Assessing nutrient pollution of soil and water bodies from Agriculture related activities in Maduru Oya watershed, Stakeholder knowledge on Good Agricultural Practises (GAP) and the need of capacity building on GAP to mitigate Environmental Pollution

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1. Introduction

Alteration of the global nitrogen cycle mainly due to anthropogenic activities has identified as one of the serious threats to the living beings. Erisman et al., (2008) reported that annual terrestrial cycling of reactive nitrogen (N_r) compounds has been doubled in the recent past. Nutrient pollution mainly due to very low nitrogen use efficiency (NUE) of fertilizer applied in farming systems globally (around 20%), 80% is wasted causing severe monitory losses and linking to an array of environmental problems in land, atmosphere and water, and health in different parts of the world. Excess N_r sources will lead to increase greenhouse gas (GHG) of N_2O while both N and P natively impact on air (NO_x), water and soil (acidification) qualitiescausing ecosystem imbalance. It was estimated that around 80% of marine pollution originates from land-based sources as non-point source pollution and waste water and nutrient pollution are identified as two major related sources (NOAA, 2019).

According to the Transboundary Assessment Programme (TWAP, 2015), 16% out of 66 large marine ecosystems (LME) studied, were at 'high' or the 'highest' risk for coastal eutrophication. Out of them, Bay of Bengal is an important LME that connected eight South Asian and South East Asian countries namely, Bangladesh, India, Indonesia, Malaysia, Maldives, Myanmar, Thailand and Sri Lanka. These countries belong to the very high-risk category based on the human development index, and indicators for fish, fisheries, pollution and ecosystem health (TWAP, 2015). High nutrient content carried to coastal areas by rivers lead to algal blooms, that cause hypoxic or anoxic conditions, increased turbidity and changes in community composition. High nutrient content in LMEs favours the dominance of species that have detrimental effects on ecosystems as well as humans (TWAP, 2015).

In Bay of Bengal, nitrogen load, nutrient ratio and merged nutrient indicator were in 'very high' category. Other than the nutrient, plastics also plays an important role in coastal pollution and coral damage. It was reported that abundance of both floating micro-plastic (<4.75 mm) and macro-plastic (>4.75 mm) in the Bay of Bengal LME was in the highest concentration category. Sri Lanka is surrounded by a rich diversity of mangroves (Jayatissa et al., 2002) and corals (Rajasuriya and White, 1995). A 11% of coral reefs in Bay of Bengal LME including Sri Lanka is under very high threat while 26% were under high threat (TWAP, 2015). By year 2030, it is expected that 23% of coral cover in this LME will be under very high to critical level category.

Corals are one of the ecosystems that is highly vulnerable to land based nutrient pollution. Coral reefs play a key role on coastal protection and provide food and habitat to over a million species (Hoegh-Guldberg et al., 2018). By mid-century, coral reefs are expected to decline by 70-90% compared to the present abundance even if the goals of Paris Climate Agreement are attained (Hoegh-Guldberg et al., 2018). Other than the nutrients, several inland pollution sources such as sediments, pathogens, toxic substances that include agrochemicals and metals, trash and plastics fall corals in danger. Release of excess nutrients to coastal ecosystems cause eutrophication, resulting in algal blooms and hypoxic conditions that create dead zone in sea (Howarth et al., 2000). The dead zone in Gulf of Mexico due to the nutrient enrichment from Mississippi river is one of the best examples (Rabalais et al, 2002). Other than that, nutrient pollution links an array of problems including fish and seabird death and loss of sea vegetation that decrease the biological diversity (Howarth et al., 2000). Nutrient pollution will also be a threat to the livelihood of the people who depends on coastal and coral ecosystems (Wilkinson, 2008).

Being a tropical country in Indian Ocean, Sri Lanka is fringed by coral reefs along different parts of the coastline (Figure 1 A). More than 200 hard coral reefs in the categories of fringing reefs, patchy reefs, sandstone reefs and rocky reefs and their combinations are recorded. According to the FAO proceeding report on Pre and Post – Tsunami Coastal Planning (2007), only two out of eight coral reefs studied in Sri Lanka showed live coral population greater than 50%. This was associated with unregulated tourism, illegal and destructive fishing and specially with the pollution associated with unplanned and unauthorised development, sewage and inappropriate disposal of waste materials.

Remarkably higher diversity of mangrove habitats and species were reported in Sri Lanka and one third of the global diversity of true mangroves in the world are found in the country (Jayatissa et al., 2002). The present extent of total mangroves of Sri Lanka is around 9,000 ha (GEOSRILANKA, 2015). The largest mangrove areas in the country are found from North, North Western and East coast, where intensive paddy cultivation is practiced in adjacent areas (Figure 1 B). Mangroves play an important role in ocean surge as happened during Tsunami, 2004. The extent of mangrove cover in the country is decreasing rapidly due to industrial shrimp farms, cutting for fuel wood and timber, hotels, settlement, coastal urban development and agrochemicals (GEOSRILANKA, 2015; Dayalatha and Ali, 2018). Since the 19th century, around 74% of mangrove forests have been disappeared in Sri Lanka. Around 34% of mangrove forests in Puttalam and Kalpitiya (in North Western part of the

country) were converted to shrimp farms (Jayasinghe and De Silva, 1992). Several shallow coastal waterbodies around Sri Lanka contain sea grasses that play an important role as food and habitat for other marine organisms, maintain water quality and economically important for coastal communities.

A) B)

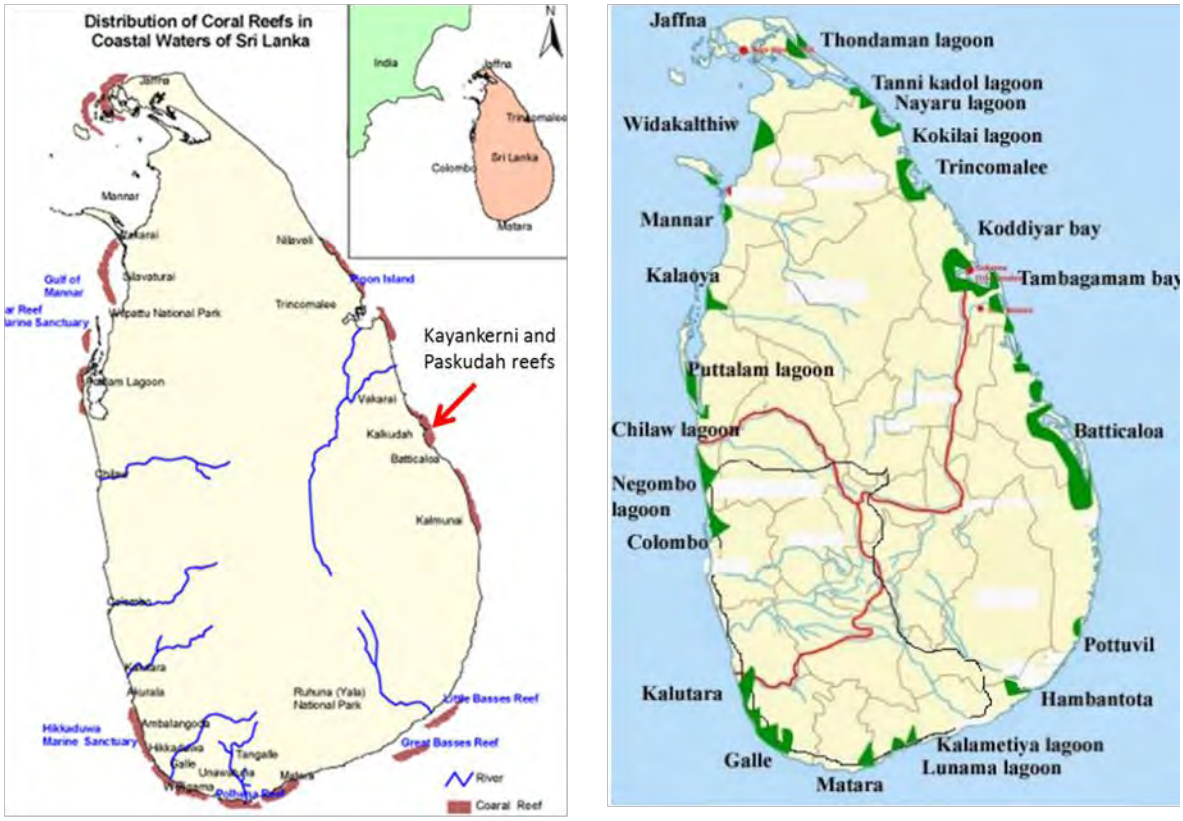

Figure 1. Distribution of (A) coral reefs (Source: FAO, marked in brown color) and (B) mangroves (Source: GEOSRILANKA, marked in green color) in Sri Lanka

1.1. Maduru Oya watershed as the case study site

Maduru Oya watershed and adjacent coastal area in Kalkudah in Batticaloa district were selected as the study area due to the ecological, social and economical significance of the area. The study was focused on two ecologically diverse coral reef systems namely; Kayankerni and Pasikudah, which are habitat to over 200 species of corals, and many plant and animal species (Dilmah Conservation, 2017). Sedimentation and decreased salinity due to changes in flow pattern and agriculture runoff cause degradation of nearshore reefs in the area (WRCT, 2015).

Land based pollution that comes through Maduru Oya river trigger this issue. Maduru Oya reservoir, river and Maduru Oya national park are the major components of the watershed. Maduru Oya is one of the major river systems in Sri Lanka, with a length of approximately 135 km. Inland area is famous among tourists to watch wildlife while coastal area, specially Pasikudah and Kayankerni are very popular among both local and foreign travellers.

Crop cultivation (especially paddy farming), livestock management (poultry and cattle), fishing and tourism are main livelihoods of the people live in the area. Detailed description on administrative boundaries, land use pattern and socioeconomic status of householders in Maduru Oya watershed is summarised later in this document.

With the increased population and development, pollution from nutrient, plastic and solid waste has become a severe environmental problem in most parts of Sri Lanka. This is a common phenomenon in all most all the countries in the South Asian region as well. In this project, Maduru Oya watershed was selected as a representative case study site where Maduru Oya tank (built by blocking Maduru Oya stream and fed by the Mahaweli River diversion scheme) provides irrigation water for intensive crop cultivation in downstream (predominant paddy cultivation with heavy usage of agro-chemical), which flows and discharge its water to the sea at Valachchenai/ Kalkudah exposing the Kayankerni and Pasikudah coral reefs, where impacts of land based nutrient pollution and mitigation measures adopted on nutrient pollution on costal ecosystems could be studied with the objective of generalizing the outcome in to similar conditions in the other countries in the region.

2. Goal and objectives

2.1. Goal

Contribution to strengthened local and regional enabling environments to foster the uptake and adoption of innovative approaches in reducing threats to coral reefs from nutrient and wastewater and other land-based pollution in Sri Lanka.

2.2. Objectives

- To enhance capacities of local stakeholders in the assessment of environmental challenges and implementation of appropriate approaches to address nutrient, wastewater and other forms of land-based pollution that impacts coral reef ecosystems;
- To strengthen the community of practice in pollution and coral reef protection at the regional level through knowledge exchange and transfer;
- To contribute to leveraging of additional financing for on-ground investments in best practices to reduce the influx of land-based pollution in the target area;
- To define methodologies for assessment and monitoring of Sustainable Development Goal targets 6.3 (improve water quality by reducing pollution) and 14.1 (prevent and significantly reduce marine pollution) associated with freshwater and marine pollution respectively, within the source-to-sea/ridge-to-reef framework;
- To contribute to obligations under relevant United Nations Environment Assembly (UNEA) resolutions associated with coral reef management, freshwater and marine pollution, in addition to obligations under the South Asian Seas Programme (SASP), notably the South Asian Seas Agreement aiming at protecting the marine environment from land and sea-based activities;
- To contribute to activities in commemoration of the 2018 International Year of the Coral Reef through UN Environment's coral reef campaign and the wider 'Call for Action' from the UN SDG 14 Ocean Conference.

