Penerbit Akademia Baru

Journal of Advanced Research Design

Journal homepage:
https://akademiabaru.com/submit/index.php/ard
ISSN: 2289-7984

Recent Use of AB Mix Nutrients for Urban Farming in Malaysia: A Mini Review

Nur Dinie Syahirah Sanusi[1], Fadhlina Che Ros[2,*], Siti Zulaikha Ngah Demon[2], Ismayadi Ismail[3], Imad Hamadneh[4]

1 Faculty of Science and Defense Technology, Universiti Pertahanan Nasional Malaysia, Kem Sg. Besi, 57000, Kuala Lumpur, Malaysia
2 Physics Department, Center for Defence Foundation Studies, Universiti Pertahanan Nasional Malaysia, Kem Sg. Besi 57000, Kuala Lumpur, Malaysia
3 Institute of Nanoscience and Nanotechnology, Universiti Putra Malaysia, 43400, Selangor, Malaysia
4 Chemistry Department, Faculty of Science, University of Jordan, 11942, Amman, Jordan

ARTICLE INFO

Article history:
Received 4 April 2024
Received in revised form 4 November 2024
Accepted 8 November 2024
Available online 30 November 2024

Keywords:
AB mix nutrients; nutrient management; environment

ABSTRACT

The use of AB mix nutrients in Malaysia is extensive especially in urban farming due to its all-inclusive-type of fertilizers. It possesses the advantage of providing a quick and high yield of agricultural products, along with a rapid response to signs of nutrient deficiency in plants due to the readily available nutrient-rich salts. However, extensive use of fertilizers led to significant environmental pollution in addition to the increase in agricultural productivity that we have today. Despite the fact that the Department of Agriculture Malaysia has published rules and suggested doses for using AB mix nutrients depending on the types of crops, farmers frequently over-fertilize their crops. Therefore, a survey has been carried out on several local agriculture entrepreneurs to compare their usage of AB mix nutrients for chili plants and the results revealed that majority of the respondents comply with the established guidelines. Sensible used of fertilizers must be promote amongst the farmers since intensive use of fertilizers will result to nutrient leaching into the soil, which contribute to environmental pollution, subsequently affecting the humans, livestock and microbial forms of life via food chain. In general, the impacts of the overuse chemical fertilizers are discussed from the aspects of plants physiology, quality of production and environment. The prospect of bio-fertilizer as a potential substitute to AB mix nutrients is also discussed. The increasing adoption of AB mix nutrients aligns with the demand for efficient urban farming methods, but it also brings into focus the critical balance between maximizing crop yield and minimizing ecological damage. This review emphasizes the significance of controlled nutrient application to prevent long-term soil degradation and groundwater contamination. Insights from comparative studies on fertigation and alternative fertilization methods, such as bio-fertilizers, provide a pathway toward more sustainable agricultural practices. The integration of bio-fertilizers into fertigation systems has shown promise in reducing reliance on chemical inputs, improving soil health, and supporting the sustainable intensification of urban agriculture. The paper also addresses the need for improved regulatory frameworks and awareness campaigns to mitigate the negative impacts of

* *Corresponding author.*
E-mail address: fadhlina@upnm.edu.my

https://doi.org/10.37934/ard.122.1.150162

chemical fertilizer overuse and to promote organic alternatives in urban farming setups.

1. Introduction

With the exponential increase of world population at present, there has been a significant demand for fresh foods. To fulfill this demand, sustainable and systematic management in food production is essential while simultaneously answering to the world's Zero Hunger campaign. In the aftermath of lockdowns caused by the global health crisis, the world encounters a massive disruption on food supply chains and major global economic recession. To reduce the crisis of food resources and to ensure food security, the production of fresh food especially in town areas must be increased. The Malaysian government through the Ministry of Agriculture and Food Industry has introduced the concept of urban farming for self- consumption, which claimed to be able to reduce household expenses through self-gardening in high-rise condominium [1]. Urban farming that is equipped with modern systems and technologies is pertinent to the busy lifestyle of city communities and limited spaces of high-rise buildings.

Other than providing food to the community, urban farming may aid in increasing household income, employment and market opportunities, whilst optimizing human capital and energy. In Malaysia, urban farming like hydroponics, fertigation and vertical farming systems are relatively new and these systems used inorganic fertilizers or locally known as AB mix nutrients since organic fertilizers are not suitable. Figure 1 shows one of innovation in fertigation system by Agro Plantations Sdn. Bhd. called 'fertigation box' for the use of urban community. This lightweight, economical, portable and small in size system does not require huge space to setup and the maximum of 250 plants can be planted using the fertigation box.

Fig. 1. 'Fertigation box' installed at Kuala Pilah, Negeri Sembilan for 250 polybags of bird's eye chili plants

The use of inorganic fertilizers has increased exponentially throughout the world and claimed to be the most contributor to the world's agricultural productivity [2,3]. Inorganic fertilizers are artificially synthesized and formulated in appropriate concentrations and combinations that usually supply three main macronutrients i.e. nitrogen (N), phosphorus (P), and potassium (K); as for AB mix nutrients, they consist of two formulated functional A and B solutions. In Malaysia, the use of AB mix nutrients in urban farming system is necessary to obtain higher yield of agricultural product within a short time and its fast-acting response towards crop when the plants show signs of nutrient deficiency is the distinct advantage over the organic fertilizers as the nutrient-rich salts are readily available for plants [4].

The role of inorganic fertilizers to supply deficient nutrients to the plants and subsequently increased agricultural output is indisputable. However, the intensive use of these fertilizers has not only contributed to the enhancement of agriculture productivity that we have achieved today, but also resulted in crucial environmental pollution [5]. They have caused serious environmental pollution including deterioration of soils' fertility and their natural properties, ground water pollution therefore, affect the marine and fisheries ecosystems, as well as the global warming issue [6]. Excess supply of micro and macronutrients causes depletion of nutritional values and its qualities for example, excessive K in soil contributes to the decrease amount of antioxidant compounds, carotene and vitamin C content in vegetables [7]. Thus, it is essential to increase the awareness for careful and prudent use of inorganic fertilizer to the farmers and community at large to safeguard our food sources and the environment. It is important to understand the types of fertilizer used and follow the recommended dose and guidelines as outlined in the agricultural policies by the Department of Agriculture Malaysia (DOA).

