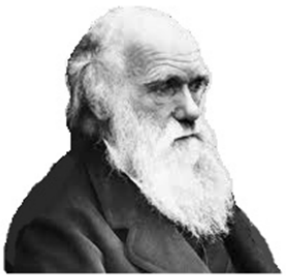
Available online at www.worldnewsnaturalsciences.com



World News of Natural Sciences

An International Scientific Journal

WNOFNS 39 (2021) 113-129 EISSN 2543-5426

The Excessive Use of Chemical Fertilizers & Dynamic Soil pH on Agricultural Land: The GIS-Based Inverse Distance Weighting (IDW)

M. Fathima Jisna[1,a], **M. H. F. Nuskiya**[1,b] & **A. L. Iyoob**[2]

[1]Department of Geography, Faculty of Arts and Culture, South Eastern University of Sri Lanka, Oluvil, Sri Lanka

[2]Land Use Policy Planning Department, District Secretariat, Ampara, Sri Lanka

[a,b]E-mail Address: jisnafathima72@gmail.com, 5fathimanuski@gmail.com

ABSTRACT

Chemical fertilizer use is highly increasing in farming activity, and the process has a significant impact on soil quality and pH which is the measurement of the acidity or alkalinity. Therefore, soil pH is the main variable because it regulates plant nutrition availability by controlling the chemical forms of various nutrients in agricultural activity. This research aims to find out the excessive use of chemical fertilizers & dynamic soil pH on agricultural land. The primary data had collected by using questionnaires, interviews, Focus Group Discussion (FGD) and soil testing. For the soil testing experiment, simple random sampling method was used to collect the sample in 11 agricultural continents using GPS technology to identify the land location and 22 soil samples were collected based on pre and post applied chemical fertilizer stage. In order to pH value were tested from the collected soil samples. Accordingly, the data were analyzed by ArcGIS 10.3 using the IDW technique. Therefore, the results find out the condition of soil quality during the pre-chemical fertilization, 9% of the land found to be slightly acidic, 27% of the land with neutral soil structure and 15% of the land with salinity soil structure. During the post-chemical fertilization, 9% of the land was found to be moderately acidic, 41% of the soil was found to be strongly acidic, 32% of the soil highly acidic and 18% of the land be moderately pH. The result of the study shown, chemical fertilizers use highly impact on soil quality and agricultural land productivity.

***Keywords*:** chemical Fertilizer, excessive use, agricultural land, soil pH, productivity

(Received 26 September 2021; Accepted 16 October 2021; Date of Publication 17 October 2021)

1. INTRODUCTION

Sri Lanka is an agricultural country and paddy has been cultivated in Sri Lanka for over 2000 years. Paddy is cultivated in 0.734 million hectares and chemical fertilization by farmers in our country during cultivation activities is seen as an unavoidable feature. About 50% of the imported chemical fertilizers are used for paddy cultivation. In worldwide, 18.1 million square kilometers of land are subject to degradation due to improper agricultural practices and excessive use of chemical fertilizer. Therefore, modern cultivation methods are being actively adopted today to get high yields in the existing landscape. Chemical fertilizers are artificially produced by humans which provide the plant with artificial nutrients such as N (nitrogen), P (phosphorus), K (potassium) found in the soil necessary for plant growth. In Sri Lanka, the excessive use of chemical fertilizers on agricultural lands during the period between 2002-2016 was 131.9 kg per hectare. However, it is best to test the soil during composting activities and know the nutrients of the respective lands and apply compost accordingly. Most farmers in Sri Lanka apply more than the recommended amount of fertilizer to their crops in order to get higher yields. Such use degrades/acidifies land and pollutes the groundwater for that about 50% of agricultural land in Sri Lanka is unusable due to soil acidification and soil degradation.

Accordingly, agriculture is the main economic activity in the Nintavur. 76.85% of the total land area is agricultural land and 24% of the population is engaged in agriculture. Paddy is cultivated in a total area of 2 790.03 ha. Most of the land in Nintavur is used for paddy cultivation. In the early days, farmers used more natural fertilizers and which was less synthetic fertilizers. At present only chemical fertilizers are used which is possible to observe a situation where the yield obtained by such use is found to be substandard. The main problem of this study is the degradation of agricultural lands due to increased chemical fertilizers during agricultural activities in Nintavur. The soil quality of agricultural lands and decreased quality of crop yields due to the use of chemical fertilizers as these lands fall into a situation where farmers lose employment opportunities due to the process and abandoned farming land.

The pH of soil is a measure of its acidity or alkalinity. A pH of 7 is neutral, while a pH of more than 7 is alkaline and less than 7 is acidic. A pH of 6 is 10 times more acid than a pH of 7. This is because pH is measured on a logarithmic scale. Soil acidification, if left untreated, can have a negative influence on agricultural output and long-term farming systems. Acidification can also reach the subsoil layers, providing major challenges for plant root development and remediation. The National Resources Conservation Service of the United States Department of Agriculture divides soil pH values into four categories: ultra-acidic (3.5–4.4), extremely acidic (3.5–4.4), very strongly acidic (4.5–5.0), strongly acidic (5.1–5.5), moderately acidic (5.6–6.0), slightly acidic (6.1–6.5), neutral (6.6–7.3), slightly alkaline (7.4–7.8), moderately alkaline (7.9–8.4), strongly alkaline (8.5–9.0), and very strongly alkaline (> 9.0).

1. 2. Objective of the Study

Main objective: The main objective of this study is to identify the impact of excessive use of Chemical fertilizer and soil acidification levels in agricultural land. Sub-objective:

- To analysis, the soil quality and pH level of paddy lands in the study area
- To Inverse Distance Weighting (IDW) the impact of excessive fertilizer use on agricultural land in the study area

- To assess the recent chemical fertilizer use and their impact and find out the proper solution to reduce the consequences

2. MATERIALS AND METHODS

This part explains how the research is conducted, research design, data collecting techniques, instrument development, provide sufficient details of the methods including the ethical conduct and data analysis techniques.