3. Investigation of nutrient pollution from agriculture related land use systems in reducing the risk of degradation of the Kayankerni and Pasikudah coral reef ecosystems

3.1. Methodological procedure

3.1.1. Literature survey

A literature survey was conducted to gather information on administrative boundaries, socio economic status and land use pattern in Maduru Oya watershed (Figure 2). The data were collected from government data sources (Department of Census and Statistics), reports (from Department of Irrigation, Mahaweli Authority) and scientific literature. The data gathered from literature survey are summarised later in this document.

3.1.2. Field observations – exposure visit

Initial field observation visit was made by the study team together with the respective Officers from the UNEP and SACEP in covering the whole watershed from Maduru Oya reservoir to the Kayankerni and Paskudah costal belt.

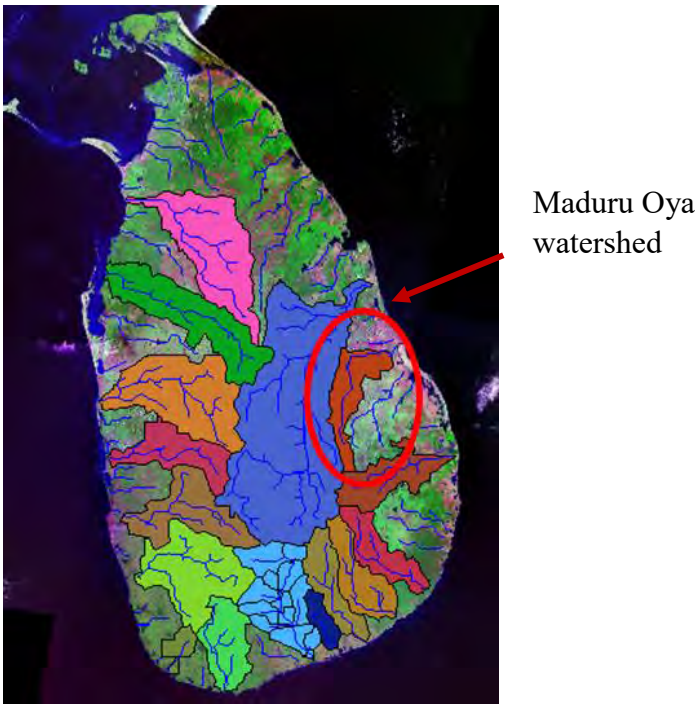

Figure 2. River drainage basins of Sri Lanka and the study area (Source: River Basins in Sri Lanka)

During this visit, discussions were held with key stakeholders of different Institutes such as Departments of Agriculture, Forest and Wildlife, Fishery and Irrigation, Mahaweli Authority, and fishing and farming community leaders. Situation assessments on major land use types, agriculture and fishing related management practices, pollution due to improper solid waste and waste water handling, etc. were gathered. Linkages were established with key stakeholder institutes and key informants to arrange future stakeholder workshops on detailed situation assessments and awarenesson good management practices. Contamination of water bodies due to dumping of waste to streams, lagoons, mangrove vegetations and drains in the city area were observed.

3.1.3. Stakeholder meeting at Aralaganwila

The 1st stakeholder meeting was held on 12th February 2019 at Aralaganwila Agricultural Research Centre with the participation of 23 government officers and 12 Leaders of Farmer organization in the region. As the key stakeholders, the Deputy Director of Agriculture (Aralaganwila Research Station), Deputy Director of Irrigation (Inter-province – Polonnaruwa), Assistant Director of Agriculture, Principal Agricultural Scientists (Soil), Research Officers, Managers of Government farms, Agricultural Instructors and Research Assistants of Agricultural Offices in the region and Mahaweli Authoritywere participated. Farmers who attended the stakeholder meeting represented different farming communities in different parts of the Maduru Oya watershed. Some of them were presidents of farmer organizations/communities.Some of photograph of the stakeholder meeting are given in the Annexure 5.1.

The program was initiated with giving an introduction about the project objectives, what is expected as the outcome of the project and future planning by the project team. Both government officers and farmers exchanged their ideas and experiences on crop cultivation, how the fields are management, types and amounts of fertilizer and other agrochemicals are used, knowledge on mismanagement and their impacts etc. Later, existing best management and good agricultural practices to mitigate nutrient pollution were discussed. Government officers briefed the actions taken to minimise usage of agrochemicals especially the nutrient losses and increase the fertiliser use efficiency as a nutrient pollution mitigation technique.

A survey was conducted using a printed questionnaire to gather information on crop details, fertiliser and other agrochemical usage, irrigation details, use of traditional and new

technological knowledge on agriculture and waste management and the issues related to agriculture and environmental pollution (Annexure 5.2).

3.1.4. Awareness program on Good Agricultural Practices to mitigate land based nutrient pollution

The 1st awareness program was held on 25th March 2019 at Aralaganwila Agricultural Research Centre with the participation of 49 people (Annexure 5.3). As the resource person, Additional Director of Seed Certification Service at Department of Agriculture Dr. (Mrs) M.G.D.L. Priyantha, who also the Director in Good Agricultural Practices (GAP) program in Sri Lanka, attended. As key stakeholders, the Deputy Director of Agriculture (Aralaganwila Research Station), Research Officers, managers of government farms, officers from Mahaweli Authority, Agricultural Instructors, Research Assistants of agricultural officers and leading farmers from several farmer organisations were participated.

An evaluation was done before and after the program to evaluate the level of awareness farmers had before the program (Annexure 5.4). Dr. Priyantha introduced the importance, the present status and the procedure of GAP certification. None of the farmers were aware about GAP certification, and after the discussion it was found that all the farmers liked to obtain GAP certificate for their products. The officers from the Department of Agriculture, the research team and farmers exchanged their ideas on GAPs and BMPs on agricultural activities.

3.2. Geographical, administrative, socioeconomic, and ecological details of Maduru Oya watershed

3.2.1. Geographical information

Maduru Oya watershed begins from the western slopes of the Budulla district and stretched towards western coast of the Batticoloa district covering wide range of land use types. Maduru Oya reservoir (dam 7º 32' 42" to 7º 39' 57 N, 81º 11' 35" to 81º 12' 21" E) was constructed under the Accelerated Mahaweli Program in 1983 and extends to North Central, Uva and Eastern provinces (Figure 3).

Maduru Oya project was implemented with the purpose of providing irrigation water to Mahaweli System B area and facilitate settlement of 35,000 farming families. The area of the System B is approximately 135,000 hectares. Following section summarises the information

on administrative boundaries, socio-economic status and land use pattern in Maduru Oya watershed.

3.2.2. Maduru Oya watershed surrounded Administrative Districts and Divisional Secretariat (DS) divisions

Maduru Oya watershed belongs to 4 administrative districts (Badulla, Polonnaruwa, Ampara and Batticaloa) and 8 Divisional Secretariat (DS) divisions as described below (Figure4). Some of the DS divisions belong to the reservoir area (Mahiyanganaya, Dimbulagala, Dehiaththakandiya, Padiyathalawa and Mahaoya) while rest of the divisions (Welikanda, KoralaiPattu and KoralaiPattu West) are from the river area.

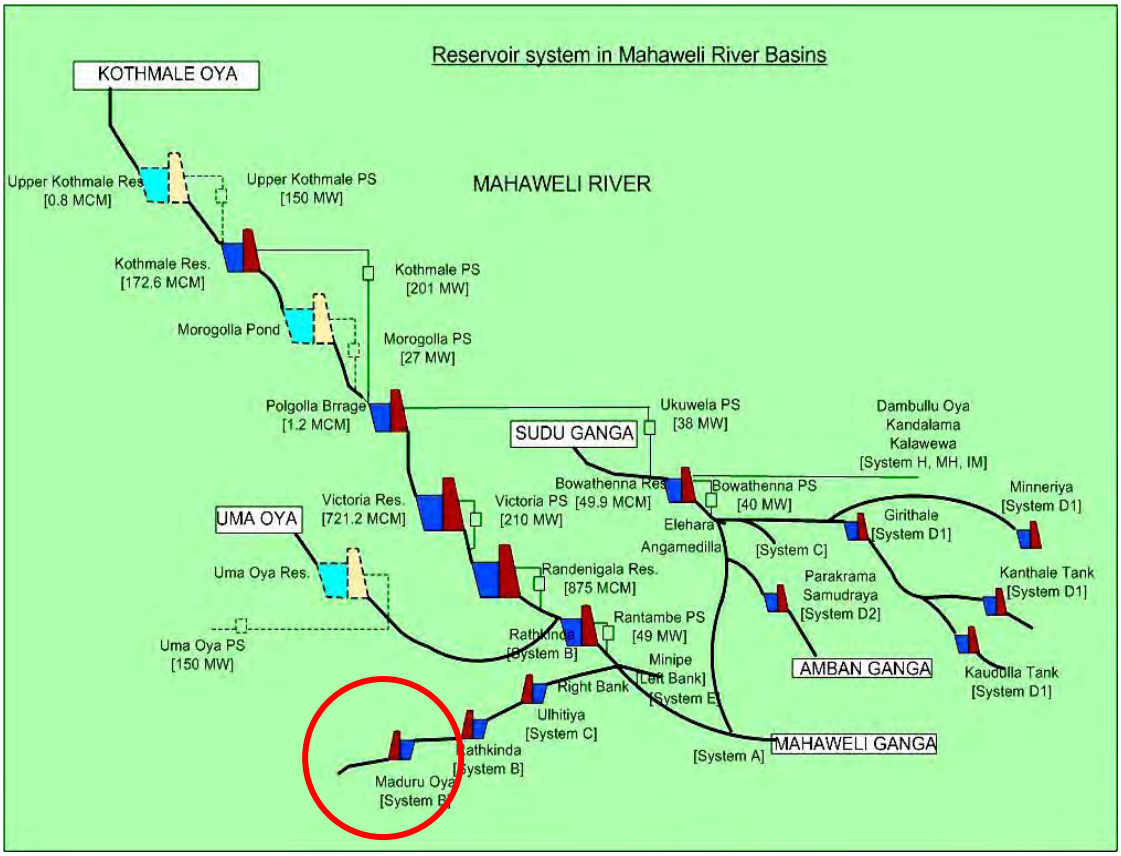

Figure 3. Reservoir system in Mahaweli river basin and the location of Maduru Oya reservoir in Mahaweli system (Source: Dilini et al., 2003)

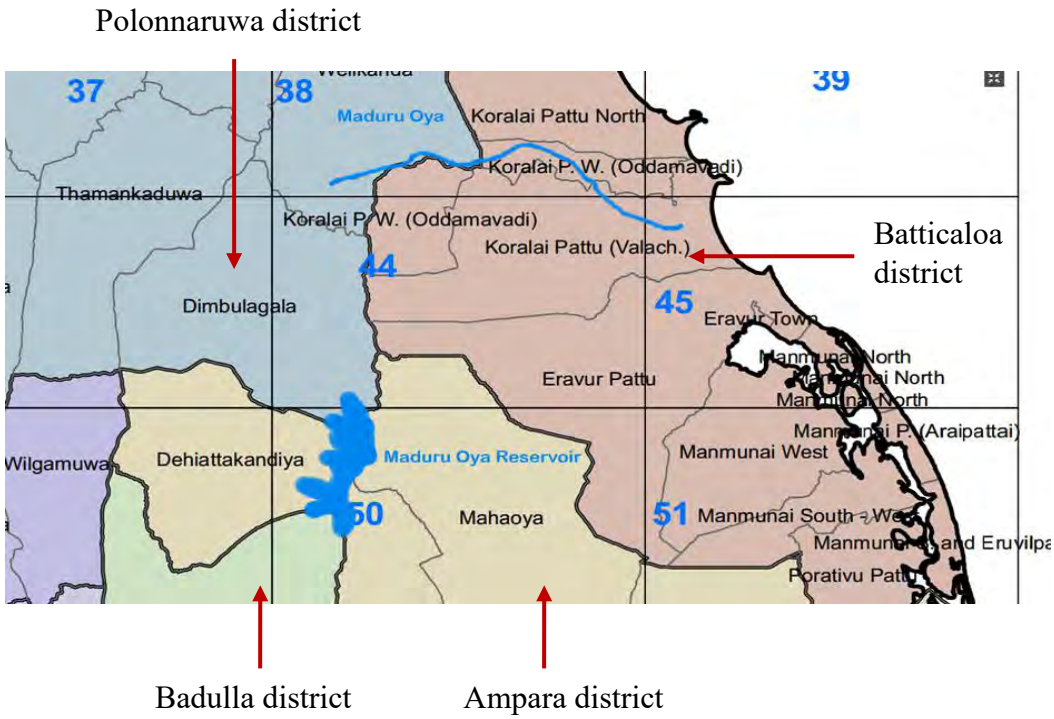

Figure 4. Divisional Secretariat (DS) divisions surrounded by Maduru Oya reservoir and river

Badulla administrative district

In Badulla district, 21.23% of the land was covered by forests while 11.22% was under plantation crops. Tea is the major plantation crop in the district. As other agricultural fields, paddy (10.85%), perennial crops (5.94%) and other field crops (4.38%) are also reported (Census and Statistics, 2017). The land use pattern of the district is given in Annexure 5.5.

