Community Resilience and Empowerment Through Urban Farming Initiative as Emergency Response

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Abstract. Currently, urban vulnerability has been exposed by catastrophic and unpredictable events which required cities to improve their resilience. Urban farming is promoted as one of the alternative strategies that could improve resilience through community empowerment aligned with re-naturing the environment. This study highlights the role of urban farming as community empowerment activities which could develop community resilience in the context of food and nutrition security specifically as emergency response. The study utilized an in-depth field survey to develop the database. The study found that urban farming could contribute to community resilience for feeding potential and nutrient sufficiency especially for targeted population who has highest risk during emergency such as the COVID-19 case. Urban farming in Malang could feed up to 50,000 inhabitants which cover only an age range of 60-64 years old. To provide sufficient vegetables for targeted population, there was a need for 1.91% (211 ha), 1.09% (120 ha), and 0.82% (91 ha) of area given each production scenarios such as normal, medium, and intensive management, respectively. The most important nutrient needs were Vitamin B1, B2, B12, D; Niacin eq.; and Folic acid due to only 10% sufficiency in the average. The study recommended specific additional vegetables to be cultivated such as red spinach and long beans since they have the highest nutrients content based on scoring.

1. Introduction
Currently, many cities are facing vulnerabilities as they are exposed to various challenges which go along with urban poverty. Developing countries are those most likely to face these challenges, including Indonesia. For an instance, resulted by urbanization, in 2020 almost 57% of Indonesian inhabitants live in the city, exceeding the average share of urban population in the world [1]. In addition, there were 9.64% people living under poverty line in 2019, lower than the national target of 9.49%. These situations go along with urban food insecurity, especially for the poor people, including malnutrition for children under 5, and environment degradation [2,3]. Based on Food Insecurity Experience Scale (FIES), Indonesia was categorized to have moderate food insecurity with a scale of 6.86/10.00 and 30.8% of children under five being stunted in 2018 [2]. A report by RAND on Labour and Population stated that the share of urban poor in total poor in Indonesia, already substantial, would...
almost certainly rise with the higher levels of urbanization in years to come [4]. Moreover, urbanization coupled with climate change would lead to urban heat stress and increase its coverage area up to 18.9% in the future (2018-2042) [5]. Urban activities coupled with urbanization have become a key contributor to global GHG emissions for energy needs at more than 70% [6]. It includes 26% of food emission where 6% comes from transportation [7]. The nexus of increasing economic growth and accelerating process of urbanization have resulted in the increase of energy needs and, thus, lead to environmental degradation [8,9]. Besides, these challenges are exacerbated by COVID-19 pandemic which resulted in the limitation of most activities, borders, and movement restriction (Pembatasan Sosial Berskala Besar-PSBB) and closure of some essential public facilities. This situation will certainly affect to community especially for the People in Need (PIN), and therefore, addressing the social factors and increasing awareness of the vital importance of food availability for citizens are already substantial. [10,11]. Given these situations, the community is required to improve its resilience in responding and coping with the challenges through community resilience and empowerment.

This paper promotes urban farming as one of the important community empowerment strategies that contribute to community resilience especially in the context of food and nutrition provision. Urban farming is defined as practices of growing, processing, and distributing food by community through intensive plant cultivation within a certain boundary. Study on urban farming for improving resilience particularly on food and nutrition provision was extensively documented [12–16]. However, urban farming for community resilience and empowerment has not been widely researched. Urban farming production was not "the antithesis of the city," but often an integrated urban activity that contributes to the resilience of cities [14]. Besides, it not only reduces hunger and malnutrition, but it is also a sustainable food production system that helps to maintain the ecosystem [12]. A study of urban farming in Italy found that, in one hectare of vegetable, the productivity can reach 2.5 kg m\(^{-2}\) yr\(^{-1}\), which could feed urban dwellers of up to 324 inhabitants [13]. A study by Sioen et al. (2017) concluded that urban farming has the potential to contribute nutrients to diets during post-disaster situations as disaster preparedness food for up to 2.5% self-sufficient [15]. As social empowerment, urban farming performance in increasing well-being and social benefit was acknowledged by previous studies [17–19]. A recent study mentioned that urban farming could also be an appropriate strategy for emergency response amid COVID-19 pandemic [11]. It concluded that urban farming may be appropriate to be applied in this situation to increase resilience, since the high uncertainty of risk and disaster may occur in upcoming years as well as to promote social empowerment. Therefore, this paper assesses the role of urban farming in increasing community resilience and empowerment in the context of potential food provision and nutrition sufficiency particularly with a sample case on how urban farming aids with responding and coping with food and nutrition needs against COVID-19 crisis.