This mini review focuses on the use of AB mix nutrients amongst the local farmers / agriculture communities in Malaysia in terms of the concentration level and amount of fertilizers application, specifically on chili planting using fertigation system. Suggestions to use other than inorganic fertilizers are also discussed but first, a brief introduction on AB mix nutrients including its nutrient compounds and properties is summarized. The articles discussed in this mini review were obtained via searching until 2022, major database such as PubMed, Scopus and Web of Science, with 'inorganic fertilizers', 'urban farming' and 'environment' as keywords.

2. The Overview of AB Mix Nutrients

This segment comprises the ingredients, preparation and basic properties of the AB mix nutrients. Here, the general ingredients of AB mix nutrients are summarized in Table 1 and the percentage of each compound can be varied depending on different types of crops. Commonly, the AB mix nutrients contain three main components of nitrogen (N), phosphate (P_2O_5), and potash (K_2O) where typically, the ratio of 10:10:10 will be used [8]. AB mix nutrients are all-inclusive-type of fertilizers; they are concentrated nutrient solutions containing stock A and B, with macronutrients as its primary ingredients apart from the micronutrients [9]. Solution A may contain half the total potassium nitrate requirement, calcium nitrate, ammonium nitrate, iron chelate whilst, solution B consists of the other half of potassium nitrate, potassium sulfate, monopotassium phosphate, magnesium sulfate and the remaining micronutrients which are necessary for healthy growth of plants and soil fertility [2]. Table 1 shows the ingredients of AB mix nutrients compounds and their function towards crop growth [10].

Preparation and the mixing of AB mix nutrients must be carried out meticulously to avoid precipitation in fertilizer tanks otherwise, the fertilizers will no longer available for the plants. Precipitation occurs when several elements are mixed together while it should not be. General rule in producing homogenous solution of fertilizers is nutrients containing phosphate (e.g. potassium phosphate, ammonium phosphate) must not be mixed together with nutrient containing calcium (e.g. calcium nitrate, calcium chloride). Concentrated nutrient containing phosphate and calcium must be prepared in different tanks, for example the calcium nutrient in the A-tank, while phosphate and sulphate nutrients in the B-tank. It is essential to ensure that the powders are completely dissolved in water before they come in contact with each other, as insolubility of powders may contribute to disproportionate concentration of fertilizer, which may affect the performance of fertilizer [11]. It may also result clogging the drip fertigation system, reducing the service life of the system and eventually causing a decrease in economic benefits [12]. Therefore, it is important to keep the water moving when adding the products to the fertilizer tank. For larger tanks, it is recommended to make use of stirring installation. The A and B concentrated solutions are best kept in cool places and closed containers to prevent direct sunlight and contamination, which may affect their efficiency [13].

Table 1
AB mix nutrients compounds and their functions [10]

Stock solution	Elements	Functions
A	$Ca(NO_3)_2$ (Calcium nitrate)	Assists with cell formation and neutralizesacids to detoxify the plant.
	Fe-EDTA	Increases the bioavailability and plant uptakeof the metals in the soil.
	KNO_3 (Potassium nitrate)	Increases frost tolerance, construct thicker cell walls, and increase the level of electrolytes in the cells.
	KH_2PO_4 (Mono-potassium phosphate) / MKP	Increases cell division and development of newplant tissue. Protecting the plant from early stress, and provides good support for fruits. Improves root and shoot growth.
	$MgSO_4$ (Magnesium sulphate heptahydrate)	To overcome magnesium deficiency in the soil. Improves nitrogen and phosphorous uptake by crops.
B	$MnSO_4$ (Manganese sulfate)	Assisting in photosynthesis, respiration, nitrogen assimilation, pollen germination, pollen tube growth, root cell elongation andresistance to root pathogens.
	$CuSO_4$ (Copper (II) sulfate)	Prevents damage to plants from mold and fungi, specify the sugar content and flavor of the fruits.
	Zn-EDTA	To produce chlorophyll, support root growth and to ensure the plants are ableto get enough nutrients.
	H_3BO_3 (Boric acid)	Essential micronutrient component. Assists in translocation of carbohydrates and sugar. Assists in increasing yields, cell division, protein formation and nitrogen metabolism. Supports water and nutrient transport throughout the plant.
	NH_4–Mo (Sodium molybdate)	As delivery vessel to transfer essential micronutrient for plants.

The concentrated solutions are then, diluted with water at the required electrical conductivity (EC) measurement. EC is an index of salt concentration and an indicator of electrolyte concentration of the solution [14,15]. It is important for A and B solutions to be in equal portion to achieve homogenous solution. Intermittent mixing is required prior to the dilution of solution A and B; measuring precise concentration of solution using EC meter is the key factor in determining the success rate of agriculture activity as EC is related to the amount of ions available to plants in the root zone. Imbalanced ion composition could inhibit the growth of plant caused by either toxicity or nutrient-induced deficiency [16]. Reliable measuring tools of EC and pH meters are also essential to control and measure the required fertilizer strength and strategy. Failure in measuring an accurate measurement will affect the growth of plants. Insufficient nutrient may contribute to the slow growth and lesser endurance towards the plant disease whilst excessive nutrient application may result to burn effect [17]. Extra care should be applied when taking the EC reading as wrong measurement may occur after a long period due to filth and wearing of the electrodes. The EC meter must be calibrated regularly and compare the measurement to the given international standard values.

Initially, lower concentration of fertilizer is given to seedlings and will gradually increase with the increasing of plants growth.