2. 1. Study Area

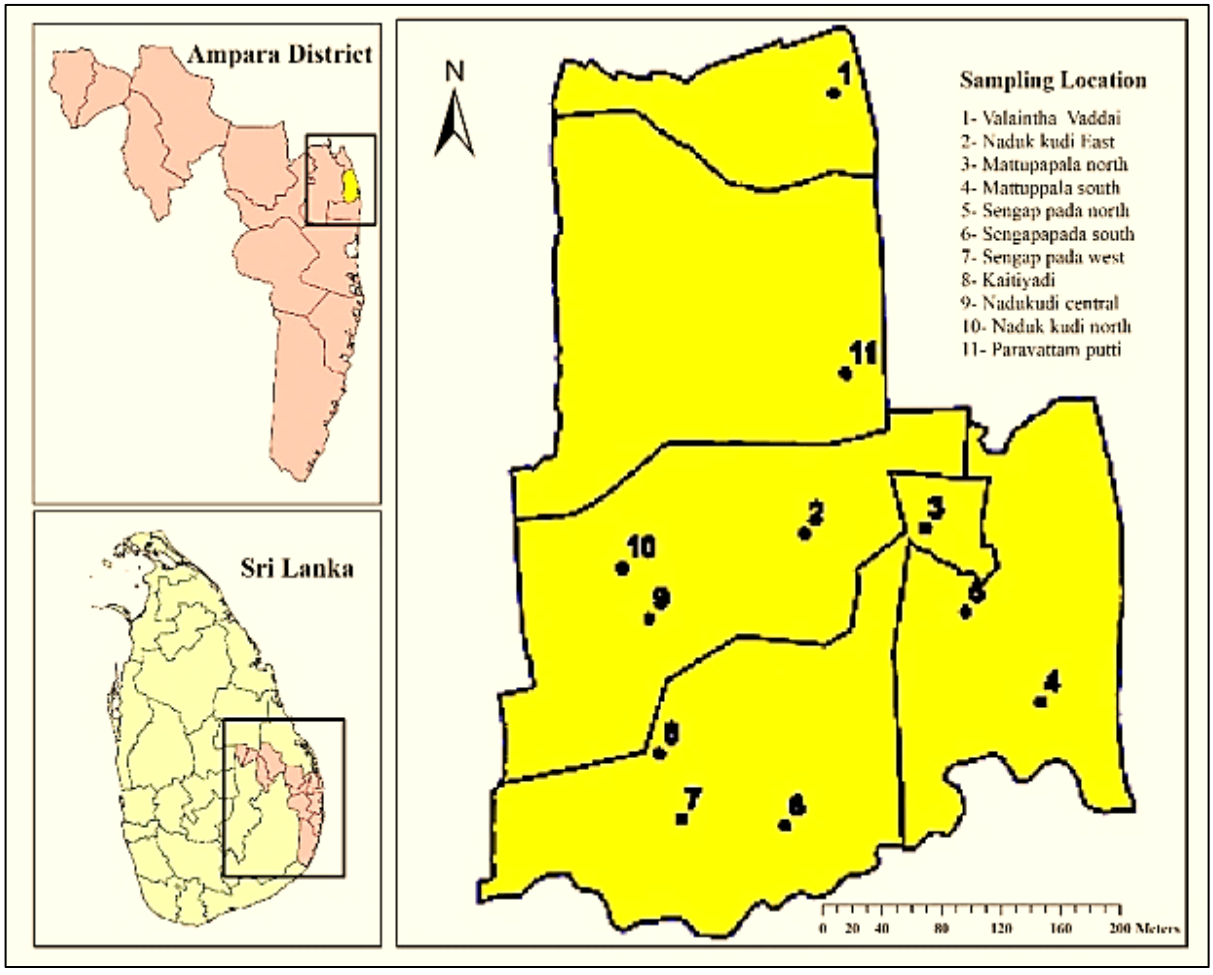


Figure 1. Spatial Location of Study Area
Source: Retrieved by the researcher (ArcGIS 10.4)

Nintavur DSD which has 25 Grama Niladhari GN division, it is located in the south part of Ampara district. It is spatially located between 81° 50’ 42” E and 7° 28’ 04” – 7° 19’ 36” N. It is bordered on the north by the Vettaru River, on the east by the Indian Ocean, on the south by the Kaliodai River, and on the west by paddy fields that border the town of Sammanthurai.

Nintavur's total size is roughly 36 square kilometers, with paddy fields covering 74 percent (2634 hectares) of the land use. Nintavur's current land use pattern shows that paddy fields cover 74% of the land, with residential land covering 9%, coconut land covering 7%, and other buildup area covering 3% and other portion of land covered by industries, water bodies, and vacant lands. The Nintavur area's main potential is paddy fields and the majority of the land is covered by paddy fields as mentioned above.

2. 2. Data Collection

The data for this study were obtained through the primary and secondary data collection methods. The primary data were collected through the questionnaire survey, interview, direct observation, and experimentation.

Questionnaire: Data were collected by selecting 5% of the total farmers of Nintavur based on the area of agricultural land and giving them 104 structured questionnaires based on a simple random sampling method.

Interview: 32 people were selected for structured interviews who are farmers, soil inspectors, agrarian service officers, Vattanai Vidhani and fertilizer store owners involved in the study.

Direct Observation: direct observation was held on 11 selected sampling locations in the study area and observe the soil conditions of the agricultural lands, characteristics of soil, uncultivated lands/ abandoned farming land, soil quality and chemical fertilizers used by the farmers, chemical fertilization methods for the field lands, etc.

Secondary data: Secondary data for this study were obtained from Nintavur Divisional Secretariat reports, Nintavur Agricultural Agrarian Department reports, previous studies, websites, and journals, etc.

2. 3. Experiment Technique

Through this study, was found to be related to the degradation of agricultural lands due to excessive fertilizer use, soil samples of agricultural lands were collected and tested for their PH value, EC (Electric Conductivity) and temperature.

Selection of Samples: Because the study area is a field that is suitable for collecting soil samples based on simple random sampling with the help of GPS (Global Positing System).

The samples were collected based on the agricultural land per continent for each season (pre-chemical fertilization - 2020.09.30, post-chemical fertilizer application - 2020.11.01) 22 soil samples were collected at a depth of 15cm using the Aurger machine. The place where the soil samples were collected in the study area was marked with sticks and collected at the same place in both seasons.

Soil Testing: The pH and temperature of the soil samples collected by the researcher were tested by pH Meter and EC (Electric Conductivity) was tested by EC Meter. Soil samples were collected before chemical fertilization which was tested on 2020.10.01 and soil samples collected after chemical fertilization were tested on 2020.11.05. Soil samples obtained from 11 sampling locations in the study area were tested and identified degradation of agricultural lands due to increased chemical fertilization based on their pH and Acidity.

Data Analysis: The obtain information from the soil testing report descriptively get some idea about the agricultural land in the study area. Based on the pH value, the researcher finds

out the acidification soil level spatially through the Inverse Distance Weighting (IDW) technique by using Arc GIS 10.3.

Table 1. Details of sample location

Sample point	Name of the Sampling Location	Latitude	Longitude
1	Valaintha vaddai	7.360169876	81.8438908
2	Naduk kudi East	7.363145561	81.84684228
3	Mattupapala north	7.322847054	81.84820343
4	Mattuppala south	7.313843482	81.85125092
5	Sengap pada north	7.313991128	81.84822638
6	Sengapapada south	7.302234817	81.83011164
7	Sengap pada west	7.302923292	81.82814654
8	Kaitiyadi	7.304791088	81.82666885
9	Nadukudi central	7.301029355	81.81183428
10	Naduk kudi north	7.319677532	81.8236047
11	Paravattam putti	7.335239174	81.84175517

Source: GPS findings, 2020

4. RESULT AND DISCUSSION

The various factors influence the degradation of agricultural lands on the study area through the excessive use of chemical fertilizers during agricultural activities which plays a major role in the current paddy cultivation activity. Therefore, the data have been obtained and analyzed from soil tests conducted at the selected agricultural land. Although the questionnaire, interviews, direct observation were used as data collection techniques to achieve the study objective.