2. Research framework
The research took place in Malang city as a case study and COVID-19 as a sample of crisis period. The city has 866,118 inhabitants and an area of 11,006 ha. According to statistical data, the city has 35,890 poor people who live under poverty line and 77,311 elderly people who are more than 60 years old. Moreover, there were 3,204 people at the intersection of poverty and old age [20]. The data was obtained through an in-depth field survey during a harvest period on 25 September – 25 October 2019 in all urban farming plot distribution within the city. Twelve plots of urban farming communities and 45 plots of residential farms which were associated with those community farms were observed. This study only focused on residential farming sites since the vegetables obtained from allotment farming were cultivated on these sites. The definition of urban farming form and inventoried area of all plots in Malang city was compiled from a previous study [21]. The research framework is shown in Figure 1 below.
2.1. Urban farming inventory
This part was extensively documented from results of a previous study [21]. Urban farming in Malang is divided by allotments and residential farms. Allotment farming was directed as nursery areas for cultivating stage and demo plot as education and training for community empowerment. This part has also documented activities of urban farmer for social cohesion. The vegetables seed were subsequently brought by urban farmer to their residential farming. According to geospatial assessment, Malang city currently has 0.40 ha area of residential farm which is equal to 0.004% and 58.27 ha available area which is equal to 0.53%. In addition, the study focused only on vegetables. There were 22 documented vegetables which were used to further analysis.

2.2. Production estimation
To estimate production capacity of residential farm, a harvest table was developed from direct calculations of farmlands which were ready for harvesting. However, most of the vegetables were not ready for harvesting and there were a limited number of notes by farmers/gardeners about annual yield of certain vegetables. It was assumed that every vegetable cultivated in different urban farming forms produces the same amount of production. There were two conditions of urban farming. For vegetables cultivated polybag-based, it was calculated that 1 m² equals to nine polybags, while for vegetables cultivated soil-based, it was directly calculated by the scale of vegetables harvested from a square meter of area. Figure 2 shows the flow of documentation for the harvest table of vegetables. For remaining vegetables that could not be harvested during the survey, a reference yield based on previous literatures [13,22,23] was used. All literatures citated in the study estimated vegetable yield through urban farming. Thereby, this harvest table can be adopted for this analysis.

The listed vegetables obtained from the survey were then inputted into the annual yield and subsequently converted into monthly yield considering the edible portion and proportion area used for specific vegetables. Edible portion ($E_p$) of vegetables was obtained from various sources [15,24,25].
To estimate the monthly harvest in edible portion as well as consider the proportion area (Rj) of each vegetable, \( Y_{\text{edible}-j} \) (Kgm\(^2\)mo\(^{-1}\)), the study employed the following formula:

\[
Y_{\text{edible}-j} = \frac{Y_{aj} \cdot E_{pj} \cdot R_j}{12}
\]

Where \( Y_{aj} \) is the annual yield of \( j^{th} \) vegetables in (Kg m\(^{-2}\)yr\(^{-1}\)), \( E_{pj} \) is the edible portion of \( j^{th} \) vegetables in % and \( R_j \) is the proportion area of \( j^{th} \) vegetables cultivated in %. This annual yield value was subsequently converted into monthly yield in edible portion by simply dividing it by 12. This value is associated with the Normal Management of Production. To estimate the total potential production of residential farming for the entire city, the following formula was used:

\[
Y_j = Y_{\text{edible}-j} \cdot A_r
\]

Where \( Y_j \) is the yield of each vegetable in (Kg m\(^{-2}\)mo\(^{-1}\)) and \( A_r \) is the total area of residential farming in m\(^2\) in the available area of 58.27 ha.

In addition to normal management, the study also developed production scenarios. The study assumed that COVID-19 increased activities at home [26] which was translated into increasing labor time for gardening. There were two types of scenarios called Medium management and Intensive management. Medium management of production was adopted from a study by Dahlin & Rusinamhodzi (2019) where production would increase by 75% associated by increasing gardening time (labor) [27], while intensive management was based on 20% of top production referring to survey results and adjusted from Orsini et al (2014) [28].

2.3. Feeding potential estimation

Since urban farming production was directed for targeted vulnerable groups, therefore, this study selected certain age groups particularly those of more than 60 years old as shown in Table 1. Verity et al. (2020) estimated fatality ratio and infection fatality ratio from aggregated time series of cases of COVID-19 in mainland China. It was found that those aged more than 60 years old had up to 6% infection fatality ratio [29].