Mahiyanganaya DS Division in Badulla District

Mahiyanganaya is the largest DS division in Badulla district with an area of 601 km^2 (21.01% of total area of district). Majority of the population (80,263) lives in rural areas (Census and Statistics, 2017). Male to female ratio was 49% to 51%. Most of the people were Sinhalese (97.2%) while a small percentage of Sri Lanka Moor (2.4%) and Sri Lanka Tamil (0.2%) lived in the region. The major religion was Buddhism (96.9%) followed by Islam (2.5%), other Christian (0.3%), Roman Catholic (0.2%) and Hindu (0.1%) (Census and Statistics, 2012).

The highest cultivated paddy lands in Badulla district were recorded from Mahiyanganaya (10,461 ha). Out of the total paddy fields, 6872 ha were cultivated from major irrigated areas while 3,071 ha were rainfed. In Mahiyanganaya, a total of 10,126.7 ha of paddy were sown

during the major season (*Maha*) of 2016/2017 and 4,582.3 ha during the minor season (*Yala*). Coconut (1,310.8 ha), banana (284.5 ha), cashew (152.2 ha) and pepper (66.4 ha) were major types of cultivations in the region. Poultry (10,299), cattle (3,968), goats (531), buffaloes (163), pigs (145), turkey (40) and duck (34) were prominent livestock species in Mahiyanganaya DS division (Census and Statistics, 2017).

Pollonnaruwa administrative district

Dimbulagala and Welikanda are two DS divisions in Polonnaruwa district that belong to Maduru Oya watershed. The highest percentage of lands in Polonnaruwa district was under forest cover (48.85%) followed by paddy fields (24.08%) and home gardens (14.12%). A 5.88% of land is large inland water (Census and Statistics, 2017). Annexure 5.5 summarises the land use pattern in Polonnaruwa district.

Dimbulagala DS division of Pollonnaruwa district

Dimbulagala is the second largest DS division in Polonnaruwa district with 581.8 km^2 (16.8% of the district) and with a population of 84,531. All the population lived in rural areas. Male to female percentage in the DS division was 50.1 to 49.9. (Census and Statistics, 2017). The highest ethnic group was Sinhalese (96.83%) followed by Sri Lanka Tamil (3.04%), Sri Lankan Moor (0.10%) and Indian Tamil (0.02%). Most of the people were Buddhists (96.02%) while Hindu (2.97%) and Roman Catholic (0.56%) also lived (Census and Statistics, 2012).

The highest cultivated extent (22,762.4 ha) of Polonnaruwa district were reported from Dimulagala while 22, 406 of ha were under major irrigated schemes. Total sown paddy extent during 2016/2017 *Maha* and 2017 *Yala* seasons were 22,762.4 and 13,887.0 ha respectively. Other than the paddy, few minor export crops such as pepper (44.8 ha), beetle (9.6 ha) and cashew (63.5 ha) were also cultivated in Dimbulagala DS division. Mango (224.2 ha), banana (165.7 ha) and orange (94.1 ha) were the prominent fruits in the DS division. As livestock, a 169,939 number of cock/hens, 13,228 of cattle, 2,354 of buffaloes, 1890 of goats and 229 of pigs were reported. Per capita land consumption is 0.7 ha in Dimbulagala DS division (Census and Statistics, 2017).

Welikanda DS Divisionof Pollonnaruwa district

Welikanda DS division is 573.75 km^2 in size with 16.55% of land size in Polonnaruwa district. All the population live in urban areas (35,834). Male to female ratio was 51.2% to 48.8%. The per capita land holding in Welikanda (1.6 ha) was the highest in Polonnaruwa district (Census and Statistics, 2017). Sinhalese (74.40%) were the largest ethnic group followed by Sri Lankan Moor (14.54%) and Sri Lankan Tamil (10.89%). A higher percentage of Buddhists (73.81%) lived in the area. Other religions in Welikanda DS division were Islam (14.59%) and Hindu (10.39%) (Census and Statistics, 2017).

Land extent of 9,667 ha was cultivated under major irrigated schemes while no rainfed paddy cultivation was reported in Welikanda in year 2017. A total of 9,667 ha were sown during 2016/2017 *Maha* season and 5,225.7 ha during the *Yala* season in 2017 in Welikanda DS division. Major crops in the area were cashew (98.7 ha), mango (114.4 ha), banana (82.3 ha) and papaw (16.7 ha). Poultry (74,024), cattle (11,220), buffaloes (4,968), goats (1,926) and pigs (492) were the major livestock species in Welikanda (Census and Statistics, 2017).

Ampara administrative district

Three DS divisions are in Ampara district. They are Maduru Oya watershed are Dehiaththakandiya, Padiyathalawa and Mahaoya. In Ampara district, most of the area were covered by forests (32.19%). Out of the total land, 22.02% were paddy fields, 6.73% were perennial crops, 5.36% were other field crops and seasonal crops while 0.46% were plantation crops. The land use pattern of Ampara district is given in the Annexure 5.5.

Dehiaththakandiya DS division of Ampara district

Dehiaththakndiya DS division is 383 km^2 in size (8.67% of district). A total of 65,328 people lived in Dehiaththakandiya while 49.7% of the population were male (Census and Statistics, 2017). In the DS division, 97.2% of the population were Sinhalese and 0.2% were Sri Lankan Tamil and Sri Lanka Moor. Most of the people were Buddhists (97.2%) while Hindu, Islam, Roman Catholic and other Christian were 0.2% each (Census and Statistics, 2012). In year 2017, major irrigated and rain-fed cultivated extent were 11,179 ha and 117 ha respectively. Per capita land consumption at Dehiattakandiya DS division was 0.6 ha (Census and Statistics, 2017).

Padiyathalawa DS division of Ampara district

The size of Padiyathalawa DS division is 379 km^2 (8.58% of district). A total of 19,855 people lived in Padiyathalawa while the population equally divided to male (50%) and female (50%). Major ethnic group was Sinhalese (99.8%) followed by Sri Lanka Tamil and Sri Lanka Moor (0.1% each). In religions, 99.8% were Buddhists while 0.1% of population were Hindu and Islam (Census and Statistics, 2012).

A higher number of rainfed fields (5,308 ha), minor irrigated (488 ha) and major irrigated (167 ha) fields were under paddy cultivation in Padiyathalawa in year 2017. A total of 2,863 ha was sown during 2016/2017 *Maha* and 285.0 ha during 2017 *Yala* season. Banana (192.2 ha), oranges (142.4 ha), cashew (111.2 ha) and pepper (96.4 ha) were major cultivations. A 6,671 of cock/hens, 878 of cattle and 46 of buffaloes were reported in the DS division. Per capita land consumption was 1.9 ha at Padiyathalawa (Census and Statistics, 2017).

Mahaoya DS division of Ampara district

Mahaoya is the second largest DS division (667 km^2) in Ampara district followed by Lahugala. Total population in Mahaoya was 22,610 in year 2017. A higher male population (50.6%) was recorded in the area. Total population in Mahaoya were Sinhala Buddhists (Census and Statistics, 2017).

Most of the paddy fields in year 2017 were rainfed (8,089 ha) followed by major irrigated (705 ha) and minor irrigated (286 ha). A total sown paddy extent during 2016/2017 *Maha* season and 2017 *Yala* seasons were 3,594 ha and 467 ha, respectively. Other than paddy, papaw was the major crop in year 2017 (1,165 ha) followed by cashew (471.7 ha) and pineapple (462.9 ha). Prominent livestock species were poultry (8,817), cattle (6,730), buffaloes (575), goats (299) and pigs (104). The highest per capita land holding in Ampara district was from Mahaoya (2.9 ha) (Census and Statistics, 2017).

Batticaloa district

Koralai Pattu and Koralai Pattu West are two DS divisions in Batticaloa district that belong to Maduru Oya watershed. In Batticaloa district, most of the lands were covered by paddy fields (24.26%), scrub/chena (21.70%) and forest (14.85%). In agricultural lands, 7.71% were other field crops, 4.31% were home gardens, 2.34% were plantation crops and 0.84% were perennial crops. The land use pattern of Batticaloa district is given in the Annexure 5.5.

Koralai Pattu (Valachchena) DS division of Batticaloa district

The area of Koralai Pattu DS division is 35 km^2 and it is 1.23% of the total area in Batticaloa district. The population in year 2017 was 24,851 while 47.8% of them were male (Census and Statistics, 2017). Most of the people were Tamils (98.85%). Small percentage of Sinhalese (0.55%) and Sri Lanka Moor (0.09%) were also lived in the DS division. The prominent religion was Hindu (87.2%) followed by other Christian (8.1%), Roman Catholic (4.4%), Buddhism (0.2%) and Islam (0.1%) (Census and Statistics, 2012).

Cultivated land extent was relatively smaller at Koralai Pattu DS division (49.4 ha) while most of them were irrigated from minor schemes (33.6 ha) in year 2017. Rest of the fields were rainfed (15.8 ha). Total sown paddy extent during 2016/2017 *Maha* and 2017 *Yala* seasons were 13.1 ha and 30.3 ha respectively. Coconut (477.8 ha), cashew (163.1 ha), mango (100.5 ha), banana (22 ha) and orange (16.3 ha) were prominent crops cultivated. Per capita land holding was 0.1 ha in Koralai Pattu DS division. Poultry (7,855), cattle (1,052), goats (517), turkey (25) and ducks (10) were livestock species found in the DS division (Census and Statistics, 2017).

Koralai Pattu West DS division of Batticaloa district

Koralai Pattu West, known as Oddamavadi is a relatively smaller DS division with 17 km^2 (0.60% of total area in Batticaloa district) and with a population of 23,581 in year 2017. Male to female percentage was 49.4% to 50.6% (Census and Statistics, 2017). Major ethnic group was Sri Lanka Moor (99.81%) while a small percentage of Sri Lanka Tamil (0.16%), Sinhalese (0.01%) and Indian Tamil (0.01%) were also lived. Islam was the major religion (99.9%) in the area (Census and Statistics, 2012).