4. 1. The use of chemical fertilizer on agricultural land

Over the total area of Nintavur, paddy is cultivated in 76.85% of the land area. Yield productivity annually increasing by the past productivity which is the role of chemical fertilizers in obtaining high which cannot be underestimated in any way to increase productivity level. Accordingly, the usage of chemical fertilizer has become a major input in today's agriculture and which are seen as an indispensable input during agricultural activities as they provide faster crop growth and higher yields. Paddy is cultivated in 76.85% of the total land area of Nintavur.

Based on the questionnaire conducted in the study area, the use of natural fertilizers like goat manure, cow-dung, poultry manure, ash, straw etc is 3 % during paddy cultivation in the area and chemical fertilizers like UREA, M.O.P (Muriate of Potash), D.S.P (Triple Super Phosphate) are used at 97% during paddy cultivation in the respective area (Figure 2).

Figure 2. Usage of Chemical fertilizer on Nintavur agricultural land (2020)
Source: Department of agrarian service report, 2020

Therefore, according to the Department of Agrarian Services, the use of chemical fertilizers during paddy cultivation is 67% for UREA and 17% for M.O.P. Fertilizer and DSP fertilizer are used at 16% (Department of Agrarian Services, 2020).

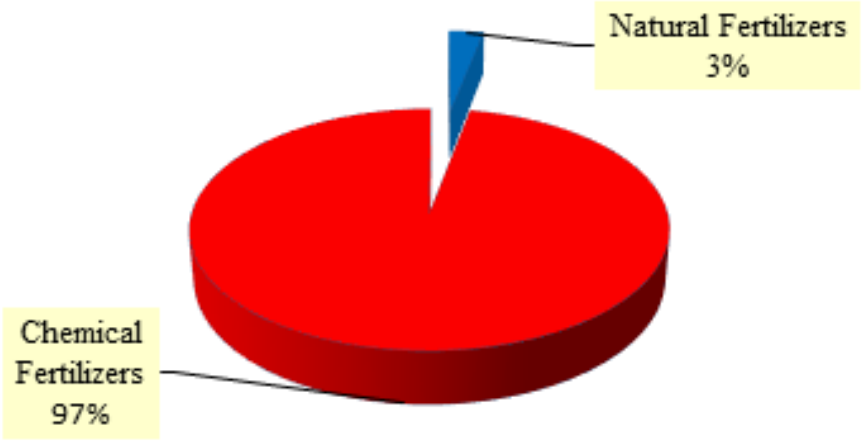


Figure 3. Usage of Chemical fertilizer during the cultivation on Nintavur agricultural land (2020)
Source: Department of Agrarian Services report, 2020

The agricultural land in Nintavur has become acidic due to the impact of increased chemical fertilizers used during agricultural activities [5]. However, farmers in the study area use a lot of chemical fertilizers during paddy cultivation without any concern for the quality of the land. Accordingly, major three types of Chemical fertilizers are mainly used during paddy cultivation in the study area (Figure 4).

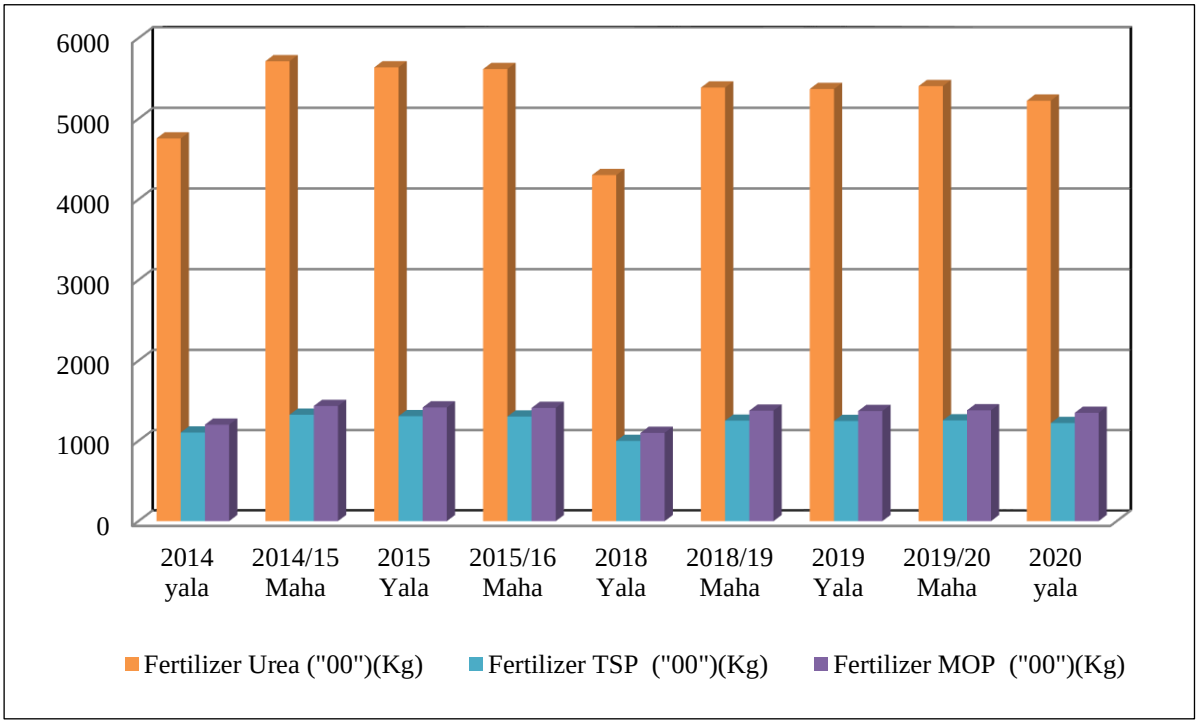


Figure 4. Nitregion fertilizer Urea [$CO(NH_2)_2$], MOP (Muriate of Potash) and TSP (Triple Super phosphate).
Source: Field collection, 2020

In the study area, the use of chemical fertilizers is higher than the natural fertilizers during paddy cultivation. Thus the study was to find out the excessive use of chemical fertilizers concerning the quality of the soil which has highly affected the agricultural land.

4. 2. Quality of the soil

Soil hygiene is the condition of the soil that is environmentally friendly and conducive to the functioning of the ecosystem. Soil quality plays a major role in determining soil health. The levels of soil chemical properties (pH) acidity and alkalinity in measuring the soil quality of agricultural lands in the study area were obtained from the report of the Department of Agricultural Agrarian Services on the quantity of agricultural lands such as Phosphorus (P) and Potassium (K) which were found based on systematic experiments.