In this paper, only the solubility of AB mix nutrients and its particle size are discussed. The raw materials are in the form of granulated / powder compound that are mixed together; this water-soluble fertilizer is believed to be more efficient due to its higher water solubility. It is important for phosphorus (monokalium phosphate) to be dissolved in water and taken up by plants, due to the source of phosphorus from raw rock phosphate possesses low water solubility [12]. Insoluble phosphate precipitation was reported as one of the main factors contributed to the clogging of drip in fertigation system. It has been reported that the clogging was due to the reaction between the fertilizer and water which resulted to the presence of solid particles [18] whilst for Haynes *et al.,* [19] and Liu *et al*., [20] inferred that the clogging substances of $CaHPO_4$ produced from the reaction of phosphate, Ca^{2+} and Mg^{2+} worsen the clogging of drip fertigation system [21,22]. Therefore, mixing during the preparation of concentrated B solution may take some time due to the slow reaction of raw rock phosphate with water [23].

Another important feature is the particle size of fertilizer; the size of particle is critical in order to promote the solubility as well as ease in handling the materials for example, rock phosphate is best to be finely ground to increase its surface area when reacts with water. There is no standard of particle size for fertilizer where many have passed through No. 6 (coarse) but not No. 18 (finer) screen; very fine particles are not easy to handle as they become cake up and dusty but not for granular materials [23]. Uniform or compatible size of particle is important especially for stable and good quality of blended fertilizers as different in particle size will contribute to the separation when handled.

3. The Trends of AB Mix Nutrients Usage in Malaysia

The primary objective of water and nutrient management in urban farming is to enhance crop growth, product quality as well as to reduce leaching and nutrient loss therefore, particular amount of water and nutrients at different stages of plant is critical. Specific formulation for the macronutrients varies as it depends on the types of crops. The AB mix nutrients is mostly used for leafy vegetables and fruit plants such as chili, melons, cucumber, eggplant and green vegetables where it is directly dripped towards the plants using fertigation method. Therefore, to control the water supply and nutrient intake is by controlling the necessary variables like the EC level of the fertilizer, amount of nutrient solution and frequency of the nutrient's application. DOA of Malaysia has provided basic guidelines in respect to these parameters specifically towards chili, rock melon, cucumber and eggplant and a survey has been performed to observe if the guidelines are conformed or vice-versa. The survey was explicitly focused on chili plant only based on two (2) plants per polybag method.

Figures 2 and 3 show the comparison bar charts of EC level and total amount of fertilizer applied from six (6) different respondents of agriculture industries in peninsular Malaysia based on weeks after planting of red chili for 12 weeks. The participating respondents denoted as MA, PBH, CB, GLE and AA, with MA, PBH and CB are based in Selangor, GLE in Johor and AA in Perlis. It is known that the variables of concentration, frequency and the amount of fertilizers applied depend on the weather, stage of plant growth and types of crops. Generally, most of the respondents adhere with the guidelines provided however, in reality excessive amount of fertilizers are often employed towards the crops, which purportedly can expedite the growth of crops and increase yield. This issue has been highlighted in a local newspaper recently that land in the Cameron Highlands is at risk of becoming barren due to farm operators excessively and continuously overuse of fertilizers without any regulation [24].

Figure 2 illustrates the chart of EC level applied for over 12-week period of all the respondents and Malaysian DOA. The EC level, which indicates salt concentration in the soil or growing medium showed an upward trend across the week, with notable peaks detected at week 9. While DOA consistently used moderate EC level, CB and AA stand out with the highest concentration throughout the period, particularly at week 9 where it approached 3.5 mS/cm. Figure 3 shows the distribution for the total amount of fertilizers applied within 12-week. GL recorded prominent data with 1 L in the first week, increased to 2.5 L at week 12, followed by AA and CB with 2 L each. Comparing the data with the recommended amount by DOA relatively, GL, CB and AA apply excessive amount of AB mix nutrient, which may be due to different types of chili variety used. Estimating nutrient management efficiency can be difficult as it depends on many factors and the disproportionate usage of chemicals and nutrients must be prevented. The next section will discuss on the importance of nutrient management and its effect towards agricultural product and environment.