Most of the cultivated fields were irrigated from major schemes (1,137 ha) while a small number of fields were rainfed (10.5 ha) in year 2017. A total of 1,146.5 ha was sown during *Maha* season 2016/2017 and 898.4 ha during *Yala* 2017. Major crops were coconut (117.3 ha), mango (13.3 ha), banana (8.0) and papaw (1.7 ha). Per capita land was 0.1 ha.Among livestock species, poultry (7,352), cattle (1,642), goats (536), buffaloes (111), duck (55) and turkey (17) were reported (Census and Statistics, 2017).

3.2.3. Major vegetation types of the Maduru Oya watershed and their biodiversity

Different types of vegetation in the Maduru Oya watershed include forests, grasslands, paddy fields, homegardens, chena and plantation crop fields (Figure 5). Dry mixed evergreen forest is the prominent forest typein the area. The dominant tree species were *Manilkara hexandra, Chloroxylon swietenia, Schleichera oleosa* and *Pleurostylia opposita*, with understorey of *Pterospermum suberifolium, Drypetes sepiaria* and *Dimorphocalyx glabellus* (Gunatilleke et al., 2008).

Rich diversity of mangrove forests exists in the coastal areas of Batticaloa and Ampara districts. Other than the forest types, villus, that periodically inundate during the flooding of rivers are also found in flood plains of Maduru Oya river.

Major forest types in Badulla district were moist montane forests (15,750.8 ha), sub montane forests (3,030.3 ha), dry monsoon forests (2,266.8 ha), lowland rain forests (1,610.6 ha) and montane forests (94.5 ha). The forest cover in Polonnaruwa district consists of 67,430 ha of dry monsoon forests, 46,388 ha of moist monsoon forests and 523.6 ha of riverine forests. In Ampara district, a large amount of dry monsoon forests (67,197 ha), moist monsoon forests (45,519 ha), riverine forests (10,148 ha) and small amount of mangrove forests (299 ha) were reported. In Battcaloa, a total of 19,733.8 ha of dry monsoon forests, 13,378.2 ha of moist monsoon forests and 1,855 ha of mangrove forests were recorded (Sri Lanka biodiversity clearing house mechanism).

Maduru Oya national park is rich in faunal diversity. The avifaunal diversity of the national park is high as 196 bird species that include nationally threatened (14) and globally threatened (3) species (Gabadage et al., 2015). Agricultural land use in the area was previously described.

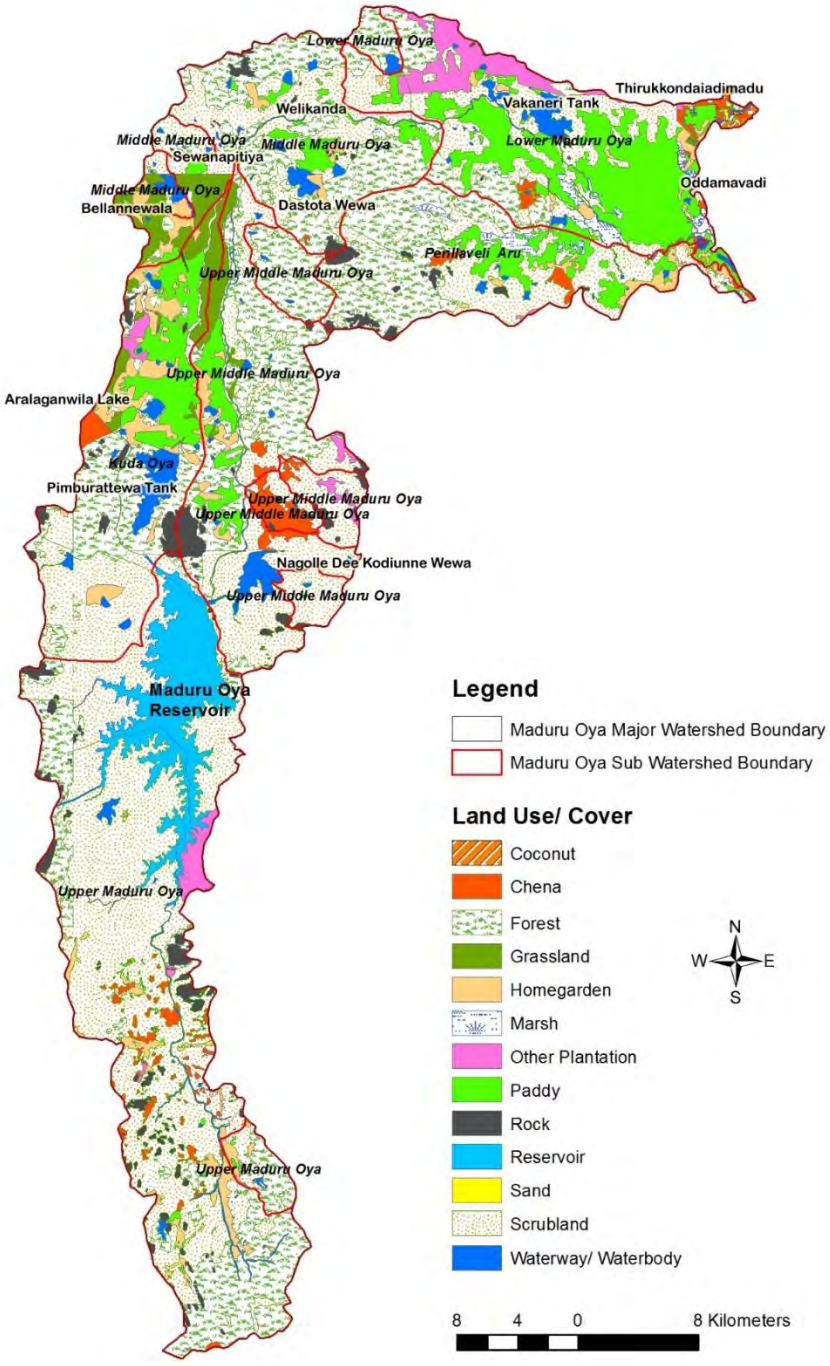

Figure 5. Land use pattern of Maduru Oya watershed

3.2.4. Paddy farming in Sri Lanka as one of the main livelihoods in the Maduru Oya watershed

In Sri Lanka rice is cultivated during *Yala* and *Maha* seasons, and the net extent harvested in both seasons in 2016 was 1.01 million ha and production was 4.4 million mt (National Fertilizer Secretariat, 2017). Even though Sri Lanka is almost self-sufficient in rice at present,

to meet the growing population demand, it is estimated that rice production should be increased about 60% by the year 2025 (Balasubramanian et al., 1999).

Sri Lanka has imported 474,330 mt of fertilizer in 2016 for the crop sector and the amount of urea was 286,276 mt (National Fertilizer Secretariat, 2017). Around 64% of the imported urea is used in paddy cultivation (NFS, 2000). The Nitrogen content in urea is 46%, and the recovery of applied nitrogen to wetland paddy is around 20-40% (Vlek et al., 1986) and sometimes it may be as low as 15%. Nitrogen fertilizer is wasted mostly due to the inefficient use and gaseous nitrogen losses as nitrous oxide (N_2O), ammonia (NH_3), Nitrogen (N_2) via different process. When consider about agronomic efficiency of Nitrogen (additional grain yield per kg N applied over no N) is low as 10 kg kg^{-1} N (Sirisena et al., 2001). Considerable amount of Nitrogen is loss through volatilization, nitrification and denitrification than leaching (Nielsen, 2006). Sri Lanka has been identified as the highest fertilizer applied country in the South Asian region (307 Kg/ha in 2015) (Source: www.knoema.com) and also in the 26th position out of 161 countries.

Ampara, Batticoloa and Polonnaruwa are the three districts where highest percentages paddy is cultivated under major irrigated (77%) and minor irrigated (19%) compared to other major rice growing districts where Maduru Oya watershed belongs. These districts are identified as the high potential paddy production districts (> 4.5-5.0 mt/ ha) where large scale commercial intensive paddy farming is practised as the main livelihood of majority of the people. Most of these farmers are settled in these regions after the establishment of Maduru Oya tank and the irrigation scheme. Department of Agriculture (DOA) recommended fertilizer amounts for Uera, MOP, TSP and Zinc Sulphate (for a three and half month old rice variety) is 225, 60, 55 and 5 kg/ha. Though, farmers are advised to buy them as strait fertilizers and mixed just before the application, most farmers buy already formulated mixtures. It was revealed that most farmers apply 25-50% more fertilizers in these regions than the DOA recommended level to get better yield without knowing the nutrient use efficiencies, fate of the applied fertilizers and other negative impacts caused to the environment. It is reported that paddy farming contributes 76% to the total N_2O emissions in the country (Second National Communication, 2000).

Fertilizer use for other land use types such as coconut, homegardens, cashew etc., are not well documented, mostly they are under-fertilized or no fertilizers are applied at all (i.e.. homegardens). Though the animal husbandry in these areas has been developing, no detailed

information is available on pollution related to these industries. Cow dung, poultry manure etc of these farms are used directly for crop cultivation as organic manure.

Compared to other land use types in the Maduru Oya watershed, paddy farming associated agrochemical use is the most significant source which contributes to nutrient pollution of water bodies, land and atmosphere causing numerous long-term negative impacts to the environment and the health of all beings.

3.2.5. Water quality status and pollution levels in Maduru Oya and other watersheds in Sri Lanka

Few attempts were made on the water quality assessment in Maduru Oya watershed. It was evident that water quality level of Maduru Oya reservoir depleted while the pollution level increased (Kasthuriarachchi et al., 2016). The highest pH that was recorded near the dam site of the reservoir exceeded the WHO standards for drinking water (Kasthuriarachchiet al., 2016). The dissolved salts or salinity content of Maduru Oya reservoir was 0.161 g l^{-1} (Silva, 2004). The sodium absorption rate, which is the proportion of sodium to calcium plus magnesium in the water, in Maduru Oya (0.916-1.167 meq l^{-1}) was below the threshold value of 6 meq l^{-1} (Silva, 2004). It was reported that total hardness ranged from 21 ppm to 68 ppm while dissolved oxygen varied from 3.3 ppm to 9.4 ppm (Kasthuriarachchi et al., 2016). In the nitrogen content, ammoniacal nitrogen varied from 0.001 ppm to 0.652 ppm, nitrite nitrogen from 0.001 ppm to 0.905 ppm while nitrate nitrogen was ranged from 0.001 ppm to 1.131 ppm (Kasthuriarachchi et al., 2016). It is expected that the accumulation of nutrients in Maduru Oya reservoir can lead to the eutrophication that makes the spreading of toxic algal species such as *Microcystis* (Kasthuriarachchi et al., 2016). Several phytoplankton types (*Cyanobacteria, Cosmarium, Pseudanabaena, Microcystic and Pediastrum*) were found in Mahaweli reservoirs including Maduru Oya as a reason of nutrient enrichment (Silva and Wijeyaratne, 1999). Agriculture (crop cultivation and animal rearing) can be suggested as the major reason for nutrient enrichment in Maduru Oya reservoir.

Other than Maduru Oya, several other watersheds, reservoirs and water sources in Sri Lanka showed water quality depletion due to agricultural related activities. Uma Oya that belongs to the Upper Mahaweli Scheme, drains a large portion of agricultural lands and therefore, total suspended solids (17.87±17.96 mgl^{-1}) and turbidity (37.84±59.88 Nephelometric Turbidity Units - NTU) were higher than the standard limits (Weerasekara et al., 2015). Vulnerability of coastal aquifers in Kalpitiya to nutrient pollution from agriculture was documented

(Jayasingha et al., 2011). Due to the intensive agricultural practices in Kalpitiya, the nitrate level of ground water in most of the locations (44% out of 225) were above the safe levels of World Health Organisation, therefore, methaemoglobinaemia (blue baby syndrome) can also be expected (Liyanage et al., 2000). Fertiliser contamination of water sources cause nutrient pollution in Mahaweli, the largest river in Sri Lanka, leading to a chronic renal failure epidemic in North Central part of the country (Bandara et al., 2010).