4. 2. 1. Soil Acidity and Alkalinity (pH) of the study area

The pH value of the soil is the equivalent of the logarithmic value of the active H^+ ion concentration in the soil solution. The acidity of the soil is measured at the pH level. Soil acidity is defined as the effect of the negative impact of the concentration of hydrogen ions on H. The pH scale is measured from 0 - 14. Where pH 6.6 - 7.3 is shown to be neutral. The pH of the soil decreases as the amount of hydrogen ions in the soil increases. Thus increasing the acidity when the pH drops below 6.5 and pH 7.4 - 14 with alkalinity.

4. 2. 2. Soil acidity

The subsequent prolonged intrusion of water washes away the volatile of $Ca^{2+,}$ Mg^{2+}, Na^{+}, K^{+} ions found in the soil elements that caused to soil reaches acidity. In study areas with low temperatures, organic matter in the soil is less dissociated, resulting in higher levels of starch and organic acids. As they accumulate on the soil surface through that soil becomes acidity. And also soil acidity is due to the absorption and release of H^{+} as plant nutrients such as Ca^{2+}, Mg^{2+}, Na^{+}, K^{+} which are the rootstocks found in soil due to prolonged and continuous cultivation. Soil acidity is also due to the SO_4^{2-} herb due to long-term continuous use of fertilizers such as $(NH_4)_2SO_4$. Gases such as N_2O, SO_2 which are released into the atmosphere, dissolve in rainwater, forming acid and reaching the soil, making the soil acidic.

4. 2. 3. Soil alkalinity

Due to the low precipitation in arid and arid areas, the salts in the soil are not subject to downward hydration, the rocks are weathered and depleted salts are released to the soil side, during the rainy season in low-lying areas that water level rises and salts arrive and accumulate in the soil, marine augmentation and soil alkalinity in agricultural lands is similar to the overuse of chemical fertilizers which are the trigger to soil alkalinity. Soil alkalinity is increased through weathering silicate, aluminosilicate, and carbonate mineral complexes containing Na^{+}, Ca^{2+}, Mg^{2+}, and K^{+}. As eroded sediments are deposited by water or wind, the above-mentioned minerals are commonly added to the soil. Soil alkalinity can also be enhanced by irrigating with water containing dissolved bicarbonates when using high-bicarbonate water. If there isn't enough water going through the soil to absorb soluble salts, alkalinity can build up. Water is either transpired by crops or evaporates rather than flowing through the soil in arid areas or in situations with inadequate internal soil water drainage. Crops' suitability for a wide variety of pH levels varies. Some crops may be intolerant to a given soil pH due to a specific mechanism.

Soil pH 5.5 is inappropriate for soybean plants when molybdenum levels are low, but when molybdenum levels are sufficient, the same pH 5.5 is ideal. The pH of the soil should be about 7.0 for most crops to thrive (neutral). This highlights the importance of bringing both acidic and alkaline soils to a neutral pH for maximum crop performance.

Table 2. The pH and temperature level (before - 1, and after - 2 fertilizer use).

Sample point	1 pH	2 pH	1 Temperature (°C)	2 Temperature (°C)	Extend of agricultural land	Land (%)
A	5.96	5.7	30.7	27.2	418	7
B	6.2	4.9	31	27.2	520	9
C	7.4	6.6	31.1	27.3	464	8
D	7.5	6.7	30.7	27.1	390	7
E	6.33	5.7	31	27.2	566	10
F	6.2	5.3	31	27	480	8.4

G	6.8	5.5	31.3	27.2	487	8.5
H	6.6	5.2	31.1	27.2	364	6.4
I	5.97	4.6	31.6	27.1	511	9.1
J	6.2	5.1	31.4	27.1	517	9.6
11	6.6	4.8	32	27.1	962	17

Source: Sample test report, 2020

Accordingly, the collected soil samples of the study area were examined and the pH of the soil was measured based on two seasons, the season before chemical fertilization in the field and the season after chemical fertilization (Table 2).

The PH of the continents indicated by the letters A and I in the season before chemical fertilization used in the study area was found to be somewhat acidic between 5.95 and 5.98. The pH of the B, F, E continents is found to be slightly acidic between 6.1 and 6.3. The pH of agricultural lands marked with H, G, K such letters is found to be neutral between 6.6 and 7.3. The PH of the two continents, the Northern Continent of the Madduppallai denoted by the letter C and the Southern Continent of the Madduppallai denoted by the letter D, is 7.4 to 7.8. In the season after chemical fertilization, the pH content of the soils on areas A, B, I and K has changed to a very acidic state. It accounts for 33% of the total agricultural land area of the study area. 90 % of the farmers said during the questionnaire analysis that the use of fertilizers of the UREA, M.O.P, and D.S.P. was the reason (Figure 5)

The Kayittiyadi continents, denoted by the letter H, initially had a neutral pH of 6.6 and later became a strong acid with a pH of 5.2 after the application of chemical fertilizers. The location is shown by the letters G and E is found to be acidic soil. The soils on the continents denoted by the letters A and F are found to be somewhat acidic. The area shown by the English letters C and D is found to be neutral soil free from salinity. Due to the infiltration of seawater in these areas. These were found to be salinity. However, after the use of chemical fertilizers, the soil becomes neutral soil. In order to change the salinity, the application of too much manure was left as per Urea fertilizer used by the farmers at the rate of 25 kg/acre, DSP fertilizer at the rate of 20 kg/acre and 10 kg M.O.P./acre. This was proved by the expression of 90% of the farmers and 95 % of the interviewers during the questionnaire analysis conducted in the study area. The pH of the soil on the sample collected locations A, B, I, K has changed to a very acidity which is 33% of the total agricultural land area of the study area. During the collected questionnaire, 90% of the farmers said that the increased level of acidity in these areas was due to the use of chemical fertilizers Urea, TSP, MOP used during paddy cultivation in these areas. The sampling location H initially had a neutral pH (6.6) and later became a strong acid soil with a pH of 5.2 after chemical fertilization. The soil shown by the location G, E is transformed into a strong acidity area (Figure 6). The sampling location A, F referred is somewhat acidic. The sampling location C, D is found to be neutral soil free from alkalinity. These were found to be alkaline due to the infiltration of seawater in these areas. However, after chemical fertilization, the soil is found to be neutral. In order to change the alkalinity, 90 % of the farmers and 85% of the interviewees in the analysis conducted in the study area that 25Kg Urea, 20Kg TSP> 10 Kg MOP manure per acre were applied more than usual during paddy cultivation.