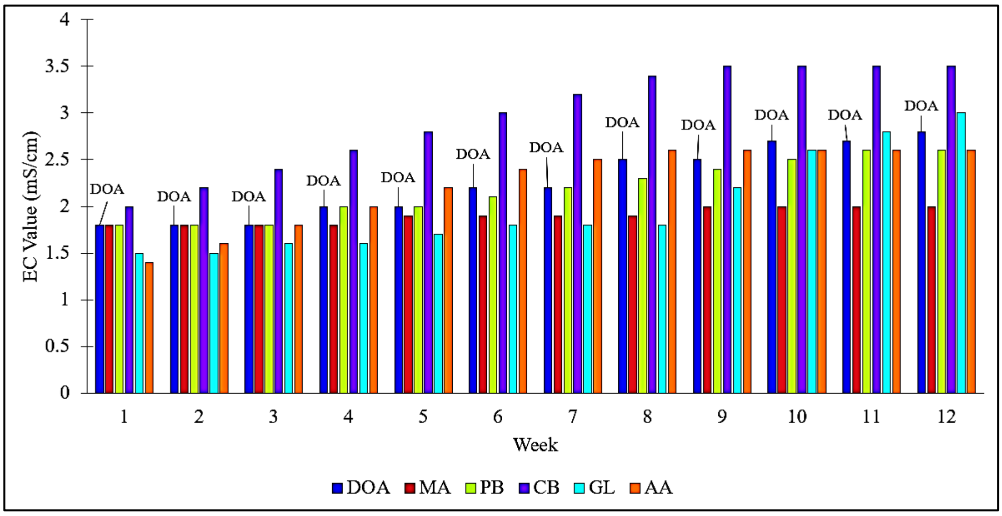

Fig. 2. Comparison of EC value versus weeks from six (6) different respondent

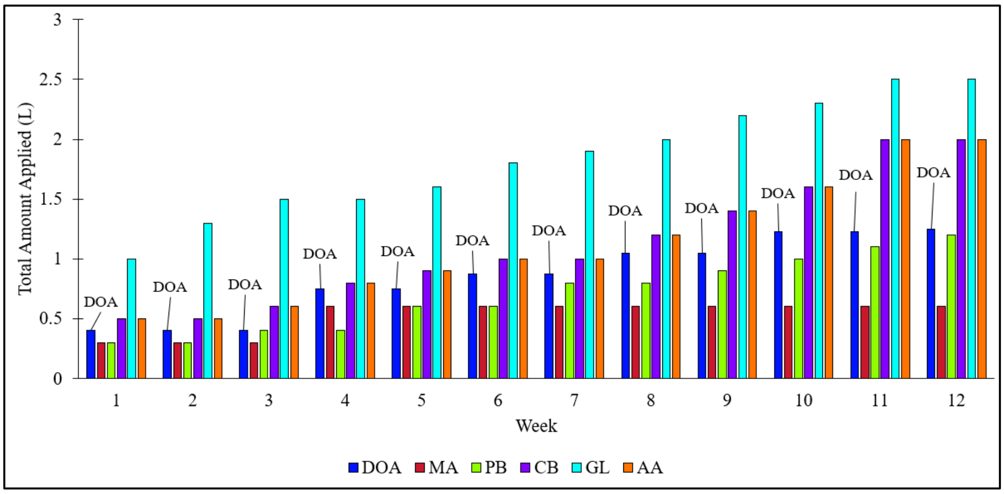

Fig. 3. Comparison of total amount of fertilizers applied (L) versus weeks from six (6) different respondents

4. Nutrient Management of AB Mix Nutrients
4.1 Impact on Plants and the Quality of Yield

Many literatures reported that the application of optimal nutrition of AB mix nutrients improved the development of the plant [25,26]. Furoidah *et al.,* [27] agreed that AB mix nutrients is a comprehensive type of fertilizer which contains all the essential nutrients for plant growth and development such as plant height, leaf width and the number of leaves. Therefore, optimization on nutrient application in agriculture is the key to improve crop production however, to execute efficient in nutrient management is one of the challenges. Excessive application of fertilizer whether organic or synthetic is prohibited as the excess nutrients are often washed away and pollute the environment. Furthermore, the impact of overuse or inadequate nutrient solution could affect the plant growth due to toxicity or nutrient-induced deficiency [28].

Optimal use of the nutrients is very important and many researchers have reported their optimum outcome. For example, research conducted by Hidayanti and Kartika [29] on red spinach, Amaranthus tricolor L. reported that the 15 ml dose of AB mix nutrients produced the plant of height, 24.2 cm with fresh weight of 18.825 g, in comparison to the controlled plant with only, 5.65 cm in height and 0.375 g in fresh weight [29]. Indeed, appropriate EC levels is required throughout the plant growth process where different stage of the growth requires different EC level and high dose of fertilizer is not a guarantee of the rise in crop yield as well as the quality of plant product. Ahirwar and Hasan [30] reported that capsicum with EC 2.4 dS/m at vegetative stage, 2.6 dS/m at flowering stage and 2.8 dS/m at fruiting stage, produced higher yield i.e. 41.15 kg. The outcome was then compared to higher EC level of 2.7, 3.0 and 3.2 dS/m at vegetative, flowering and fruiting stages, respectively [30]; the latter was reported to produce lower yield at 20.05 kg.

Extremely high level of nutrient supply will lead to the risk of burnt-like effect as the nutrient supply exceed the level phytotoxicity. The plants will suffer symptoms of bronzing leaves and dead leaf tips or margins due to plasmolysis process where the plant cells lose water and the cytoplasm shrinks away from the cell wall that causes the plant to wilt. The water uptake by the plants decreased with the increasing EC treatments therefore, excessive dose of fertilizer can contribute to the limit in productivity due to osmotic stress [16]. Hidayanti & Kartika [29] revealed that the rise of EC to 20 ml/L of AB mix nutrients on Amaranthus tricolor L. did not significantly increase the height of plant and yield. Albornoz *et al.,* [31] reported similar observation on lettuce that with over-fertilization, the yield of lettuce reduced due to the decreased in stomatal conductance and leaf area therefore, decreased in its fresh and dry weight.

The importance of EC level is crucial that it can affect the photosynthesis process of a plant. Literature reported that for tomato plant under high salt stress, dark green colour of the leaves were observed which attributable to high chlorophyll content due to the enhancement of salt tolerance [32]. On the contrary, studies on the low EC level in pakchoi resulted to the low chlorophyll content of the leaves, which contributed to the deficiencies of nutrient elements like N, Mg and Fe that were vital for chlorophyll biosynthesis [16,32]; other signs of nutrient deficiencies are stunt growth, weak leaf and chlorotic leaves [25]. Food quality including the taste and crude fibre content of the plant are also dependent on the level of EC application. Diets with high content of fibre are reported to be good for health, but too much of it will affect digestibility [33-35]. It has been reported that crude fibre content decreased with the increasing of EC and the taste was poor in both high and low EC concentrations. Studies on pakchoi reported that the highest fibre content was found in the controlled sample and for the taste scores, pakchoi with 2.4 mS/cm recorded the highest with 8.22 ± 0.37 scores, followed by 1.8 mS/cm with taste scores 8.00 ± 0.55. Conversely, the highest nutrient solution of pakchoi with 9.6 mS/cm depicted the lowest taste scores with 4.2 ± 0.37 [16,35]. In the matter of crude protein content, it was reported that the protein content increased with the increasing level of EC treatments due to the low water content in high EC treatment [16,36]. Crude protein is the measure of total protein content calculated from the nitrogen content of a food source.

Soluble sugars content in a food source may also be affected with the increasing of EC nutrient solution and this fact is supported by Ding *et al.,* [34] and Fallovo *et al.,* [36] that the soluble sugar content in pakchoi and lettuce were found decreased with the increasing of EC solution [16,37]. Studies have shown that the sugar content in pakchoi reduced from 1.69 ± 0.17 to 0.74 ± 0.03 % FW at 0 to 9.6 mS/cm treatments, whereas for lettuce, the sugar content decreased with the increasing of EC level from 0.3 to 3.6 dSm^{-1}. The reduction in sugar content was reported due to the high respiration rate of vegetable tissue in high EC treatments however, the dependency of sugar content on EC treatment is debatable [38]. Many literatures reported otherwise and stated that the sugar reduction was attributable to lower enzyme activities; for example, Amalfitano *et al.,* [39] found that the soluble sugar content in Friariello pepper increased with the increasing EC. The increment was in the range between 3.8 and 4.4 dSm^{-1} subject to the type of sugar compound of the plant [39]. Generally, other than producing high quality of plant production, knowledge on EC levels is very important as it may lead to the cost-effective use of plant inputs as well as minimizing the loss of plant product over the time. The high level of salt in the plants is an indication that modification of EC level is essential prior damage to the plants appears. The excessive use of fertilizer affects not only the metabolic system, physiology and productivity of the plants, but also cause to serious environmental pollution and health hazards, which will further describe in the next section.

