' market. Therefore, it can be concluded that the short organic food supply chains of the studied direct farmers' market in Kurunegala are climate smart as they have achieved economic, social and environmental sustainability.

Distance from farm to the market has affected the sustainability of the direct farmers' market. Some of the farmer vendors had discontinued because of the higher distance and thereby the higher transportation cost and time. In order to reduce the distance, in future implementations, direct farmers' markets should be implemented in regional areas where regional organic farmers also have the easy access.

Necessary actions should be taken to maintain the authenticity of the products as the market basically depends on trust of the customers on the quality of the products. Even though there was a certification system (PGS), the system should be regularly monitored by relevant authorities. Furthermore, the vendors' forums should be more empowered in order to self-sustain the system with minimum external support. In conclusion, the studied organic direct farmers' market was climate smart with reference to economic, social and environment sustainability though still there is a room for further improvements. The climate smartness had achieved through GAP, PGS and collective action as a direct farmers' market. Therefore, it can be recommended to establish such markets in other possible areas of the county and other countries in the region with similar contexts.

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