Feeding potential was the capability of urban farming production in fulfilling recommendation of vegetables consumption per capita within a certain period. It was calculated as follows:

\[
\text{Feeding population} = \frac{Y_{(\text{edible})i} \cdot A_r}{\text{Consumption per capita}}
\]

Where \( Y_{(\text{edible})i} \) is the sum of edible production of \( i^{th} \) scenarios (Kg m\(^{-2}\) mo\(^{-1}\)) and consumption per capita for adult was 269.5 gr day\(^{-1}\) equal to 8.08 kg mo\(^{-1}\) on average [30]. However, vegetables intake based on age strata followed by the National Institute for Research on Food and Nutrition (INRAN) was also considered to estimate percentage coverage of vegetable consumption under different scenario and age strata. The number of populations of targeted age group and vegetables intake can be seen as follows.

| Table 1. Number of targeted population and vegetables intake recommendation. |
|---------------------------------|---------------|-----------------|-----------------|-----------------|
| Age   | Number of Population | Consumption per capita [Kg day\(^{-1}\) person\(^{-1}\)] | Total Daily Requirement [Kg day\(^{-1}\)] | Total Monthly Requirement [t mo\(^{-1}\)] |
|-------|----------------------|-------------------------------------------------|-----------------------------------|---------------------------------|
| 60 - 64 | 27,787              | 0.2695                                        | 7488.60                          | 224.66                         |
| 65 - 69 | 19,556              | 0.2695                                        | 5270.34                          | 158.11                         |
| 70 - 74 | 13,785              | 0.2695                                        | 3715.06                          | 111.45                         |
| 75 +   | 16,183              | 0.2695                                        | 4361.32                          | 130.84                         |
|-------|----------------------|------------------------------------------------|-----------------------------------|---------------------------------|
|       | 77,311              |                                                |                                   |                                 |
In addition to that, Percentage Area Needed (PAN) was also calculated to estimate area needs to produce sufficient vegetables in a month for three categories population-k. The categories were Poor population (35,890 inhabitants); The highest risk population was set as the target in this study (77,311 inhabitants); and those of both the poor and the highest risk (3204 inhabitants) [20]. PAN was calculated with the following equation:

\[
PAN_k(\%) = \frac{\text{Population}_k \times \text{Consumption per capita}}{g_{(\text{edible})}\times A} \tag{4}
\]

Where \(A\) is the area of Malang city (11,006 ha).

2.4. Nutrition sufficiency estimation

Nutrients self-sufficiency during emergency was used to estimate nutrition sufficiency, considering the recommended mean daily per capita nutrient intake for emergency food in developing countries as shown in Table 2 [31]. An emergency is indicated as a post-chemical, biological, radiological, and nuclear disaster, while minimum requirements of calories and nutrients were considered similar among disasters. Therefore, it was applied for this particular case of COVID-19 crisis.

The study highlighted monthly self-sufficiency of nutrients during emergency concerning the targeted population (>60 years old). For this analysis, vegetables in weight and specific nutrients needs were considered. Therefore, all nutrients content for each vegetable was documented considering available area and potential production as shown in Appendix A.

The following formula was used to estimate the monthly self-sufficiency of nutrient intake under different scenarios (\(N_{Sm}\), %):

\[
N_{Sm}(\%) = \frac{g_{(\text{edible})}\times A_r}{N_{Sm} \times \text{Pop}} \tag{5}
\]

Where \(N_{Im}\) is the monthly intake of each nutrients (Kg person\(^{-1}\) mo\(^{-1}\)) and Pop is the total targeted population (77,311 inhabitants).

| Nutrient                     | Recommend Daily Intake per Person |
|------------------------------|----------------------------------|
| Vegetables in weight \(^1\)  | 269.5 g                          |
| Vitamin A (retinol) equivalent | 500 mcg                          |
| Vitamin D                    | 3.8 mcg                          |
| Thiamin (Vitamin B1)         | 0.9 mg                           |
| Riboflavin (Vitamin B2)      | 1.4 mg                           |
| Niacin equivalents           | 12 mg                            |
| Folic acid                   | 160 mcg                          |
| Vitamin B12                  | 0.9 mcg                          |
| Vitamin C                    | 28 mg                            |
| Iodine                       | 150 mcg                          |
| Iron                         | 22 mg                            |
| Calcium                      | 0.5 g                            |

Table 2. Recommended mean daily nutrient intake per capita for emergency food in developing countries [31].