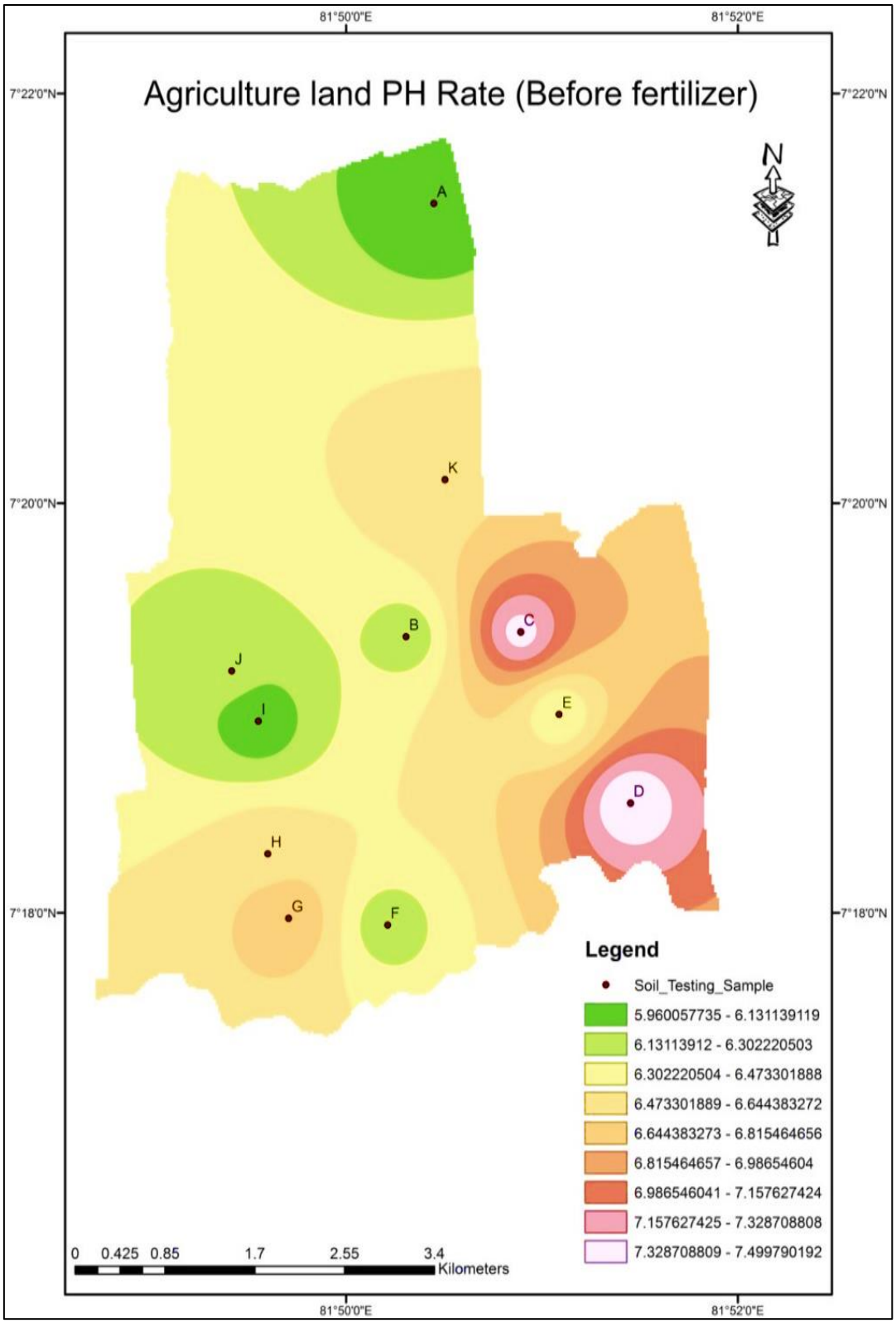


Figure 5. Agriculture land pH rate (before use of chemical fertilizer)
Source: IDW analysis result

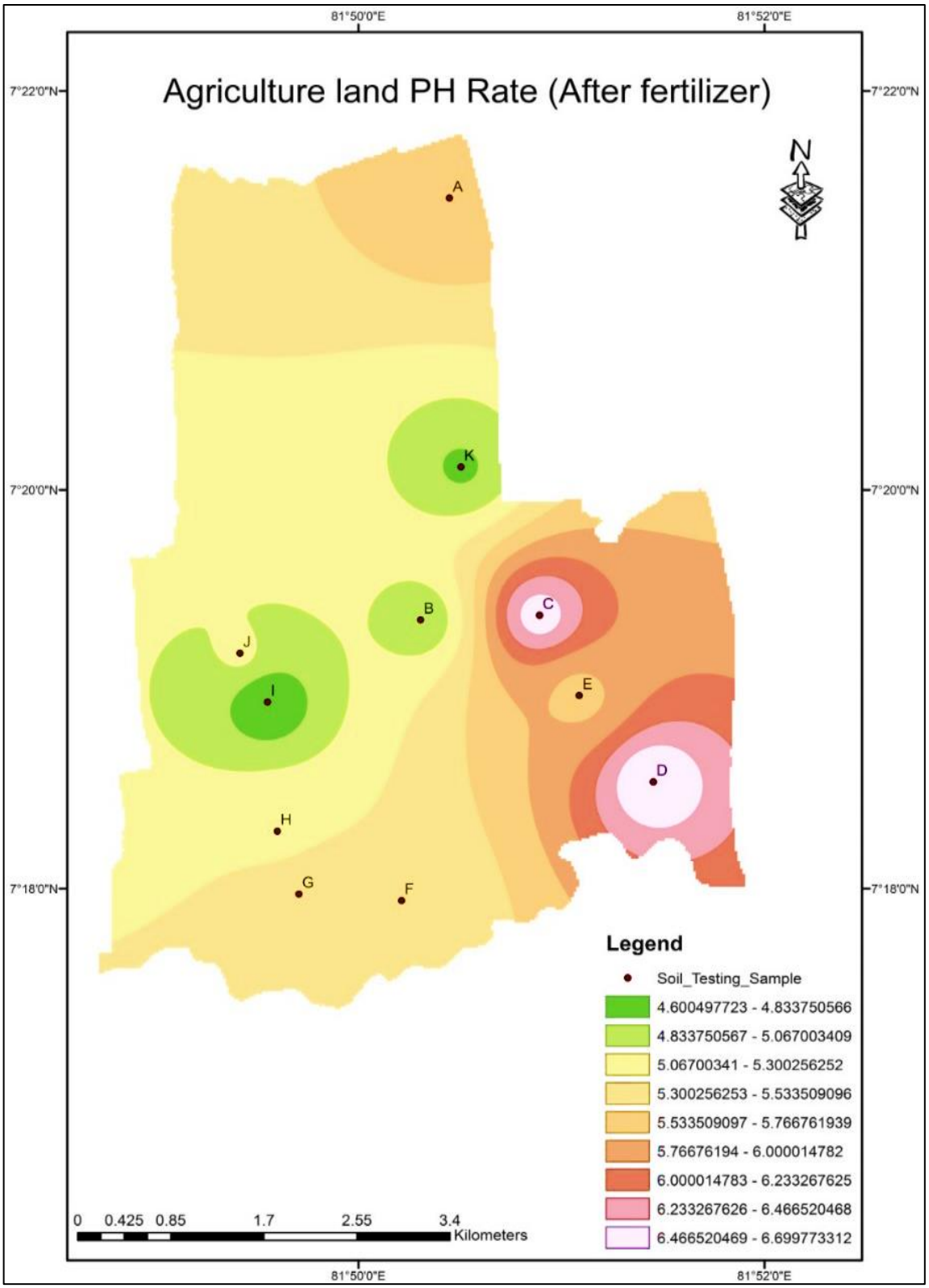


Figure 6. Agriculture land pH rate (After fertilizer)
Source: IDW analysis results

Table 3. The average pH of the study area based on Inverse Distance Weighting (IDW).