4.2 Impact on Environment

Utilization of drip irrigation systems in fertigation method may reduce the use of fertilizer, prevent wastage of fertilizer on the environment and increase the crop yield hence, drip fertigation has been identified as one of the efficient and precise method to apply fertilizer [12]. However, such intensive use of AB mix nutrients in Malaysia, as shown in Figures 2 to 3 may result in nutrient leaching into the soils and pollute the environment which eventually contribute to low quality of food, soil degradation, micronutrient deficiency and causing toxicity to microbial flora present in the soil [2,28]. One of the phenomena from the long-term application of fertilizers is soil acidification which commonly occur in regions with medium to high rainfall where leaching slowly acidifies soil over the time. As hydrogen cations developed within the soil that reduces the soil pH, soil acidification occurs when a proton donor like nitric, carbonic or sulphuric acid is supplemented to the soil [2]. Soil acidification can diminish the organic matter content of soil expeditiously, which affects valuable organisms, pest growth and even contribute to undesirable release of greenhouse gases [40]. The emission of greenhouse gases is due to the overuse of N fertilizer in which nitrogen is very volatile and subject to loss; the long-term use of nitrogen fertilizer in large quantities may diminish the balance of N, P and K macronutrients, resulting in decreased crop yield [41]. Recent studies showed that crops used approximately 35 % from 115 million tonnes of nitrogen only and the remaining two-thirds become environmental pollutant, globally [5].

Continuous and excessive application of fertilizers can result in accumulation of toxic heavy metals like cadmium (Cd) and arsenic (As) in soils. Other than containing major elements for plant nutrition, chemical fertilizers may also contain trace elements of heavy metals that are known to be harmful and cause serious health problem [2]. The accumulation of heavy metals in fruits and grains and vegetables is due to the overuse chemical fertilizers that stimulated the rising level of trace elements in soil and, subsequently affected the humans, livestock and microbial forms of life via food chain. Other complication that attributes to the overuse of chemical fertilizers is the accumulation of salts and minerals of fertilizers in soil. This causes to the long-term soil compaction and degradation. The fine and shapeless salts in fertilizers cover the surface of soil, which reduced the rate of water percolation in the soil, therefore, resulted to poor aeration and drainage, limited root growth and affected the water and natural nutrient uptake of the plants [2,42].

5. Future Recommendations

With the recent price hikes of the raw materials of chemical fertilizers and to improve sustainability of agriculture, it is highly recommended to consider the use of other type of fertilizer that is healthier, eco-friendly, low-cost nutrient sources and efficient. Bio-fertilizer used living microorganisms that colonize the interior plants. The use of microbes has been reported to increase the crop production and food safety by accelerating certain microbial process, which then increase the availability of nutrients for plant uptake. Bio-fertilizers are also reported may increase soil fertility and promote plant growth by adjusting the insolubility of phosphate in soil and atmospheric nitrogen [2]. Reports shown that the yield of crop increased between 10 % and 40 % along with the increase of nutrient content including essential amino acids, vitamins, protein content and nitrogen fixation [43,44]. However, urban farming system is often associated with the use and delivery of solubilized AB mix nutrients and not using liquid bio-fertilizer.

Kiran *et al.,* [45] stated that the microbes can be delivered specifically to the root area in the fertigation system of cotton and broccoli. It has been reported that it can increase the rate growth of the plants and has high potential to be used in fertigation system [44-47]. According to Nazrul *et al.,* [47] bio-fertilizers has promising potential to be applied in fertigation system depending on the types of microbes and their lifespan in the fertigation drip and the medium of the plant [47]. The use of bio-fertilizers application as the substitute for chemical fertilizers needs to be expanded to reduce the reliance on chemical fertilizers that are harmful to the environmental ecology and human health [48].

Chemical fertilization is causing devastating harm to human health and environment [49]. Its use leads to pollution and contamination of soil. Reliability on chemical fertilizers for increasing the yield will promote further decrease of soil quality and contamination of soil as well as groundwater, subsequent in the loss of ecological balance [50]. Therefore, course of actions and awareness of the consequences on excessive use of chemical fertilizers needs to be enhanced nationally and globally [51]. The government should take immediate measures in monitoring and promoting safe agricultural practice among the farmers by minimizing the use of chemical fertilizers and pesticides and empowering more research and innovations to develop future fertilizers that can preserve the quality of soil and farm produce. Selecting organic fertilizers instead of chemical ones is also an alternative as they can sustain agricultural practices by safeguarding the natural environment. To date, there are numerous agriculture-based technologies that have been developed including nano-fertilizers, controlled released fertilizers, as well as tools to assist in time and the placement of fertilizers in minimizing the losses to the environment such as Y-drops, streamer nozzles, strip tillage equipment and many others [52-54]. There are also new fertilizers technology that have been developed to improve the efficiency and utilization rate of fertilizer by unlocking nutrient uptake obstacles rather than increasing the nutrient level of the soil [55,56]. All of these are potential alternatives that can be used to save our environment and ecosystem.

6. Conclusions

AB mix nutrient has been extensively used in Malaysia especially in fertigation and hydroponic systems. Like other chemical fertilizers, it has been claimed to be the contributor of agricultural productivity, however, it can also be harmful to humans and environment if the amount of application is more than what is needed by crops. Chemical fertilizers must be used with caution as the main problem is the improper use of fertilizer including frequent applications in order to expedite, enlarge the size and increase the yield of productivity. To safeguard our environment and guarantee sustainable agricultural production are challenging tasks, which require full cooperation from all parties. It is about time to restrict the use of chemical fertilizer as the accumulation of mineral salts in the soil due to massive fertilization and overflow into the source of water will contaminate the chain of food source including water, soil and air. Therefore, deterioration of health occurs with the increasing risk of cancer like leukaemia lymphoma, brain tumour, prostate and many more. Promotional and awareness campaigns on the importance to consume healthy and high-quality foods for better health must be intensified, so that the demand in organic food will escalate which leads to a surge on organic farm markets.