According to the available information, it can be concluded that agricultural activities cause nutrient pollution in water sources, rivers and watersheds in Sri Lanka including Maduru Oya watershed. Important locations to monitor water contamination from agricultural fields of Maduru Oya are mapped and key land use types were observed (Figure 6).

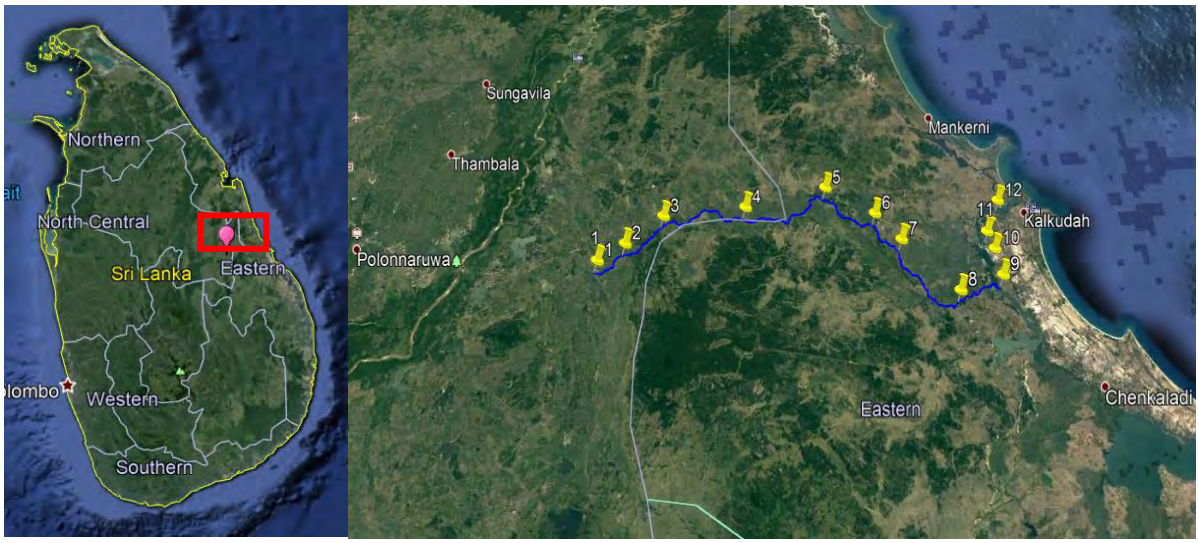

Figure 6. Water polluted sites, sources of pollution and key land use types observed in Maduru Oya watershed during the exposure visit. The observed area was marked in a red square (Left).

3.2.6. Major health issues among the communities in the Maduru Oya watershed

Chronic Kidney Disease with unknown etiology (CKDu) is the major health issue in the Maduru Oya watershed area for nearly past two decades, especially in North Central province of the country. The etiology of the disease is not known yet, but researches have proposed that fertilizers, pesticides, herbicides, heavy metals and water hardness as possible causes (Wijkström et al., 2018). Therefore, with a higher confidence, it is believed that agriculture has a direct relationship with CKDu. The mitigation of nutrient pollution through BMPs is an urgent necessity to reduce the causative agents.

3.3. Outcomes of the stakeholder meetings and awareness program

3.3.1. Stakeholder meeting 1

Results of the questionnaire survey and the stakeholder discussions clearly indicated that farmers in this region use heavy doses of inorganic fertiliser in the form of mixed fertilisers (100% of farmers) than the DOA recommended level with the objective of getting higher yield just based on field observations and/or following what others do whether it is necessary or not. From the discussion with agricultural officers and farmers, it was found that most of the paddy fields are conventional intensive farming systems and add agrochemicals, while farmers rarely cultivate paddy organically. Farmers normally use the fertiliser received through government subsidy scheme while majority of the farmers apply more urea and even ammonium sulphate that are not normally recommended for paddy fields in these areas. Some farmers indicated the poor land preparation and poor water management were the two major reasons for low nutrient use efficiency as most of the fertilisers lost to the soil and finally to the water bodies without being used by the plants. Farmers involve in cattle and buffalo management and maintain them as free rearing. So, their dung and urine can always have a possibility to contaminate the water.

Farmers have not received any formal training on the scientific basis on need of fertiliser application, role played by different elements, why different types are added in different time periods based on the phonological developments etc. Same applied for other agrochemicals applied such as pesticides, weedicides as well. Most of the farmers are following these managements as routing practices without proper understanding. It was revealed that about 85% are getting information from inappropriate sources such as from agrochemical shops. Farmers also use several incorrect methods to control pests and diseases that pollute the environment. One good example is the use of kerosene oil to control plant hoppers. Most of the farmers (90%) did not receive/attend any training or awareness programs on waste management, best management practices (BMP), good agricultural practices (GAP) and on climate change and its impacts. Therefore, a huge gap exists on BMP and GAPs and highlighting the need of capacity building of the farmers and other related stakeholders in the Maduru Oya watershed.

Farmers (85%) use traditional knowledge as well as new technologies especially on management aspects in agriculture. Though farmers were somewhat aware about the negative impacts of agrochemical of insecticides and weedicides on human health, initially they were

not aware that chemical fertilizers can cause negative impacts to environment if they are over used or misused. After the deliberations of negative impacts of excess use of agrochemicals, all farmers understood the importance of taking precautionary measures without sacrificing their crop yield which is the main or the only family income source. They highlighted that though the purpose of application of fertilizers to increase crop yield, reducing indirect impacts of pollutingsoil or water bodies would be a challenging task. But almost all the farmers do not know how to mitigate soil and water pollution in agriculture. Therefore, farmers are very much interested to know the possible ways of mitigating soil and water pollution from agrochemicals. They highlight the need of systematic capacity building of stakeholders of all level on mitigating measures (GAPs/BMPs) and providing appropriate technologies together with value addition to their products in order to ensure the sustainability of any attempts made in this regard. Overall, it is confirmed the need of capacity building among farmers in Maduru Oya watershed on GAPs/BMPs and any specific nutrient pollution mitigation measures to make sure that the nutrient pollution in the region is minimized and downstream ecosystems are protected.

Key comments/findings of the stakeholder meeting were summarised as followings.

1 Main income source for many is the paddy farming
2 Apply excess fertilizers to increase the yield
3 Many have the concern that the quality of fertilizers has been going down
4 Changes in government policies on the fertilizer subsidy programs which determine the amount of usage, yield, and income generated
5 Not getting the correct fertilizer types as correct time
6 Difficulty in finding quality inputs, high cost (seeds, agrochemicals etc), and lack of labour
7 Inappropriate use of pesticides and other agrochemicals due to lack of knowledge
8 Lack of adequate extension services when it is needed and availability of advanced technologies
9 Lack of knowledge on best management practices (BMPs) and good agricultural practices (GAPs).
10 Some farmers are already aware about health impacts of use of pesticides and cultivate small plot with minimum use of agrochemicals for their consumption.
11 Farmers were not aware on the impact of livestock management on nutrient pollution.
12 Need of capacity building on nutrient pollution mitigation was identified.

3.3.2. Stakeholder awareness program on role of nutrients, ways of losing them and Good Agricultural practices

Questionnaire survey results revealed that farmers do not know the importance of soil analysis to measure the nutrient status (80%), identification of optimum nutrient levels (85%), use of colour charts to identify nutrient deficiencies (90%), use site specific fertiliser application (95%) and characteristics and impact of different fertilisers (especially on basal dressing, top dressing and urea (85%)). Further, most of the farmers (around 90%) were not aware on the impact of fertiliser and other agrochemicals on soil, water and air pollution. Farmers were also not aware on best management practices (85%). The evaluation before the awareness program highlighted the importance and need of awareness on best management practices.

The most effective practical methods to prevent or reduce nonpoint pollution sources can be simply defined as best management practices (BMPs) (Centner et al., 1996). They include structural and non-structural control methods and operation and maintenance procedures (Centner et al., 1996). The BMPs should be technically feasible and socially acceptable by the communities in the area. Proposed BMPs/BAPs guidelines are attached in the Annexure 5.6.

After the deliberation on role of nutrients, ways of losing them, and BMPs and Good Agricultural practices etc., all participants convinced about the need of implementing good agricultural practices to increase the safety of food produced while reducing the environmental pollution. Teaching materials on GAPs were also distributed among farmers (Annexure 5.7). Several farmers were interested to get the GAP certification to their farm and farm products.

3.4. Importance of future intervention for sustainable management of land and marine ecosystems

The impacts of nutrient pollution are not localized as the non-point pollution sources can damage towider range of communities/ecosystems. Therefore, mitigation of nutrient pollution needs clear understanding and attention of able stakeholders in all related sectors. It is important to strengthen the linkage and collaboration between key stakeholders/institutes to execute appropriate actions in a sustainable manner and policy level intervention.

The key stakeholders identified to mitigate nutrient pollution in Maduru Oya watershed were Department of Agriculture, National Aquaculture Development Authority (NAQDA), Marine Environment Protection Authority (MEPA), Department of Irrigation and non-government organizations (NGOs). Proper linkage between all the parties is important for sustainable management of land and marine ecosystems.

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5. Annexures

Annexure 5.1: Awareness program at Aralaganwila - 25th March 2019

Annexure 5.2: Questionnaire

Capacity building needs on sustainable nutrient management to reduce soil, water and coastal pollution in the Maduru Oya watershed – 12th February 2019

Name :……

Address :……

TP No. : …… **GN Division** :……

DS Division : ……**Farmer Organization:** ……

Date : ……..

1. **Age**

Below 35	
36-45	
46-55	
56-65	
Above 65	

2. **Educational level**

No formal education	
Up to grade 5	
Up to grade 8	
Up to grade 11	
Up to Advanced level	
Degree	

3. **Annual income**

Below 100,000	
100,000 – 500,000	
Above 500,000	

Other Income Sources

4. **Cultivation details**

Crop	**Extent (Acres)**	**Yield**	**Land Preparation (traditional/ machinery)**	**Seeds (traditional/ improved)**

5. Fertilizer usage

Crop	Type	Amount	Application method	Amount received by the subsidy scheme (kg)	Amount bought (kg)	Place you bought extra fertilizer	How you get the knowledge on fertilizer

6. **Other agrochemicals (insecticide/fungicide/ herbicide etc)**

Crop	Type (name)	Reason	Amount	Application method	Place you bought	How you get the knowledge on agrochemicals

7a. **Cultivation is rainfed/ irrigated(underline the answer)**

b. **Water is enough for irrigation (underline the answer)**

8. **Advantages and disadvantages of fertilizer application**

Advantages	Disadvantages

9. **Extra knowledge(underline the answer)**

Training programs/capacity building on waste management (Attended/ not attended).
Training programs/capacity building on good management practices (Attended/ not attended).
Training programs/capacity building on climate change (Attended/ not attended).