Season	Minimum pH	Maximum pH	Average pH
Before fertilizer use	5.97	7.5	7.12
After fertilizer use	4.6	6.7	5.46

Source: IDW analysis results

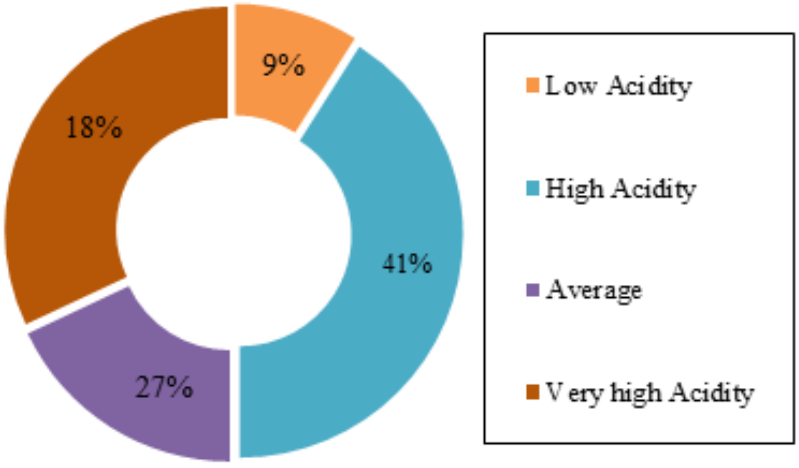


Figure 7. Percentage of pH sampling location (before fertilizer use)
Source: sample test report, 2020

During the pre-chemical fertilization period in the study area, 9% of the agricultural land area is found to be slightly acidic, 27% of the agricultural land with neutral soil structure and 15% of the agricultural land with salinity soil structure. During the post-chemical fertilization period in the study area, 9% of the agricultural land was found to be moderately acidic, 41% of the land area was found to be strongly acidic, 32% of the area was found to be highly acidic and 18% of the agricultural land was found to be moderately PH but there is no agricultural land which was found to be salinity. The average pH value of paddy fields during the pre-chemical fertilization season is from the neutral range of 7.12 which Converts to strong acid with a pH of 5.46. Therefore, the urea, DSP and MOP which were used extensively during paddy cultivation in the region, is the factor in such acid conversion of the study area. This factor was affirmed from the report of the Department of Agrarian Services and the results of 90% of the questionnaire analysis conducted among the farmers in the study area. During the pre-chemical fertilization period in the study area, 9% of the agricultural land was found to be slightly acidic, 46% of the land was found to be slightly acidic, 27% of the agricultural land was found to be moderately loamy and 15% was alkaline (Figure 7). During the post-chemical fertilization period in the study area, 9% of agricultural lands were found to be moderately acidic, 41% of the lands were found to be highly acidic, 32% of the lands were found to be

highly acidic and none of the agricultural lands with moderate pH were found to be 18% (Figure 8).

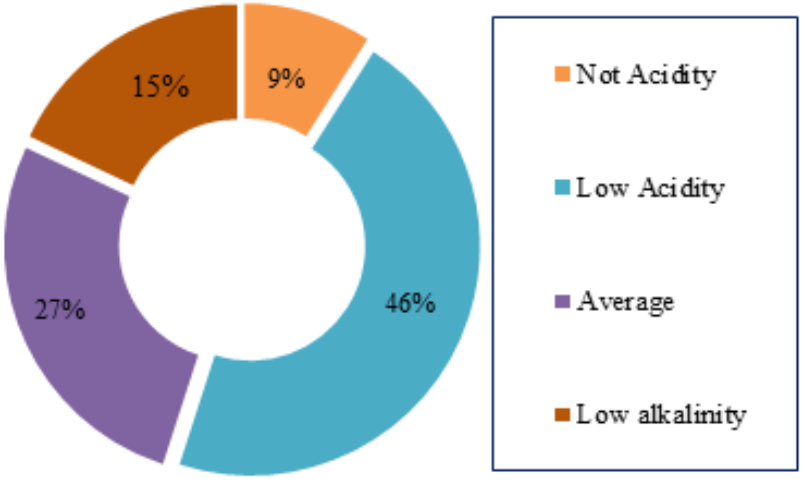


Figure 8. Percentage of pH sampling location (after fertilizer use)
Source: sample test report, 2020