Acknowledgement
The authors would like to thank Universiti Pertahanan Nasional Malaysia (UPNM) for providing the facilities and funding for this research. This research was funded by Tabung Amanah fund, UPNM.

References
[1] Murdad, Rosmah, Mardiana Muhiddin, Wan Hurani Osman, Nor Elliza Tajidin, Zainol Haida, Azwan Awang, and Mohamadu Boyie Jalloh. "Ensuring urban food security in Malaysia during the COVID-19 pandemic—Is urban farming the answer? A review." *Sustainability* 14, no. 7 (2022): 4155. https://doi.org/10.3390/su14074155

[2] Nadarajan, Stalin, and Surya Sukumaran. "Chemistry and toxicology behind chemical fertilizers." In *Controlled Release fertilizers for sustainable agriculture*, pp. 195-229. Academic Press, 2021. https://doi.org/10.1016/B978-0-12-819555-0.00012-1

[3] Phibunwatthanawong, Thanaporn, and Nuntavun Riddech. "Liquid organic fertilizer production for growing vegetables under hydroponic condition." *International Journal of Recycling of Organic Waste in Agriculture* 8 (2019): 369-380. https://doi.org/10.1007/s40093-019-0257-7

[4] Sambo, Paolo, Carlo Nicoletto, Andrea Giro, Youry Pii, Fabio Valentinuzzi, Tanja Mimmo, Paolo Lugli, Guido Orzes, fabrizio Mazzetto, Stefania Astolfi, Roberto Terzano, and Stefano Cesco. "Hydroponic solutions for soilless production systems: issues and opportunities in a smart agriculture perspective." *Frontiers in plant science* 10 (2019): 923. https://doi.org/10.3389/fpls.2019.00923

[5] Craswell, Eric. "Fertilizers and nitrate pollution of surface and ground water: an increasingly pervasive global problem." *SN Applied Sciences* 3, no. 4 (2021): 518. https://doi.org/10.1007/s42452-021-04521-8

[6] Rashmi, I., Trisha Roy, K. S. Kartika, Rama Pal, Vassanda Coumar, S. Kala, and K. C. Shinoji. "Organic and inorganic fertilizer contaminants in agriculture: Impact on soil and water resources." *Contaminants in Agriculture: Sources, Impacts and Management* (2020): 3-41. https://doi.org/10.1007/978-3-030-41552-5_1

[7] Pereg, Lily, and Mary McMillan. "Scoping the potential uses of beneficial microorganisms for increasing productivity in cotton cropping systems." *Soil Biology And Biochemistry* 80 (2015): 349-358. https://doi.org/10.1016/j.soilbio.2014.10.020

[8] Roy, Ranendra Narayan, A. Finck, G. J. Blair, and H. L. S. Tandon. "Plant nutrition for food security." *A guide for integrated nutrient management. FAO Fertilizer and Plant Nutrition Bulletin* 16, no. 368 (2006): 201-214. https://doi.org/10.1017/s0014479706394537

[9] Hermanto, B., Dian Habibie, A. F. Lubis, and R. A. Syahputra. "Analysis of Pakcoy Mustard (Brassica rapa) growth using hydroponic system with AB mix nutrition." In *Journal of Physics: Conference Series*, vol. 1819, no. 1, p. 012059. IOP Publishing, 2021. https://doi.org/10.1088/1742-6596/1819/1/012059

[10] Resh, Howard M. *Hydroponic food production: A definitive guidebook for the advanced home gardener and the commercial hydroponic grower*. *Environment & Agriculture*, CRC press, 2022. https://doi.org/10.1201/9781003133254

[11] Timon, David, S. J. Isaac, K. Batta, N. N. Zakawa, P. A. Wuta, William Wilfred, and C. S. Yusuf. "The response of cocoyaM (Colocasia esculentus (L). Schott) to mixture of organic and inorganic fertilizers in Mubi, Adamawa State Nigeria." *GPH-International Journal of Agriculture and Research* 4, no. 07 (2021): 01-14. https://doi.org/10.5281/zenodo.6860028

[12] Liu, Chunye, Rui Wang, Wene Wang, Xiaotao Hu, Yong Cheng, and Fulai Liu. "Effect of fertilizer solution concentrations on filter clogging in drip fertigation systems." *Agricultural Water Management* 250 (2021): 106829. https://doi.org/10.1016/j.agwat.2021.106829

[13] Draman, S. F. S., S. M. Shukri, N. S. I. Ishak, A. S. A. Samad, and A. F. Pauzi. "Optimization of AB Fertilizer for Plant Growth in Fertigation Using Central Composite Design." In *IOP Conference Series: Materials Science and Engineering*, vol. 1176, no. 1, p. 012010. IOP Publishing, 2021. https://doi.org/10.1088/1757-899X/1176/1/012010

[14] Carmo, Davi Lopes do, Laís Botelho de Lima, and Carlos Alberto Silva. "Soil fertility and electrical conductivity affected by organic waste rates and nutrient inputs." *Revista Brasileira de Ciência do Solo* 40 (2016): e0150152. https://doi.org/10.1590/18069657rbcs20150152

[15] Kerner, E. H. "The electrical conductivity of composite media." *Proceedings of the Physical Society. Section B* 69, no. 8 (1956): 802. https://doi.org/10.1088/0370-1301/69/8/304

[16] Ding, Xiaotao, Yuping Jiang, Hong Zhao, Doudou Guo, Lizhong He, Fuguang Liu, Qiang Zhou, Dilip Nandwani, Dafeng Hui, and Jizhu Yu. "Electrical conductivity of nutrient solution influenced photosynthesis, quality, and antioxidant enzyme activity of pakchoi (Brassica campestris L. ssp. Chinensis) in a hydroponic system." *PloS one* 13, no. 8 (2018): e0202090. https://doi.org/10.1371/journal.pone.0202090

[17] Zulkarami, B., M. Ashrafuzzaman, and I. Mohd Razi. "Morpho-physiological growth, yield and fruit quality of rock melon as affected by growing media and electrical conductivity." *Journal of Food Agriculture & Environment* 8, no. 1 (2010): 249-252.