10. **Application/ use of knowledge (Mark the answer byX)**

	Use traditional knowledge	No use traditional knowledge	Use new technological knowledge	Do not use technological knowledge
Agriculture				
Waste management				
Mitigate environment pollution				

11. **Constraints(Mark the answer byX)**

Constraint	Strongly agree	Agree	N/A	Disagree	Strongly disagree
Climate change is a constraint for agriculture					
Soil pollution constraint for agriculture					
Water pollution constraint for agriculture					
Lack of new knowledge on agriculture					
Lack of quality seeds					
Market facilities not enough					

12. **Climate change(Mark the answer byX)**

	Reduced	**Increased**	**No change**
Rainfall amount			
Rainfall intensity			
Extreme rainy events			
Day time temperature			
Night time temperature			
Rainfall pattern	Changed ( )	-	No change ( )
Other ……..			
……			

13. **Waste management**

Household		**Agricultural**	
Type	**Waste management method**	**Type**	**Waste management method**

14. **Other**

……
……
……
……
……

Annexure 5.3: Stakeholder meeting at Aralaganwila - 12th February 2019






Annexure 5.4: Evaluation forms for awareness program

Annexure 5.4.1: Evaluation form – before the awareness program

Capacity building on sustainable nutrient management to reduce soil, water and coastal pollution in the Maduru Oya watershed

A

25th March 2019 - Aralaganwila

		Aware	Not aware
1	Soil analysis to measure the nutrient status and its importance		
2	Identify nutrient deficiency/overuse at the field		
3	Use of colour charts to identify nutrient deficiencies		
4	Site specific fertiliser application		
5	Knowledge on characteristics and impact of fertilisers		
	Basal dressing		
	Top dressing		
	Urea		
6.1	Are you aware about these things?		
6.2	If so, institutes that provide you the knowledge		

		Impact	No impact	Do not know
1	Impact of fertiliser overuse to the environment			
2	Impact of fertiliser on water			
3	Impact of fertiliser on soil			
4	Impact of fertiliser on air/ atmosphere			
5	Impact of pesticides and other agrochemicals on water			
6	Impact of pesticides and other agrochemicals on soil			
7	Impact of pesticides and other agrochemicals on air/ atmosphere			
8	Environmental impact of agriculture			
9	Impact of environmental pollution on agriculture			
10	Impact of agrochemicals on health			
11	Your preference to consume chemical contaminated food	Like ( )	Do not like ( )	
12	Use of good agricultural practices to mitigate environmental pollution	Can ( )	Cannot ( )	
13	Best management practices – BMPs can be used for agriculture	Agree ( )	Disagree ( )	

Comments

……

……

……

Annexure 5.4.2: Evaluation form – after the awareness program

Capacity building on sustainable nutrient management to reduce soil, water and coastal pollution in the Maduru Oya watershed

25th March 2019 - Aralaganwila B

		Aware	Not aware
1	Soil analysis to measure the nutrient status and its importance		
2	Identify nutrient deficiency/overuse at the field		
3	Use of colour charts to identify nutrient deficiencies		
4	Site specific fertiliser application		
5	Knowledge on characteristics and impact of fertilisers		
	Basal dressing		
	Top dressing		
	Urea		
6.1	Are you aware about these things?		
6.2	If so, institutes that provide you the knowledge		

		Impact	No impact	Do not know
1	Impact of fertiliser overuse to the environment			
2	Impact of fertiliser on water			
3	Impact of fertiliser on soil			
4	Impact of fertiliser on air/ atmosphere			
5	Impact of pesticides and other agrochemicals on water			
6	Impact of pesticides and other agrochemicals on soil			
7	Impact of pesticides and other agrochemicals on air/ atmosphere			
8	Environmental impact of agriculture			
9	Impact of environmental pollution on agriculture			
10	Impact of agrochemicals on health			
11	Your preference to consume chemical contaminated food	Like ( )	Do not like ( )	
12	Use of good agricultural practices to mitigate environmental pollution	Can ( )	Cannot ( )	
13	Best management practices – BMPs can be used for agriculture	Agree ( )	Disagree ( )	

Suggestions

……
……
……

Annexure 5.5: Land use pattern of districts in Maduru Oya watershed

	District							
Nature of land	**Badulla**		**Ampara**		**Polonnaruwa**		**Batticaloa**	
	Area (ha)	**%**	**Area (ha)**	**%**	**Area (ha)**	**%**	**Area (ha)**	**%**
Forest	60,733.4	21.23	142,100.0	32.19	169,348.6	48.85	42,382.0	14.85
Home gardens	1,555.6	0.54	35,319.5	8.00	48,932.9	14.12	12,288.0	4.31
Paddy lands	31,049.9	10.85	97,236.8	22.02	83,453.5	24.08	69,224.0	24.26
Perennial crops	16,990.0	5.94	29,720.7	6.73	n.a	-	2,406.2	0.84
Plantation crops	32,110.1	11.22	2,041.6	0.46	893.5	0.26	6,688.6	2.34
Other field crops (seasonal crops)	12,535.0	4.38	23,667.3	5.36	2,184.7	0.63	22,006.0	7.71
Large inland waters	5,723.9	2.00	17,650.0	4.00	20,397.2	5.88	24,400.0	8.55
Abandoned land	1,119.1	0.39	27,292.7	6.18	7,212.5	2.08	8,341.0	2.92
Build up land (roads/buildings/playgrounds)	13,091.1	4.58	11,702.9	2.65	732.9	0.21	9,944.0	3.48
Scrub/ Chena	295,09.2	10.31	29,714.7	6.73	11,476.4	3.31	61,942.0	21.70
Other	142,415.9	49.78	25,053.8	5.67	2,006.0	0.58	6,8160.0	23.88
Total	286,100.0		44,1500.0		346,638.2		285400.0	

Annexure 5.6: Best Management Practice (BMP) guidelines for nutrient pollution mitigation in Maduru Oya watershed

Paddy is the major crop in the Maduru Oya watershed and agriculture can be suggested as one of the predominant sources nutrient pollution that have an impact on Kayankerni and Pasikudah coral reef ecosystem. Therefore, in this document, a major focus on BMPs was given for agriculture.

The document is structured as follows. Part A describes the existing BMPs in the area and Part B summarises the proposed BMPs for Maduru Oya watershed. Sustainability of the farm as well as the ecosystem is important, therefore the UN sustainable development goals (SDGs) were also included under BMPs where possible. The proposed BMPs were broadly divided into three categories as agriculture, industry and other.

Part A - Existing Best Management Practices

Following are the BMPs currently practised by farmers in Maduru Oya watershed.

1. **Site specific fertiliser recommendation**

The Department of Agriculture Sri Lanka initiated the site specific fertiliser recommendation program to reduce the nutrient wastage. Because most of the farmers are unaware of the nutrient status of their fields and apply an excess amount of fertilizer even than the general recommendation. The Department of Agriculture charges Rs. 290.00 to analyse the soil properties in one sample which is lesser than the 10% of the original cost and the charge from the private laboratories.

Aralaganwila research station is one of the major government agricultural institutes in Maduru Oya watershed and according to their statistics, a total of 317 farmers analysed their soil from the station and received their own site specific fertiliser recommendations for the year 2018.

Popularisation of site-specific fertiliser application helps to mitigate nutrient pollution.

2. **Proper land preparation**

Proper land preparation increases crop production as well as the nutrient and moisture use efficiency. This includes the use of appropriate ploughs to suit the condition in different fields and plough to appropriate depths.

3. **Water management**

Clearing and plastering of bunds in rice fields increase the water retentionand therefore, maximise the nutrient use efficiency. Farmers already believed that lack of repairing of bunds reduce the water retention. Further, they believed that fertiliser use efficiency is high in the fields where bunds are properly constructed. A field that has properly prepared bunds can retain more water than the normal fields. Land preparation plays an important role in water management, and finally have a positive impact on nutrient use efficiency. Therefore, special attention is needed on repairing of bunds during the land preparation in paddy fieldsin order to maximise the nutrient use efficiency.

4. **Organic farming**

Two types of organic farming practices were observed in the area. One is farmers practice conventional chemical farming with inorganic fertilisers and apply some organic fertilisers. They also practice pest/ disease control methods using traditional knowledge and organic mixtures instead toxic agrochemicals. Therefore, the cultivation was not completely organic, but comparatively lesser usage of agrochemicals were observed.

Some other farmers cultivated organic rice with the instructions and support from the Presidents' Secretariat Office. These farmers did not use any kind of inorganic fertilisers and agrochemicals. Unfortunately, the project was terminated, and farmers do not have a chance to practice organic rice cultivation due to this issue.

However, organic farming minimises the use of inorganic agrochemicals and increase soil health, therefore minimise the nitrogen and phosphorus pollution from agricultural fields.

Part B - Proposed Best Management Practices

The following are the proposed BMPs for Maduru Oya watershed.

1. Agriculture

Precision agriculture

Conventional farm fields should be improved to precision farming locations where detailed mapping that include slope and soil nutrient status in the entire field should be developed. Appropriate crop selection should be practiced based on the land suitability classification. New technology such as drones, Global Positioning System (GPS) and computer/ smart phone-based applications should be promoted.

1.1.BMPs on fertiliser application

The goal of the fertiliser BMPs is to optimise the yield with sufficient nutrient supply while minimising damage to the environment by reducing nutrient losses (Nutrient Management Handbook 2016). It also focusses on the increment of nutrient use efficiency. Following are the guidelines for BMPs on fertiliser application. BMPs on fertiliser management will improve the quality of water that comes under the Goal 6 of UN SDGs.

Initial nutrient status

The amount of fertiliser required for a field varies with the amount of nutrients supplied by the soil. The soil nutrient content depends on the soil type, previous crop and land preparation method (incorporation of crop residues). Therefore, it is important to analyse the initial nutrient status of the soil before application of fertilisers.

Other than soil nutrient levels, the nutrients in animal manures, green manures, composts and crop residues should also be analysed.

Right source

Before selection of the fertiliser type, it is important to think on the right source in terms of susceptibility to nutrient losses, nutrient interactions and/or compatibility issues. Organic fertiliser is a good source that minimises nutrient pollution. Nitrate fertilisers should not apply to waterlogged soils and some fertilisers that have an acidifying effect should be used for alkaline soils or with lime application in acidic soils. The right source depends on the crop, climate, soil properties, economic status and application methods.

Right rate

Different crops require a different amount of nutrients and their requirement varies with the growth stage of the crop. Nutrient losses can be minimised by the right rate of fertiliser application to balance the nutrient supply with crop demand. Excess fertiliser application leads to both crop damage and environmental pollution.

Right time

As already mentioned above, uptake rates of nutrients depend on the growth stage of the crop. If the nutrients are available in the soil for a longer period to uptake they can be loss from the root zone and pollute the groundwater. External factors like rainfall should also be considered on the time of fertiliser application. The application of fertiliser on heavy rainy periods will washout the nutrients and contaminate water bodies. Therefore, fertiliser application is not advised on heavy rainy days.

Proper application of fertiliser

If the fertilisers are applied to the soil correctly, there is less chance to be lost by the means of runoff. Incorporation of fertiliser to the soil disturbs soil structure that can trigger the erosion, but the surface application of phosphorus and nitrogen fertilisers without incorporation are not recommended.

Since nitrogen can loseregardless of the application method, it is important to apply the sufficient amounts. Split application of fertiliser increases the nutrient use efficiency and minimise the nutrient loss by leaching.

Advanced technologies for fertiliser application

Use of advanced technologies for manure application such as slow releasing fertilisers that release plant available nutrients gradually are important. It will increase the efficiency of fertiliser application and reduce nutrient loss.

There are different types of nitrogen inhibitors that reduce denitrification and leaching that enhance the nitrogen use efficiency. Dicyandiamide (DCD) and 3, 4-dimethypyrazole phosphate (DMPP) are common nitrogen inhibitors. Ureases inhibitors decrease the rate of the urea hydrolysis by blocking the active site of urease, therefore, minimise the nitrogen losses.

Fertiliser application with the use of irrigation, that is known as fertigation is important for the precision placement of fertiliser.

1.2.Organic manures

Not only the inorganic sources of nitrogen, but proper handling is also important for livestock manures such as cattle, poultry and pig and digested sewage sludge that contain a relatively higher amount of readily available nitrogen. Application of these organic manures on sandy soil should be done with proper care as the risk of nitrogen leaching is high. Application of organic manure will improve degraded soil that is important to minimise the hunger (Goal 2 of UN SDGs) and minimise the use of synthetic fertiliser that is important to reduce GHG emission (Goal 13 of UN SDGs).