In addition to that, the study also proposes selected vegetables, based on nutrients contents, for urban farming recommendation. This selection was predominantly based on the survey and nutrient content. The nutrient content of each vegetable was scored and compared among all surveyed vegetables. The scoring was calculated as follows:

\[
\text{Score} = \frac{(n_{ij} - n_{\text{min}-i})}{(n_{\text{max}-i} - n_{\text{min}-i})}
\]

(6)
Where $n_i$ is the $i^{th}$ of nutrient content in the $j^{th}$ vegetables (g), $n_{\text{min}-i}$ is the minimum value of $i^{th}$ nutrient among all vegetables, and $n_{\text{max}-i}$ is the maximum value of $i^{th}$ nutrient among all vegetables.

3. Urban farming inventory and potential production

The harvest table of inventoried vegetables is shown in Table 3 below. They are in order of priority and frequency of the vegetables cultivated by urban farmer. Annual yield and frequency of harvesting were obtained directly based on survey and interviews with urban farmers. Some of the urban farmers properly documented the yield per harvest time therefore the data was well documented. The proportion of area of each vegetable was documented subjectively by the author due to the limitation in measuring one by one of each farmland and privacy issues. It shows that water spinach and mustard mostly occupied the urban farm area at up to 12%. The monthly harvest in edible portion was acknowledged as normal management scenario which was 0.30 Kgm$^{-2}$mo$^{-1}$ in total. While considering the available area for urban farming, this potential could provide production of up to 174,650.34 Kg mo$^{-1}$.

The study also considered potential production called medium and intensive management. Medium management was acknowledged from previous studies where production would increase by 75% associated with increasing gardening time (labor) [27]. Therefore, it was 0.52 Kgm$^{-2}$mo$^{-1}$ in total in edible portion. It was also supported by studies of urban farm production in medium-biointensive and farm production observation [32, 33]. While for intensive management, it was 0.69 Kgm$^{-2}$mo$^{-1}$, which was based on 20% of top production referring to survey result and adjusted by previous studies [28].

Table 3. Harvest table of inventoried vegetables.

| No | Vegetable     | $Y_{dij}$ [Kgm$^{-2}$yr$^{-1}$] | $f$ [Period] | $E_{dij}$ [%] | $R_j$ [%] | $Y_{edible-j}$ [Kgm$^{-2}$mo$^{-1}$] | $Y_j$ [Kg mo$^{-1}$] |
|----|---------------|---------------------------------|--------------|--------------|----------|-------------------------------------|---------------------|
| 1  | Water Spinach | 3.27                            | 12           | 100%         | 12%      | 0.0327                              | 19059.97            |
| 2  | Mustard       | 4.88                            | 25           | 100%         | 12%      | 0.0468                              | 27262.40            |
| 3  | lettuce       | 4.61                            | 26           | 85%          | 11%      | 0.0360                              | 20947.73            |
| 4  | Tomato        | 4.85                            | 10           | 100%         | 4%       | 0.0162                              | 9419.60             |
| 5  | Pak choy      | 2.06                            | 9            | 85%          | 5%       | 0.0073                              | 4244.98             |
| 6  | Eggplant      | 8.20                            | 14           | 90%          | 4%       | 0.0246                              | 14333.32            |
| 7  | Chili Pepper  | 4.10                            | 18           | 100%         | 4%       | 0.0137                              | 7962.96             |
| 8  | Celery        | 2.43                            | 26           | 63%          | 5%       | 0.0057                              | 3344.95             |
| 9  | Spinach       | 2.44                            | 12           | 90%          | 7%       | 0.0128                              | 7467.53             |
| 10 | Cabbage       | 3.66                            | 16           | 85%          | 4%       | 0.0104                              | 6045.14             |
| 11 | Chayote       | 5.87                            | 36           | 100%         | 3%       | 0.0147                              | 8547.55             |
| 12 | Red spinach   | 2.44                            | 12           | 90%          | 7%       | 0.0128                              | 7467.53             |
| 13 | Red Chili     | 0.88                            | 18           | 100%         | 4%       | 0.0029                              | 1713.01             |
| 14 | Cauliflower   | 2.44                            | 4            | 75%          | 3%       | 0.0046                              | 2666.97             |
| 15 | Leek          | 2.93                            | 11           | 100%         | 3%       | 0.0073                              | 4267.15             |
| 16 | Broccoli      | 1.95                            | 11           | 50%          | 3%       | 0.0024                              | 1422.39             |
| 17 | Cucumber      | 17.09                           | 7            | 98%          | 3%       | 0.0419                              | 24393.92            |
| 18 | Mint leaves   | 0.53                            | 4            | 100%         | 2%       | 0.0009                              | 509.82              |
| 19 | Bean          | 1.55                            | 12           | 90%          | 2%       | 0.0023                              | 1354.67             |
| 20 | Basil Leaf    | 0.67                            | 26           | 100%         | 1%       | 0.0066                              | 326.53              |
| 21 | Long Beans    | 2.93                            | 12           | 75%          | 1%       | 0.0018                              | 1066.79             |
| 22 | Shallot       | 2.00                            | 26           | 85%          | 1%       | 0.0014                              | 825.43              |
|    | Total         | 0.30                            |              |              |          | 174,650.34                          |
4. Social value of urban farming