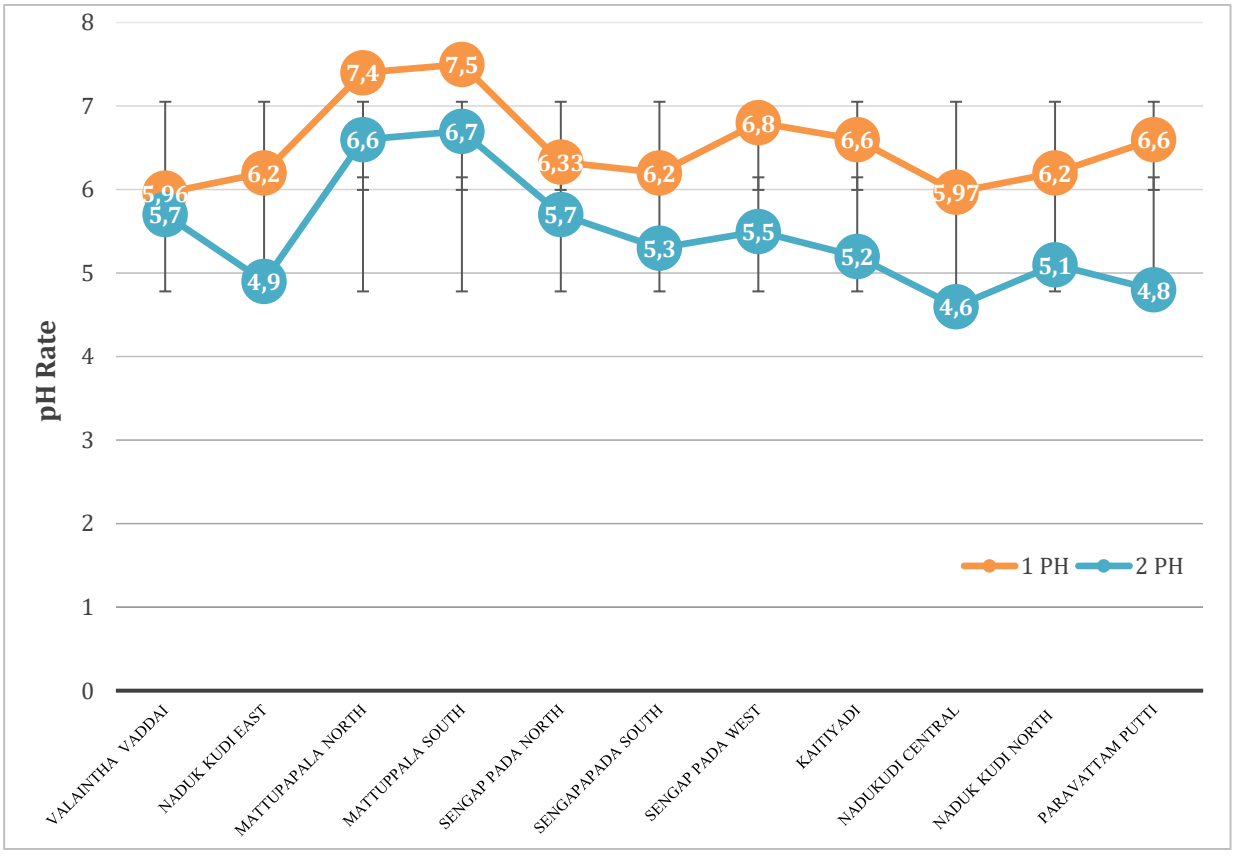


Figure 9. Dynamic pH level of sampling location
Source: sample test report, 2020

The following graph (Figure 9) showed the comparing the pH value of the two seasons of the study area. The curved disc sampling location appears to be somewhat acidity with no change after chemical fertilization. The sampling of Midwest East and sengappada South are found to be somewhat acidic and strongly acidic. Has changed. The northern part has changed from a slightly acidic state to a high acidic state, while the northern continent in the middle has changed from a slightly acidic state to a very acidic state and the Paravattam bottle continent has changed from a neutral to a very acidic state.

5. CONCLUSION

The soil pH has an impact on soil and crop productivity. Although the pH of soil can vary from 1 to 14, most crops prefer a pH of 5.5 to 7.5. On the other hand, certain crops have evolved to thrive at pH values outside of the optimal range. Because it affects a range of chemical and biological activities, soil pH is a master variable in soils. It is a measurement of the acidity or alkalinity of a soil. In agriculture, soil pH is important because it regulates plant nutrition availability by controlling the chemical forms of various nutrients and their chemical interactions.

Recommendation for reduce the impact of excessive fertilizer usage

- **Organic fertilizers are neutral or slightly acidic:** Organic manures can be placed to balance the acid level found in the study area. Naturally available plant and animal wastes in Nintavur can be produced and used at a very low cost. Fertilizers made from goat, cow and poultry manure have very few adverse effects compared to chemical fertilizers. Although crop yields are low in farm manures, other crop values, trace elements, nutrients and crop growth factors are particularly active in soil enrichment. Another characteristic of these is that they stand in the soil for a long time and bear fruit. Therefore, it is better to use organic manures in combination with chemical fertilizers to make up for the shortfall and make the existing supplement more effective. Research in many countries has shown that they can not only produce higher yields but also protect the soil when mixed and used separately.
- **Use the nature-friendly fertilizer:** Also known as agricultural lime, is the main means of regulating the acid level. The use of remote fertilizers should be compelled to adjust the acidity of the agricultural lands among the cultivators in the study area to a moderately stable P level. Remote is available at very affordable prices.
- **Selection of paddy varieties that can withstand the degradation of agricultural land:** In the aftermath of the all-out Green Revolution, potent rice varieties have been introduced to withstand various impacts on global paddy production. BW_297-2 which can withstand the acidity of the existing field lands and give better yields and healthier inputs. Cultivation of BW_272-3 can compensate for the impact of soil degradation on crops
- **Raising awareness among farmers:** Farmers are the least educated. Therefore the process of land degradation can be brought under control by setting up appropriate awareness projects about agricultural lands among them. Farmers need to be clarified

about the following issues. Adverse effects of unbalanced fertilization, the importance of natural fertilizers. Techniques for controlling the degradation process of land. Appropriate methods for selecting fertilizers for the field ', soil testing and the need for chemical fertilization should be fully clarified among the farmers in the study area.

- **Fertilizer subsidy is provided by the Government of Sri Lanka for chemical fertilizers used in agricultural lands:** Similarly, the government should put in place appropriate programs and policies to encourage the use of natural fertilizers. In conjunction with this, we will be able to control the degradation of agricultural lands by allowing farmers to purchase chemical fertilizers at very affordable or free soil tests and only if appropriate, by creating model farmlands with organic fertilizers and by drawing the attention of farmers to the use of natural fertilizers
- **Teaching soil testing method among farmers:** Will every farmer be able to carry out soil testing on their farmlands without any financial cost and hassle by providing soil testing equipment in collaboration with the Department of Agricultural Agrarian and related organizations which are suitable for testing the condition of the soil in their farmlands when they are engaged in agricultural activities and have a system that is easily handled by the farmers? Can be carried out. In mode
- **Following the advice of the officer in charge of agricultural activities:** Some farmers over-use chemical fertilizers to make decisions on issues such as land quality issues on agricultural lands and impacts on crop growth. Fertilization of agricultural land should be done only with the guidance of the officer in charge of agricultural activities following their guidance and avoiding such activities.
- Avoid the use of nitrogen fertilizers as much as possible and replace them with non-acidic fertilizers.
- Concern about the land can be created among farmers by taking legal action against those who act indifferently towards the quality of agricultural land.
- The quality of the soil can be maintained by creating an environment where earthworms can grow on agricultural lands. There is no doubt that by addressing the above issues in the study area, a balanced course in chemical fertilizers can be created and the degradation process in agricultural lands can be brought under control.