Proper storage of organic fertiliser

Organic fertilisers should be stored properly to make sure that they are impermeable and not contaminate the water. Adequate storage of livestock manure will reduce the amount of money that need to buy fertiliser in the next season.

Organic manure is not recommended to apply on flooded or waterlogged fields. Special attention should be given on applying organic manure to sloping lands close to surface waters.

Manure heaps in fields should be covered properly to avoid the washout by rain.

1.3.Other BMPs on agriculture

Genetic materials with high resource use efficiency

There are some crop varieties that are efficient in nutrient usage. It is important to use genetic materials with high resource use efficiency to get the maximum from small amount of nutrients and to avoid nutrient wastage as well.

Pesticides

Pesticides must apply according to the label recommendations to minimise the environmental damage.

Soil management

Good soil management is essential to maximise the land productivity and to control nutrient leaching. Poor plant growth and poor drainage can be expected in soils with poor structure and can be a key factor in erosion and runoff. Therefore, soil improvement is important (Goal 2 of UN SDG).

Selection on crops based on a capability assessment will increase land productivity.

Control soil erosion

Soil erosion by water has a negative impact on both crop production and the environment. Nutrient rich soil can be accumulated to water streams and finally ended up at the ocean. Therefore, BMPs on the reduction of soil erosion are importantin order to have quality water (Goal 6 of UN SDG). Buffer stipes, cover crops, minimum disturbance to soil and mulching are some of thelow cost soil erosion control methods.

Buffer stripes

Maintain a strip of deep-rooted plants along streams and canals to filter runoff. Buffer areas also can be maintained between the farm and the water source. The amount/width of the buffer varies with the type of the farm/ farming activity and the water source.

Minimum disturbance to ground cover

Precision tillage is important. Avoid unnecessary land preparation and deep ploughing. No till and conservation tillage are good alternatives to control soil erosion.

Cover crops

Cover crops will reduce soil erosion and improve the soil physical and biological properties. It is important to select cover crops that suit the area.

Mulching

Crop residues from the previous harvest can use as a mulching material to control the soil erosion successfully. Mulched soil can retain more moisture than the bare soil. The retained moisture can increase the nutrient uptake that leads to higher yield.

Reduce nutrient runoff

Nutrient runoff can be reduced by the reduction of the speed of water flow because the flow rate is directly related to the carrying capacity of the running water. Contour tillage and sediment ponds will slow the runoff water flow. Ditches in the fields can reduce sediment loss. This will falls under Goal 6 of UN SDGs.

Proper irrigation management

The leaching of nutrients can be reduced by adjusting the rate, amount and the timing of irrigation. Advanced irrigation techniques such as drip irrigation should be promoted in the area for other fields crops and vegetable cultivation. This also will be helpful under climate change (Goal 13 of UN SDG) because water availability will be negatively affected under climate change.

Organic farming

In organic farming, synthetic fertilisers and other agrochemicals (herbicides, fungicides and etc.) are replaced with organic fertilisers and environmentally friendly organic chemicals made from plant extracts. Therefore, the use of environmental friendly farming methods such as organic farming minimise the nutrient pollution, enhance soil properties and increase ground water recharge.

Practice crop rotation

Different heights of root zones will utilise the nutrient content throughout the time in crop rotation. Therefore, the nutrient will not washout and pollute the water bodies.

Composting

Organic wastes such as waste from livestock can be used to produce compost. It will reduce odours, stabilise nutrients and provide them for crop production.

2. Industry

2.1. Waste water treatment and proper discharge

Waste and septic water from industries, houses and hotels contain a lot of pollutants such as heavy metals, microorganisms and toxic materials other than the nitrogen and phosphorus. All these pollutants can be carried out by water to the sea. Proper treatment of waste water is

important before discharge to the environment. Waste water treatment plants should be implemented at the industry level and hotels.

3. Other

3.1.Establishment of wetlands

The wetlands help to filter the pollutants from water and enhance the water quality. The recovery of old/ damaged wetlands, maintenance of existing and the creation of wetlands are important. This will also minimise the damage from the flood and conserve the biodiversity.

3.2.In and around houses

If the soaps, detergents, fertiliser and animal manure were not handled or disposed properly, they will contaminate water and contribute to the nutrient pollution. Therefore, proper disposal of detergents and manure at household level is important.

3.3.Awareness

Awareness of the consequences of mismanagement practices on the nutrient pollution and the impact of BMPs for a sustainable ecosystem is essential. Capacity building through workshops and seminars should be arranged.

Annexure 5.7: Training materials distributed among farmers

- ගුණාත්මයෙන් ඉහළ පොහොර භාවිතය
- නිර්දේශිත පොහොර නිවැරදි මාත්‍රාවෙන් යෙදීම
- රසායනික පොහොර නිසි ලෙස ගබඩා කර භාවිතා කිරීම
- හැකි සෑම විටම ක්ෂේත්‍රයේදී නිපදවාගත් කාබනික පොහොර භාවිතා කිරීම සුදුසු වන අතර, පිටතින් ගෙනෙන කාබනික පොහොර යොදන්නේ නම්, අවශ්‍ය ප්‍රතිකාර කිරීමෙන් පසු පමණක් භාවිතා කිරීම

7. පසු අස්වනු හානි වැලැක්වීම

- නියමිත පරිණත (මේරූ) අවධියේදී අස්වනු නෙලීම
- දවසේ සුදුසු කාලයේදී අස්වනු නෙලීම
- උචිත ශිල්ප ක්‍රම/උපකරණ භාවිතා කිරීම
- පිරිසිදු, සුදුසු භාජනවල ඇසිරීම

8. ගොවිපල කළමනාකරණය

- යහපත් කෘෂි පිළිවෙත් වලට අදාල වාර්තා නඩත්තු කිරීම, යාවත්කාලීන කිරීම

(බහුවාර්ෂික බෝග සඳහා අවම වශයෙන් වසර 2 ක කාලයක් හා කෙටිකාලීන බෝග සඳහා කන්න දෙකක්)

- යහපත් කෘෂි පිළිවෙත් වලට අදාල පරීක්ෂණාගාර විශ්ලේෂණ වාර්තා නඩත්තුව
- ගොවිපල ශ්‍රමිකයන් පුහුණු කිරීම
- යහපත් කෘෂි පිළිවෙත් නිසි අයුරින් සිදුවේදැයි නැවත පරීක්ෂාකර බැලීම

9. සේවක සෞඛ්‍ය හා සුඛසාධනය

- පානීය ජල පහසුකම්
- සනීපාරක්ෂක පහසුකම්
- විවේක ස්ථාන
- නීත්‍යානුකූල වැඩ පරිසර තත්ත්ව සැපයීම
- ශ්‍රමිකයන් වෛද්‍ය පරීක්ෂණවලට යොමු කිරීම

10. අනුරේඛනය (Traceability)

අවසන් කෘෂි නිෂ්පාදිතයේ, නිෂ්පාදන ක්‍රියාවලියට අදාල තොරතුරු දැනගැනීමේ ක්‍රමවේදය අනුරේඛනය නම් වේ.

තාක්ෂණික තොරතුරු

ඒ. එච්. එම්. රොෂාන්, සහකාර කෘෂිකර්ම අධ්‍යක්ෂ (කෘෂි ව්‍යාපාර උපදේශන)
එල්. ඒ. පී. පෙරේරා, වැඩබැටහන් සහකාර (කෘෂිකර්ම)

වැඩි විස්තර හා උපදෙස් සඳහා

කෘෂි ව්‍යාපාර උපදේශන අංශය
ව්‍යාප්ති හා පුහුණු මධ්‍යස්ථානය
කෘෂිකර්ම දෙපාර්තමේන්තුව
පේරාදෙණිය

දුරකථන හා ෆැක්ස් - 081-2388754

සැකසුම - *ජාතික කෘෂිකර්ම තොරතුරු හා සන්නිවේදන මධ්‍යස්ථානය, ගන්නෝරුව*

මුද්‍රණය - *කෘෂිකර්ම මුද්‍රණාලය, ගන්නෝරුව*

ගුණාත්මක හා සෞඛ්‍යාරක්ෂිත එළවළු හා පලතුරු

නිෂ්පාදනය සඳහා යහපත් කෘෂි පිළිවෙත්

කෘෂිකර්ම දෙපාර්තමේන්තුව, කෘෂිකර්ම අමාත්‍යාංශය
2018

කෘෂිකාර්මික බෝග නිෂ්පාදනය කිරීමේදී වගාවට යොදන කෘෂි රසායන හා අනෙකුත් යෙදවුම් අවම මට්ටමකින් භාවිතාකර, පරිසර හිතකාමී, තිරසාර ගොවිපලක් තුළින් ගුණාත්මක හා සෞඛ්‍යාරක්ෂිත බෝග අස්වැන්නක් ලබා ගැනීමට සිදු කරන්නා වූ පිළිවෙත් හා ක්‍රියාකාරකම් යහපත් කෘෂි පිළිවෙත් (GAP) වේ.

යහපත් කෘෂි පිළිවෙත්හි ප්‍රධාන අංග

1. ගුණාත්මක හා සෞඛ්‍යාරක්ෂිත ආහාර
2. පාරිසරික තිරසාර බව
3. ආර්ථික ඵලදායීතාව
4. සමාජීය පිළිගැනීම

යහපත් කෘෂි පිළිවෙත් භාවිතයේ වැදගත්කම

කෘෂි නිෂ්පාදකයාට හා අලෙවිකරුවාට;

- වගාවේ නිෂ්පාදන වියදම අවම කර ගැනීම තුළින් වැඩි ආදායමක් සහ වැඩි ලාභයක්
- ගුණාත්මක අස්වැන්නක් තුළින් වැඩි වෙළඳපොළ වටිනාකමක් සහ වැඩි ආදායමක්
- ගොවිපල තුළින් සෞඛ්‍යාරක්ෂිත නිෂ්පාදන
- ජාත්‍යන්තර හා සුපිරි වෙළඳසැල් සඳහා සෞඛ්‍යාරක්ෂිත නිෂ්පාදන සැපයීමට නව වෙළඳපොළ අවස්ථා
- GAP මඟින් ක්‍රමවත් ගොවිපලක් පිහිටුවා ගොවිපල පරිසරය වැඩිදියුණු වීම
- ගොවිපල සේවකයන්ගේ සෞඛ්‍ය හා ආරක්ෂාව සුරක්ෂිත වීම
- නිෂ්පාදන ප්‍රතික්ෂේප වීම අවම වීම

පාරිභෝගිකයාට;

- ගුණාත්මකව හා සෞඛ්‍යාරක්ෂිතව නිපදවූ කෘෂි නිෂ්පාදන විශ්වාසනීයභාවයකින් පරිභෝජනය කිරීමට හැකි වීම
- කෘෂි නිෂ්පාදන නිසා ඇති විය හැකි සෞඛ්‍යමය අවදානම අඩුවීම
- පරිසර හිතකාමී වීම

යහපත් කෘෂි පිළිවෙත් කාබනික කෘෂිකර්මයෙන් වෙනස් වන්නේ කෙසේද?

- කාබනික කෘෂිකර්මයේදී කෘතිමව සංස්ලේෂිත බාහිර කෘෂි යෙදවුම් (රසායනික පොහොර හා කෘෂි රසායන වැනි) කිසිවක් භාවිතා නොවේ.
- **යහපත් කෘෂි පිළිවෙත් යටතේ බාහිර කෘෂි යෙදවුම් (නිර්දේශිත පොහොර හා කෘෂි රසායන) නියමිත මාත්‍රාවෙන්, අත්‍යාවශ්‍ය අවස්ථාවේදී පමණක් භාවිතා කෙරේ.**

- මේ අනුව අවසන් නිෂ්පාදිතයේ අඩංගු පළිබෝධනාශක හා බැර ලෝහ ප්‍රමාණය එහි උපරිම අවශේෂ සීමාව (MRLs) නොඉක්මවයි.
- එමෙන්ම හානිකර ක්ෂුද්‍ර ජීවීන් හා භෞතික අපද්‍රව්‍ය වලින් තොර වීම නිසා ගුණාත්මය හා සෞඛ්‍යාරක්ෂිත බව තහවුරු වේ.