Urban farming has potential values especially for human well-being as documented by previous research [17–19]. One study about social value of urban rooftop farming found that the average of willingness to pay for social benefits in Hongkong was US$ 56.20 mo⁻¹person⁻¹m⁻². For comparison, the charge for renting a plot in an urban rooftop farm was US$ 48.54 mo⁻¹person⁻¹m⁻² [17]. Another study found that home gardens (residential farming) provided a large set of ecosystem services especially cultural services as the category most valued i.e., education, learning, recreational, and other social values [18]. According to [19], in terms of the social dimension, it was observed that urban farming initiative implementation in Mexico City clearly follows international policy recommendations, which invests in capacity building and has policies to help vulnerable groups and women. Something similar was found in Malang city cases. The government supported the initiative of urban farming through providing training and financial support, while citizen actively participated and collaborated with each other to emerge urban farming in their surrounding areas (Figure 3).

5. Feeding potential

Urban farming was also promoted for its feeding potential in addition to its social value. Table 4 shows feeding potential under different scenarios of production. The scenarios are based on simulation accompanied by survey result. Considering a level of consumption per capita at 8.08 kgmo⁻¹, given the existing area (0.4 ha), urban farming could feed 148, 258, and 345 inhabitants under different scenarios, respectively. Acknowledging the potential area, 58.27 ha, this could feed from 21,000 up to 50,000 inhabitants given the scenarios. This is equal to that in a hectare of urban farming area, it could potentially feed 367, 642, and 857 under different scenarios used, respectively. A similar study found that a vegetable garden could feed 324 citizens under scenario production of 2.5 kgm⁻²yr⁻¹ and consumption per capita of 211.2 gday⁻¹ [34]. This shows that urban farming can potentially contribute to feeding people if it is utilized optimally.

Table 4. Feeding potential under different scenarios of production.

| Scenarios  ᵇᵗʰ | \( Y_{(edible)}\) [Kgm⁻²mo⁻¹] | Existing area | Potential area (% targeted population) |
|----------------|---------------------------------|---------------|---------------------------------------|
| 1-Normal management | 0.30                           | 148           | 21,385 (28%)                         |
| 2-Medium management [27] | 0.52                           | 258           | 37,423 (49%)                         |
| 3-Intensive management [28] | 0.69                           | 345           | 49,932 (65%)                         |

*with average consumption per capita 8.08 kgmo⁻¹

It should be considered that the current existing area was not sufficient to feed all inhabitants especially the elderly (>60 years old) as targeted population for emergency response amid the COVID-19 pandemic. If we looked into the potential area, it still could not feed the targeted group. The
targeted group were 77,311 inhabitants while the arable land of residential farming could only feed 21,000 in normal management and, even in the intensive management scenario, 50,000 inhabitants. As shown in Figure 4 as well, this urban farming could only cover and feed the range of age strata of 60-64 years old. Only 60-69 age group could be covered by the intensive management scenario. It was therefore recommended to create an intensive cultivation management with sophisticated and new technologies to increase potential yield.

Figure 4. Percentage coverage of vegetable consumption under different scenarios and age strata.

In order to estimate area needs to produce sufficient vegetables in a month for the targeted population, the Percentage Area Needed (PAN) was calculated as shown on Table 5. As mentioned earlier, the city only has 0.004% of existing residential farming area and 0.53% of potential area. Based on PAN result, it could only cover for the poor population on medium and intensive management scenarios, and with all scenarios for the poor and highest risk population group. While for the targeted population (elderly > 60 years old), both existing and available area could not feed this group yet. If we focused on the targeted population, it would need an area of 211 ha, 120 ha, and 91 ha, to provide sufficient vegetables for elderly in accordance with the scenarios.