[18] Xiao, Yang, Changjian Ma, Mengyao Li, Lili Zhangzhong, Peng Song, and Yunkai Li. "Interaction and adaptation of phosphorus fertilizer and calcium ion in drip irrigation systems: the perspective of emitter clogging." Agricultural Water Management 282 (2023): 108269. https://doi.org/10.1016/j.agwat.2023.108269

[19] Haynes, R. J. "Principles of fertilizer use for trickle irrigated crops." *Fertilizer research* 6 (1985): 235-255. https://doi.org/10.1007/BF01048798

[20] Liu, Lu, W. Q. Niu, Z. G. Wu, Y. Guan, and Y. Li. "Risk and inducing mechanism of acceleration emitter clogging with fertigation through drip irrigation systems." *Transactions of the Chinese Society for Agricultural Machinery* 48, no. 1 (2017): 228-236. http://dx.doi.org/10.6041/j.issn.1000-1298.2017.01.030

[21] Maglia, Filippo, Filippo Farina, Monica Dapiaggi, Ilenia G. Tredici, and Umberto Anselmi-Tamburini. "Transport properties in bulk nanocrystalline Sm-doped ceria with doping content between 2 and 30 at.%." *Solid State Ionics* 225 (2012): 412-415. https://doi.org/10.1016/j.ssi.2011.12.015

[22] Oldham, Larry, and Keri Jones. "Inorganic fertilizers for crop production." *Mississippi State University Extension Publication 2500* (2020).

[23] Teles, Ana Paula Bettoni, Marcos Rodrigues, and Paulo Sergio Pavinato. "Solubility and efficiency of rock phosphate fertilizers partially acidulated with zeolite and pillared clay as additives." *Agronomy* 10, no. 7 (2020): 918. https://doi.org/10.3390/agronomy10070918

[24] Rosli, Fahmy A. "Eksklusif: "Tanah mati ancam Cameron Higland." *Berita Harian Online*, 2019.

[25] Bisht, Nikita, and Puneet Singh Chauhan. "Excessive and disproportionate use of chemicals cause soil contamination and nutritional stress." *Soil Contamination-Threats and Sustainable Solutions* 2020 (2020): 1-10. https://doi.org/10.5772/intechopen.94593

[26] Harjadi, S. S., W. D. Winarno, and S. Ketty. "Aspek-aspek penting budidaya tanaman buah-buahan." *Dihimpun oleh GA Wattimena* (2010).

[27] Furoidah, Nanik, and Endang Sri Wahyuni. "Peningkatan Hasil Sayuran Lokal Kabupaten Lumajang di Lahan Terbatas." *Jurnal Agri-Tek* 17, no. 2 (2017).

[28] Rosnina, Rosnina, and Sarah Mauliza. "Optimization of AB-mix fertilizer on varieties of hydroponic lettuce (Lactuca sativa L.)." *Journal of Tropical Horticulture* 3, no. 2 (2020): 86-91. http://dx.doi.org/10.33089/jthort.v3i2.56

[29] Hidayanti, Lilik, and Trimin Kartika. "Pengaruh nutrisi AB Mix terhadap pertumbuhan tanaman bayam merah (Amaranthus tricolor L.) secara hidroponik." *Sainmatika: Jurnal Ilmiah Matematika dan Ilmu Pengetahuan Alam* 16, no. 2 (2019): 166-175. https://doi.org/10.31851/sainmatika.v16i2.3214

[30] Ahirwar, S., and M. Hasan. "The Effect of Electrical Conductivity of Irrigation Water on Water Uptake by Capsicum in Soilless Media." *International Journal of Current Microbiology and Applied Sciences* 7, no. 12 (2018): 2307. https://doi.org/10.20546/ijcmas.2018.712.262

[31] Albornoz, Francisco, J. Heinrich Lieth, and José A. González-Fuentes. "Effect of different day and night nutrient solution concentrations on growth, photosynthesis, and leaf NO3-content of aeroponically grown lettuce." *Chilean journal of agricultural research* 74, no. 2 (2014): 240-245. http://dx.doi.org/10.4067/S0718-58392014000200017

[32] Stefanov, Martin, Ekaterina Yotsova, Georgi Rashkov, Katya Ivanova, Yuliana Markovska, and Emilia L. Apostolova. "Effects of salinity on the photosynthetic apparatus of two Paulownia lines." *Plant Physiology and Biochemistry* 101 (2016): 54-59. https://doi.org/10.1016/j.plaphy.2016.01.017

[33] Dhingra, Devinder, Mona Michael, Hradesh Rajput, and R. T. Patil. "Dietary fibre in foods: a review." *Journal of Food Science and Technology* 49 (2012): 255-266. https://doi.org/10.1007/s13197-011-0365-5

[34] Baer, David J., William V. Rumpler, Carolyn W. Miles, and George C. Fahey Jr. "Dietary fiber decreases the metabolizable energy content and nutrient digestibility of mixed diets fed to humans." *The Journal of nutrition* 127, no. 4 (1997): 579-586. https://doi.org/10.1093/jn/127.4.579

[35] Ding, Xiaotao, Yuping Jiang, Hong Zhao, Doudou Guo, Lizhong He, Fuguang Liu, Qiang Zhou, Dilip Nandwani, Dafeng Hui, and Jizhu Yu. "Electrical conductivity of nutrient solution influenced photosynthesis, quality, and antioxidant enzyme activity of pakchoi (Brassica campestris L. ssp. Chinensis) in a hydroponic system." *PloS one* 13, no. 8 (2018): e0202090. https://doi.org/10.1371/journal.pone.0202090

[36] Mullins, G. L., S. E. Alley, and D. W. Reeves. "Tropical maize response to nitrogen and starter fertilizer under strip and conventional tillage systems in southern Alabama." *Soil and Tillage Research* 45, no. 1-2 (1998): 1-15. https://doi.org/10.1016/S0167-1987(97)00069-X