ක්ෂේත්‍රයේදී GAP ක්‍රියාත්මක කිරීමේ පියවර

1. ඉඩමේ ඉතිහාසය හා ඉඩම කළමනාකරණය

බෝග නිෂ්පාදන රසායනිකව හා ජීව විද්‍යාත්මකව දූෂණය වීම වැලැක්වීම සඳහා, ඉඩම අතීතයේදී භාවිතා කළේ කුමන කටයුතු සඳහාද යන්න පිළිබඳ අවදානය යොමු කළ යුතුය. බෝග නිෂ්පාදන දූෂණය වීමේ අවදානම වලක්වා ගැනීම සඳහා ඒ පිළිබඳ වාර්තාවක් තබා ගැනීම අත්‍යාවශ්‍ය වේ.

2. ගොවිපල ව්‍යුහ හා ඒවා කළමනාකරණය

ගොවිපල වටා ආරක්ෂක වැටවල් සැකසීම, ඇතුල්වීම හා පිටවීම සඳහා ගේට්ටු සවි කළ යුතුය. සුළං අධික ප්‍රදේශ වල සුළං බාධක යෙදීම කළ යුතුයි. ගොවිපල උපකරණ, යන්ත්‍රෝපකරණ සඳහා වෙන්වූ ස්ථාන තිබිය යුතුය.

3. වගාව ස්ථාපිත කිරීම හා වගා නඩත්තුව

- එක් එක් බෝගය සඳහා සුදුසු ප්‍රභේද හා ගුණාත්මක බීජ භාවිතය
- බිම් පිළියෙල කිරීම
- ක්ෂේත්‍රයේ සිටුවීම
- පුහුණු කිරීම
- වල් පැළෑටි මර්දනය
- පොහොර යෙදීම
- ජල සම්පාදනය
- අස්වනු නෙලීම හා පසු අස්වනු හැසිරවීම නිර්දේශයන්ට අනුකූලව සිදු කිරීම

4. ඒකාබද්ධ රෝග හා පළිබෝධ කළමනාකරණය (IPM)

- පරීක්ෂාකාරී වීම, හඳුනාගැනීම හා ක්ෂණික ක්‍රියාමාර්ග ගැනීම
- වැලැක්වීමේ ක්‍රියාමාර්ග ගැනීම (බෑග් යෙදීම, උගුල්, ඇම යෙදීම, කෘමි ප්‍රතිරෝධී දැල් භාවිතය)
- නිර්දේශිත පළිබෝධනාශක නියමිත මාත්‍රාවට අත්‍යාවශ්‍ය අවස්ථාවලදී යෙදීම
- භාවිතා කළ පළිබෝධනාශක පිළිබඳ වාර්තා තබා ගැනීම

5. පළිබෝධනාශක කළමනාකරණය

- පළිබෝධනාශක වගකීමෙන් යුතුව භාවිතා කිරීම
- නිවැරදි ආකාරයට පළිබෝධනාශක ගබඩා කිරීම
- ලේබලයේ උපදෙස් පරිදි කටයුතු කිරීම
- අවම විෂ සහිත පළිබෝධනාශක නියමිත මාත්‍රාවෙන් පමණක් යෙදීම
- සියළු ආරක්ෂක ක්‍රියාමාර්ග අනුගමනය කරමින් පුහුණු ශ්‍රමිකයෙක් විසින් යෙදීම
- පළිබෝධනාශක අපද්‍රව්‍ය කළමනාකරණය

6. ඒකාබද්ධ පැළෑටි පෝෂක කළමනාකරණය (IPNS)

- පස් පරීක්ෂාකර බෝගයට අවශ්‍ය පොහොර ප්‍රමාණය පමණක් යෙදීම

සහතිකකරණ ලද SL-GAP නිෂ්පාදන හඳුනාගන්නේ කෙසේද?

සෑම සහතිකකරණ ලද නිෂ්පාදන ඒකකයක්ම SL-GAP ප්‍රවර්ධන ඒකකයේ නිළධාරියකුගේ අධීක්ෂණය යටතේ ඇසුරුම් කිරීම සිදුකරන අතර සෑම ඇසුරුමක් සඳහාම SL-GAP ලාංඡනය හා අනුරේඛිත කේතනයක් (QR Code) සහිත ස්ටිකරයක් හෝ ලේබලයක් යොදනු ලැබේ. එමඟින් නිෂ්පාදනය පිළිබඳ සියලු තොරතුරු ලබාගත හැකි අතර ඔබගේ ස්මාර්ට් ජංගම දුරකථනයෙන් QR Code reader යෙදවුම (Mobile Phone App) මඟින් නිෂ්පාදිත ගොවිපලේ සිට සියලු ක්‍රියාදාමයන් ඇතුළත් අදාල තොරතුරු ක්ෂණයකින් ඔබවෙත ලබාගත හැක.

GAP නිෂ්පාදන ලබා ගත හැකි ස්ථාන

සහතිකකරණය ලැබූ ගොවිපළ එළවළු හා පලතුරු පාරිභෝගිකයන් වෙතට පත් කිරීම අරමුණු කොට ගෙන, තෝරාගත් සුපිරි වෙළඳසැල් හා කෘෂිකර්ම දෙපාර්තමේන්තුවේ අනුග්‍රහයෙන් ස්ථාපිත විශේෂිත GAP නිෂ්පාදන අලෙවි සැල් ජාලයක් මඟින් SL - GAP සන්නාමය සහිතව විශ්වාසනීය ලෙස සැපයීම් කටයුතු කිරීමට සැලසුම් කරමින් පවතී.

වැඩි විස්තර හා උපදෙස් සඳහා
SL - GAP *සහතිකකරණ ඒකකය,*
කෘෂිකර්ම දෙපාර්තමේන්තුව, පේරාදෙණිය.
දුරකථන : 081-206 8081
slgapcertification@ gmail.com

සැකසුම
ජාතික කෘෂිකර්ම තොරතුරු හා සන්නිවේදන මධ්‍යස්ථානය, ගන්නොරුව

මුද්‍රණය
කෘෂිකර්ම ප්‍රකාශන ඒකකය, ගන්නොරුව

නිරෝගිමත් පරපුරක් සඳහා සෞඛ්‍යාරක්ෂිත එළවළු, පලතුරු

SLGAP
DEPARTMENT OF AGRICULTURE - SRI LANKA

SL - GAP සහතිකකරන ඒකකය
කෘෂිකර්ම දෙපාර්තමේන්තුව, කෘෂිකර්ම අමාත්‍යාංශය

එළවළු හා පලතුරු සඳහා ප්‍රමිතියක් අවශ්‍ය ඇයි?

එළවළු හා පලතුරු වල නැවුම් බව වෙළඳපොළ රාක්කය මතදී පමණක් ආරක්ෂා වියයුත්තක් නොව, ගොවිපළ නිෂ්පාදනයේ සිට පරිභෝජනය දක්වාම ආරක්ෂා කළයුත්තකි. අප මිලදී ගන්නා එළවළු හා පලතුරු කිසිදු නියාමනයකින් තොරව, අධික ලෙස කෘෂි රසායන වැනි බාහිර යෙදවුම් භාවිතයෙන් නිෂ්පාදිත විය හැකි වීමත්, අපිරිසිදු පසු අස්වනු සැකසුම් හේතුවෙන් විවිධ බාහිර අපද්‍රව්‍ය සමඟ ස්පර්ෂිත බැවින් ඒවා භාවිතයෙන් බොහෝ පිරිස් ඍජු හා වක්‍ර ලෙස සෞඛ්‍ය තර්ජනයන්ට ලක්වීමත් සිදුවේ. මෙම තත්ත්වය තුල පාරිභෝගික අප මිල දී ගන්නා නිෂ්පාදනයන්හි ගුණාත්මකභාවය හා සෞඛ්‍ය ආරක්ෂිත බව සඳහා ප්‍රමිතිකරණයක් හා විශ්වාසනීයත්වයක් ලබාගැනීමේ අවශ්‍යතාවයක් මතුව ඇත.

ප්‍රමිතිකරණයක් හඳුන්වා දීම

ඉහත අවශ්‍යතාවය හඳුනාගත් කෘෂිකර්ම දෙපාර්තමේන්තුව නැවුම් එළවළු හා පලතුරු සඳහා ප්‍රමිතිකරණ සහතිකයක් නිකුත් කිරීමට පියවර ගෙන ඇත.

ඒ අනුව SLS 1523 ප්‍රමිතිකරණය යටතේ යහපත් කෘෂි පිළිවෙත් (Good Agricultural Practices - GAP) පියවරයන්ට අනුකූලව නිෂ්පාදනය කරන එළවළු හා පලතුරු සඳහා SL-GAP සහතිකය නිකුත් කරනු ලැබේ. මෙමඟින් පාරිභෝගික ඔබ අතට පත්වන එළවළු හා පලතුරු වල ප්‍රමිතිය සහතික වන අතර විශ්වාසනීයත්වය සුරැකේ.

SL-GAP නිෂ්පාදන යනු මොනවාද?

කෘෂිකර්ම දෙපාර්තමේන්තුවේ SL-GAP ප්‍රවර්ධන ඒකකයේ අධීක්ෂණයෙන් කෘෂි යෙදවුම් වලට අදාලව නිර්දේශ අනුගමනය කරමින් තිරසර බවින්, පරිසර හිතකාමීව, සමාජ පිළිගැනීමක් සහිතව, බාහිර අපද්‍රව්‍යන්ගෙන් තොරව ගුණාත්මක හා සෞඛ්‍යාරක්ෂිතව එළවළු හා පලතුරු නිෂ්පාදනය කර එම නිෂ්පාදනයන් අදාළ පිරිවිතරයන්ට අනුකූලව නිපදවා ඇතිබවට SL-GAP සහතිකකරණ ඒකකයෙන් සහතික කිරීමෙන් අනතුරුව වෙළඳපොළ වෙත නිකුත්කරන ලද නිෂ්පාදනයන් වේ.

SL-GAP නිෂ්පාදන පරිභෝජනය තුළින් අපහට අත්වන වාසි මොනවාද?

- විශ්වාසනීය අයුරින් ගුණාත්මකව හා සෞඛ්‍ය ආරක්ෂිතව නිපදවූ එළවළු පලතුරු වැනි කෘෂි නිෂ්පාදන භාවිතයෙන්, කෘෂි නිෂ්පාදනයන්ගෙන් ඇතිවිය හැකි සෞඛ්‍යමය අවදානම අවමවීම.
- කෘෂි රසායන අවශේෂයන්ගෙන් තොර ආහාර භාවිතය තුළ නීරෝගිමත් අනාගත දරු පරපුරක් බිහිවීම.
- සමාජ පිළිගැනීමකින් යුතු පරිසර හිතකාමී පරිභෝජනයක් තුළින් ආත්මාභිමානයක් ලබා ගත හැකිවීම.

යහපත් කෘෂිකාර්මික පිළිවෙත්

Good Agricultural Practices (G.A.P)

SLGAP

DEPARTMENT OF AGRICULTURE, SRI LANKA

සෞඛ්‍යාරක්ෂිත ආහාර නිරෝගිමත් දිවියක්

Safe Food Good Health

ආර්. එස්. විජේසේකර
කෘෂිකර්ම දෙපාර්තමේන්තුව
කෘෂිකර්ම අමාත්‍යාංශය

2016