Table 5. Percentage Area Needed (PAN) to produce sufficient vegetables in a month for selected population based on three categories.

| Scenarios | $Y_{food/h}$ [Kgm$^{-2}$/mo$^{-1}$] | Poor population | Targeted population | Poor and highest risk |
|-----------|---------------------------------|-----------------|---------------------|----------------------|
| 1-Normal management | 0.3 | 0.89% | 1.91% | 0.08%* |
| 2-Medium management [27] | 0.52 | 0.51%* | 1.09% | 0.05%* |
| 3-Intensive management [28] | 0.69 | 0.38%* | 0.82% | 0.03%* |

*could cover and feed those in certain population group(s) associated with the available area of residential farm (0.53%).

To better understand how this PAN could feed inhabitants, detailed information is provided in Figure 5. It shows that the current state of urban farming was very low. Moreover, there was a huge gap between the current state, potential area, and policy target implementation as shown in grey mesh. However, at the same time, there is potential that the community could collaborate with each other to start urban farming initiatives for their self-sufficiency and improve resilience. Here, it is also shown clearly that the potential area was lower than PAN of each scenario (PAN-1, -2, and -3). As mentioned earlier, PAN which focused on targeted population was 1.91% (211 ha), 1.09% (120 ha), and 0.82% (91 ha) for each production scenario respectively, in order to provide sufficient vegetables for elderly
in accordance with the scenarios. These are shown in green, blue, and orange vertical lines in Figure 4 below.

**Figure 5.** A simulation of vegetable production on arable land in relation to population and hectares available.

6. **Nutrition self-sufficiency**

The weight-based estimations from the recommended per capita vegetable intake and production in Malang city for targeted population indicated a self-sufficiency rate of 28%, 49% and 65% in the normal, medium, and intensive management, respectively. In addition to vegetables in weight self-sufficiency, the study also estimated nutrients sufficiency in accordance with production scenarios as shown in Figure 6. As recommended by [31] regarding important nutrients during emergency, Figure 6 shows that the most important nutrient need to be substituted were Vitamin B1, B2, B12, D; Niacin eq.; and Folic acid due to only 10% sufficiency on average.

**Figure 6.** Monthly self-sufficiency in each production scenario focused on the targeted population group.
The study also recommended vegetables which are appropriate to be cultivated based on scoring of nutrient contents as shown in Figure 7 and Table 6. The most recommended vegetables were red spinach and long beans. Showing nutrient content in 100 g vegetables in weight, Figure 7 can be utilized by urban farmers to select appropriate vegetables based on nutrient needs.

![Figure 7. Nutrient content in 100 g vegetables.](image)

**Table 6.** Score of selected vegetables based on nutrient contents.

| Vegetables    | Surveyed sites | Score Nutrients Content |
|---------------|----------------|-------------------------|
| Red spinach   | 45             | 0.4628                  |
| Long Beans    | 30             | 0.4117                  |
| Chili Pepper  | 52             | 0.2760                  |
| Red Chili     | 44             | 0.2760                  |
| Water Spinach | 56             | 0.2676                  |
| Spinach       | 49             | 0.2533                  |
| Mustard       | 56             | 0.2441                  |
| Broccoli      | 38             | 0.2360                  |
| Chayote       | 46             | 0.2240                  |
| Bean          | 34             | 0.2125                  |
| lettuce       | 55             | 0.1585                  |
| Mint leaves   | 36             | 0.1415                  |
| Basil Leaf    | 31             | 0.1415                  |
| Leek          | 43             | 0.1258                  |
| Pakchoy       | 54             | 0.0888                  |
| Cabbage       | 48             | 0.0888                  |
| Cauliflower   | 44             | 0.0888                  |
| Tomato        | 55             | 0.0763                  |
| Celery        | 51             | 0.0532                  |
| Eggplant      | 53             | 0.0373                  |
| Onion         | 22             | 0.0325                  |
| Cucumber      | 37             | 0.0230                  |
7. Conclusion
The research revealed urban farming as a way to support local community resilience and empowerment. As community empowerment, the urban farming case in Malang city promoted collaboration and social cohesion among citizens, particularly urban farmers. On the other hand, the allotment farming was used as demo plots for learning and training citizens about cultivating vegetables as well as a place for social interactions. For community resilience, urban farming contributed to the community both in feeding potential or nutrient sufficiency especially for targeted population who has the highest risk during emergency such as the COVID-19 case. A hectare of urban farming area could potentially feed 367, 642, and 857 for each scenario used. Given the potential area of urban farmland in Malang city, it could feed up to 50,000 inhabitants. This value could only cover and feed the age strata range of 60-64 years old. The Percentage Area Needed (PAN), focusing on targeted population, was 1.91% (211 ha), 1.09% (120 ha), and 0.82% (91) respectively given each production scenario, in order to provide sufficient vegetables for elderly people. In addition to vegetables in weight, important nutrients during emergency were also identified. It was found that the most important nutrient needed to be substituted were Vitamin B1, B2, B12, D; Niacin eq.; and Folic acid due to their current sufficiency of only 10% on average. This study recommends types of vegetables to be cultivated such as red spinach and long beans due to them having the highest nutrient content based on scoring. This study may be applied in different scales and timeframe or any other cases to develop community resilience. There were some limitations especially in production estimation and feasibility of urban farming development.