References

[1] Jayasumana, C., Fonseka, S., Fernando, A. *et al.* Phosphate fertilizer is a main source of arsenic in areas affected with chronic kidney disease of unknown etiology in Sri Lanka. *SpringerPlus* 4, 90 (2015). https://doi.org/10.1186/s40064-015-0868-z

[2] Anuga Liyanage, Peter R Grace, Clemens Scheer, Daniele de Rosa, Sudheera Ranwala, David W Rowlings, Carbon limits non-linear response of nitrous oxide (N2O) to increasing N inputs in a highly-weathered tropical soil in Sri Lanka. *Agriculture, Ecosystems & Environment,* Volume 292, 2020, 106808, https://doi.org/10.1016/j.agee.2019.106808

[3] Rupasinghe, I.S.U., Leelamanie, D.A.L. Comparison of municipal and agriculture-based solid waste composts: short-term crop-yield response and soil properties in a tropical Ultisol. *Biologia* 75, 809–818 (2020). https://doi.org/10.2478/s11756-020-00464-4

[4] M. I. M. Kaleel, The Impact on Wetlands: A Study Based on Selected Areas in Ampara District of Sri Lanka. *World News of Natural Sciences* 7 (2017) 16-25

[5] Beata Draszawka-Bołzan, Effect of pH and soil environment. *World News of Natural Sciences* 8 (2017) 50-60

[6] W.C.P. Egodawatta, U.R. Sangakkara, P. Stamp, Impact of green manure and mineral fertilizer inputs on soil organic matter and crop productivity in a sloping landscape of Sri Lanka, *Field Crops Research*, Volume 129, 2012, Pages 21-27, https://doi.org/10.1016/j.fcr.2012.01.010

[7] C. B. Dissanayake. (1991) The fluoride problem in the ground water of Sri Lanka — environmental management and health. *International Journal of Environmental Studies* 38:2-3, pages 137-155

[8] Moses Oghenenyoreme Eyankware, Philip Njoku Obasi, A holistic review of heavy metals in water and soil in Ebonyi SE, Nigeria; with emphasis on its effects on human, plants and aquatic organisms. *World News of Natural Sciences* 38 (2021) 1-19

[9] Rakesh Gothwal, O. P. Jangir, Assessment of soil properties of a lentic ecosystem in semiarid region: Nakki Lake, Mount Abu, India. *World Scientific News* 149 (2020) 81-91

[10] Loganathan, P., & Balakrishnamurti, T. (1980). Effects of NPK Fertilizers on young Coconut (Cocos nucifera) on a Sandy Soil in Sri Lanka. *Experimental Agriculture*, 16(1), 41-48. doi:10.1017/S0014479700010681

[11] Loganathan, P., Dayaratne, P., & Shanmuganathan, R. (1982). Evaluation of the phosphorus status of some coconut-growing soils of Sri Lanka. *The Journal of Agricultural Science*, 99(1), 25-33. doi:10.1017/S002185960005499X

[12] Sukanta Maity, Police Sandeep, Sanjay Kumar Sahu, A. Vinod Kumar, Experimental and modelling investigation of caesium adsorption on soil samples around DAE facility, India. *World Scientific News* 139(2) (2020) 201-220

[13] Sardar Md Shahriar Alam, Macksuma Khatun, Md Shahidul Islam, Amitabh Shuva Chakma, Role of Chemical Fertilizers (NPKSZn) and Missing of Major Nutrients (NPK) on Rice Yield. *World Scientific News* 162 (2021) 133-147

[14] Darshani Kumaragamage & Srimathie P. Indraratne (2011) Systematic Approach to Diagnosing Fertility Problems in Soils of Sri Lanka, *Communications in Soil Science and Plant Analysis*, 42:22, 2699-2715, DOI: 10.1080/00103624.2011.622818

[15] H. M. Saman Kumara Herath, Darshani Kumaragamage, Srimathie P. Indraratne. (2013) Performance of an Optimized Nutrient Management Approach for Tomato in Central Sri Lanka. *Communications in Soil Science and Plant Analysis* 44:20, pages 3049-3060

[16] K. Nishanthi, M. I. M. Kaleel, Assessment of solid waste management in Wattala-Mabola urban council, Sri Lanka. *World Scientific News* 160 (2021) 145-157

[17] Dana Cordell, Elsa Dominish, Mohamed Esham, Brent Jacobs, Madhuri Nanda. (2021) Adapting food systems to the twin challenges of phosphorus and climate vulnerability: the case of Sri Lanka. *Food Security* 13:2, pages 477-492.

[18] Y.C. Aluwihare, M. Ishan, M.D.M. Chamikara, C.K. Weebadde, D.N. Sirisena, W.L.G. Samarasinghe, S.D.S.S. Sooriyapathirana. (2016) Characterization and Selection of Phosphorus Deficiency Tolerant Rice Genotypes in Sri Lanka. *Rice Science* 23:4, pages 184-195

[19] Bandara, J.M.R.S., Wijewardena, H.V.P., Bandara, Y.M.A.Y. *et al.* Pollution of River Mahaweli and farmlands under irrigation by cadmium from agricultural inputs leading to a chronic renal failure epidemic among farmers in NCP, Sri Lanka. *Environ Geochem Health* 33, 439–453 (2011). https://doi.org/10.1007/s10653-010-9344-4

[20] Dharma-wardana, M.W.C., Amarasiri, S.L., Dharmawardene, N. *et al.* Chronic kidney disease of unknown aetiology and ground-water ionicity: study based on Sri Lanka. *Environ Geochem Health* 37, 221–231 (2015). https://doi.org/10.1007/s10653-014-9641-4

[21] Dahanayake, K., Ratnayake, M.P.K. & Sunil, P.A. Potential of eppawala apatite as a directly applied low-cost fertilizer for rice production in Sri Lanka. *Fertilizer Research* 41, 145–150 (1995). https://doi.org/10.1007/BF00750756

[22] Elizabeth C. Stone, George M. Hornberger. Impacts of management alternatives on rice yield and nitrogen losses to the environment: A case study in rural Sri Lanka. *Science of The Total Environment*, Volume 542, Part A, 2016, Pages 271-276, https://doi.org/10.1016/j.scitotenv.2015.10.097

[23] C. B. Dissanayake & S. V. R. Weerasooriya (1987) Medical geochemistry of nitrates and human cancer in Sri Lanka, *International Journal of Environmental Studies*, 30:2-3, 145-156, DOI: 10.1080/00207238708710389

[24] Bhadranie Thoradeniya, Uthpala Pinto, Basant Maheshwari. (2019) Perspectives on impacts of water quality on agriculture and community well-being—a key informant study from Sri Lanka. *Environmental Science and Pollution Research* 26:3, pages 2047-2061

[25] Sansfica M. Young, A. Pitawala, Jagath Gunatilake. (2010) Fate of phosphate and nitrate in waters of an intensive agricultural area in the dry zone of Sri Lanka. *Paddy and Water Environment* 8:1, pages 71-79

[26] McDonough, L.K., Meredith, K.T., Nikagolla, C. *et al.* The water chemistry and microbiome of household wells in Medawachchiya, Sri Lanka, an area with high prevalence of chronic kidney disease of unknown origin (CKDu). *Sci Rep* 10, 18295 (2020). https://doi.org/10.1038/s41598-020-75336-7

[27] K. A. I. L. Wijewardena Gamalath. Beautiful, natural places and tourist attractions in Sri Lanka. *The Institute of Biopaleogeography named under Charles R. Darwin* 3 (2021) 1-44. eBook ISBN 978-83-949342-2-4