[37] Fallovo, Carlo, Youssef Rouphael, Elvira Rea, Alberto Battistelli, and Giuseppe Colla. "Nutrient solution concentration and growing season affect yield and quality of Lactuca sativa L. var. acephala in floating raft culture." *Journal of the Science of Food and Agriculture* 89, no. 10 (2009): 1682-1689. https://doi.org/10.1002/jsfa.3641

[38] Nieman, Richard H. "Some effects of sodium chloride on growth, photosynthesis, and respiration of twelve crop plants." *Botanical Gazette* 123, no. 4 (1962): 279-285. https://doi.org/10.1086/336163

[39] Amalfitano, Carmine, Laura Del Vacchio, Silvano Somma, Antonio Cuciniello, and Gianluca Caruso. "Effects of cultural cycle and nutrient solution electrical conductivity on plant growth, yield and fruit quality of'Friariello'pepper grown in hydroponics." *Horticultural Science* 44, no. 2 (2017). https://doi.org/10.17221/172/2015-HORTSCI

[40] Rowell, D. L., and A. Wild. "Causes of soil acidification: A summary." *Soil Use and Management* 1, no. 1 (1985): 32-33. https://doi.org/10.1111/j.1475-2743.1985.tb00651.x

[41] Lu, Chaoqun, and Hanqin Tian. "Net greenhouse gas balance in response to nitrogen enrichment: perspectives from a coupled biogeochemical model." *Global change biology* 19, no. 2 (2013): 571-588. https://doi.org/10.1111/gcb.12049

[42] Massah, Jafar, and Behzad Azadegan. "Effect of chemical fertilizers on soil compaction and degradation." *Agricultural Mechanization in Asia, Africa and Latin America* 47, no. 1 (2016): 44-50.

[43] Bhardwaj, Deepak, Mohammad Wahid Ansari, Ranjan Kumar Sahoo, and Narendra Tuteja. "Biofertilizers function as key player in sustainable agriculture by improving soil fertility, plant tolerance and crop productivity." *Microbial cell factories* 13 (2014): 1-10. https://doi.org/10.1186/1475-2859-13-66

[44] Murugaragavan Ramasamy, T. Geetha, and M. Yuvaraj. "Role of biofertilizers in plant growth and soil health." *Nitrogen fixation* 1 (2020). https://doi.org/10.5772/intechopen.87429

[45] Kiran, A. Sai, K. Avil Kumar, M. Uma Devi, B. Balaji Naik, and S. Triveni. "Effect of Biofertigation and Chemical Fertilizers on Yield Attributes and Yield of Rabi Maize (Zea mays L.)." *International Journal of Economic Plants* 9, no. May, 2 (2022): 152-157. https://doi.org/10.23910/2/2022.0466a

[46] Ahmad, Farah, Iqbal Ahmad, and M. S. Khan. "Screening of free-living rhizospheric bacteria for their multiple plant growth promoting activities." *Microbiological research* 163, no. 2 (2008): 173-181. https://doi.org/10.1016/j.micres.2006.04.001

[47] Abd Wahid, Ahmad Nazrul, Latiffah Noordin, and P. C. K. Hoe. "Bio fertilizer application in a fertigation system." (2011).

[48] Selim, E. M., A. A. A. El-Fattah, M. M. Abouel-Magd, and M. A. Khalafallah. "Efficiency of bio-fertigation on nutrients uptake by broccoli and soil microbial biomass under sandy soil conditions." (2009): 280-286.

[49] Latha, P., S. Jeyaraman, and R. Prabakaran. "Effect of microbial and chemical fertilizer on egg plant (Solanum melongena Linn.) C. Var CO-2." *International Journal of Pure Applied Bioscience* 2 (2014): 119-124.

[50] Hajagha, Reza Isazadeh, Saliha Kirici, Leila Tabrizi, Ahmad Asgharzadeh, and Aydin Hamidi. "Evaluation of growth and yield of Purple Coneflower (Echinacea purpurea L.) in response to biological and chemical fertilizers." *Journal of Agricultural Science* 9, no. 3 (2017): 160-171. https://doi.org/10.5539/jas.v9n3p160

[51] Srivastav, Arun Lal. "Chemical fertilizers and pesticides: role in groundwater contamination." In *Agrochemicals Detection, Treatment And Remediation*, pp. 143-159. Butterworth-Heinemann, 2020. https://doi.org/10.1016/B978-0-08-103017-2.00006-4

[52] Rani, Lata, Komal Thapa, Neha Kanojia, Neelam Sharma, Sukhbir Singh, Ajmer Singh Grewal, Arun Lal Srivastav, and Jyotsna Kaushal. "An extensive review on the consequences of chemical pesticides on human health and environment." *Journal of cleaner production* 283 (2021): 124657. https://doi.org/10.1016/j.jclepro.2020.124657

[53] Hussein, H. S., H. H. Shaarawy, Nabila H. Hussien, and S. I. Hawash. "Preparation of nano-fertilizer blend from banana peels." *Bulletin of the National Research Centre* 43 (2019): 1-9. https://doi.org/10.1186/s42269-019-0058-1

[54] Nair, Keshav. "The effects of clinotpitolites vs. control-release fertilizer on nitrate leached from silt loam soil." (2018).

[55] Yoon, Ho Young, Jeong Gu Lee, Lorenzo Degli Esposti, Michele Iafisco, Pil Joo Kim, Seung Gu Shin, Jong-Rok Jeon, and Alessio Adamiano. "Synergistic release of crop nutrients and stimulants from hydroxyapatite nanoparticles functionalized with humic substances: Toward a multifunctional nanofertilizer." *ACS omega* 5, no. 12 (2020): 6598-6610. https://doi.org/10.1021/acsomega.9b04354

[56] Shafee, Farah Amira Ahmad, Nasir Shafiq, and Syed Ahmad Farhan. "Strategies for Improvement of Water Quality in Urban Lakes." *Progress in Energy and Environment* (2024): 1-5. https://doi.org/10.37934/progee.29.1.15