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### Appendix A. Nutrient content of each vegetables in the amount of potential production.

| No | Vegetables      | Potential production (considering available area) | Sum of proximate | Water | ENERC | ENERCT | PROTCNT | FAT | CHOAVLDF |
|----|----------------|--------------------------------------------------|------------------|-------|-------|--------|---------|-----|----------|
| 1  | Water Spinach  | 19,059.97                                        | 19,441           | 17,344.57 | 7,529 | 31,640 | 648.04 | 133.42 | 743.34 |
| 2  | Mustard        | 27,262.40                                        | 27,753           | 25,135.93 | 8,588 | 36,150 | 627.04 | 81.79  | 1090.50 |
| 3  | lettuce        | 20,947.73                                        | 21,094           | 19,544.23 | 5,111 | 21,597 | 649.38 | 133.42 | 460.85 |
| 4  | Tomato         | 9,419.60                                         | 9,561            | 8,750.80  | 2,967 | 12,481 | 122.45 | 8.49   | 224.98 |
| 5  | Pak choy       | 4,244.98                                         | 4,334            | 3,922.36  | 1,375 | 5,794  | 59.43  | 41.90  | 51.29   |
| 6  | Eggplant       | 14,333.32                                        | 14,669           | 13,229.66 | 5,025 | 21,110 | 140.47 | 164.29 | 701.54 |
| 7  | Chili Pepper   | 7,962.96                                         | 7,605            | 6,531.22  | 3,956 | 16,709 | 148.91 | 35.04  | 153.87 |
| 8  | lettuce        | 20,947.73                                        | 21,094           | 19,544.23 | 5,111 | 21,597 | 649.38 | 133.42 | 460.85 |
| 9  | Spinach        | 7,467.53                                         | 7,520            | 7,056.81  | 1,508 | 6,347  | 67.21  | 29.87  | 216.56 |
| 10 | Cabbage        | 6,045.14                                         | 6,172            | 5,585.71  | 1,959 | 8,252  | 84.63  | 12.09  | 320.39 |
| 11 | Chayote        | 8,547.55                                         | 8,719            | 7,667.16  | 3,573 | 15,035 | 307.71 | 51.29  | 384.64 |
| 12 | Red spinach    | 7,467.53                                         | 7,632            | 6,608.76  | 3,405 | 14,315 | 164.29 | 59.74  | 470.45 |
| 13 | Red Chili      | 1,713.01                                         | 1,636            | 1,405.01  | 851   | 3,595  | 32.03  | 7.54   | 150.92 |
| 14 | Cauliflower    | 2,666.97                                         | 2,723            | 2,464.28  | 864   | 3,640  | 37.34  | 5.33   | 141.35 |
| 15 | Leek           | 4,267.15                                         | 4,357            | 3,802.03  | 1,967 | 8,300  | 85.34  | 12.80  | 332.84 |
| 16 | Broccoli       | 1,422.39                                         | 1,466            | 1,280.15  | 606   | 2,552  | 38.40  | 1.42   | 89.18  |
| 17 | Cucumber       | 24,393.92                                        | 24,627           | 23,881.65 | 2,147 | 9,026  | 48.79  | 48.79  | 341.51 |
| 18 | Mint leaves    | 509.82                                           | 511              | 455.27    | 351   | 1,460  | 9.69   | 26.00  | 18.86  |
| 19 | Bean           | 1,354.67                                         | 1,380            | 1,213.79  | 608   | 2,567  | 32.51  | 4.06   | 97.54  |
| 20 | Basil Leaf     | 326.53                                           | 328              | 291.60    | 225   | 935    | 6.20   | 16.65  | 12.08  |
| 21 | Long Beans     | 1,066.79                                         | 1,101            | 130.15    | 3,878 | 16,443 | 184.55 | 16.00  | 731.82 |
| 22 | Shallot        | 825.43                                           | 839              | 735.54    | 380   | 1,608  | 9.08   | 0.83   | 77.10  |
Continuing from previous page…

| No | Vegetables   | FIBTG | ASH | CA   | FE   | ZN   | RETOL | CARTB | OTH CAR | VA RAE |
|----|--------------|-------|-----|------|------|------|-------|-------|---------|--------|
| 1  | Water Spinach| 381.20| 190.60| 12.7702 | 0.4384 | 0.0953 | 0.0000 | 0.5224 | 0.5339  | 0.0658  |
| 2  | Mustard      | 490.72| 327.15| 59.9773 | 0.7906 | 0.0545 | 0.0000 | 0.4068 | 1.3544  | 0.0903  |
| 3  | Lettuce      | 146.63| 251.37| 19.9003 | 0.5027 | 0.0230 | 0.0000 | 0.2461 | 0.5346  | 0.0428  |
| 4  | Tomato       | 141.29| 56.52 | 0.7536 | 0.0565 | 0.0188 | 0.0000 | 0.0495 | 0.1467  | 0.0102  |
| 5  | Pak choy     | 80.65 | 38.20 | 1.9527 | 0.0212 | 0.0127 | 0.0000 | 0.0020 | 0.0014  | 0.0002  |
| 6  | Eggplant     | 430.00| 1.2900| 0.0330 | 0.0229 | 0.0008 | 0.0000 | 0.0008 | 0.0000  | 0.0001  |
| 7  | Chili Pepper | 119.44| 69.28 | 1.1148| 0.0820 | 0.0207 | 0.0000 | 0.0425 | 0.0029  | 0.0758  |
| 8  | Celery       | 86.97 | 43.48 | 1.6725 | 0.0334 | 0.0167 | 0.0000 | 0.0027 | 0.0017  | 0.0003  |
| 9  | Spinach      | 52.27 | 97.08 | 12.3961| 0.2614 | 0.0448 | 0.0000 | 0.0000 | 0.1712  | 0.0071  |
| 10 | Cabbage      | 114.86| 54.41 | 2.7808 | 0.0302 | 0.0181 | 0.0000 | 0.0028 | 0.0020  | 0.0003  |
| 11 | Chayote      | 170.95| 136.76| 11.7956| 0.3163 | 0.0171 | 0.0000 | 0.0897 | 0.1453  | 0.0135  |
| 12 | Red spinach  | 164.29| 164.29| 38.8311| 0.5227 | 0.0597 | 0.0000 | 0.5470 | 0.0388  | 0.0472  |
| 13 | Red Chili    | 25.70 | 14.90 | 0.2398 | 0.0176 | 0.0045 | 0.0000 | 0.0091 | 0.0006  | 0.0163  |
| 14 | Cauliflower  | 50.67 | 24.00 | 1.2268 | 0.0133 | 0.0080 | 0.0000 | 0.0013 | 0.0009  | 0.0001  |
| 15 | Leek         | 89.61 | 34.14 | 2.5603 | 0.0981 | 0.0128 | 0.0000 | 0.0093 | 0.0041  | 0.0009  |
| 16 | Broccoli     | 41.25 | 15.65 | 0.3983 | 0.0142 | 0.0071 | 0.0000 | 0.0013 | 0.0106  | 0.0001  |
| 17 | Cucumber     | 73.18 | 73.18 | 7.0742 | 0.1952 | 0.0488 | 0.0000 | 0.0127 | 0.0639  | 0.0037  |
| 18 | Mint leaves  | 1.53  | 0.00  | 0.5404 | 0.0082 | 0.0010 | 0.0000 | 0.0000 | 0.0000  | 0.0000  |
| 19 | Bean         | 25.74 | 6.77  | 1.3682 | 0.0095 | 0.0054 | 0.0000 | 0.0095 | 0.0075  | 0.0011  |
| 20 | Basil Leaf   | 0.98  | 0.00  | 0.3461 | 0.0052 | 0.0007 | 0.0000 | 0.0000 | 0.0000  | 0.0000  |
| 21 | Long Beans   | 34.14 | 4.27  | 1.7389 | 0.0736 | 0.0043 | 0.0000 | 0.0015 | 0.0000  | 0.0001  |
| 22 | Shallot      | 14.03 | 2.89  | 0.1898 | 0.0017 | 0.0014 | 0.0000 | 0.0000 | 0.0000  | 0.0000  |
| No | Vegetables       | THIA [Kg] | RIBF [Kg] | NIA [Kg] | VIT B6 [Kg] | FOLATE [Kg] | VIT B12 [Kg] | VIT C [Kg] | VIT D [Kg] |
|----|-----------------|-----------|-----------|----------|-------------|-------------|--------------|------------|------------|
| 1  | Water Spinach   | 0.0133    | 0.0686    | 0.3812   | 0.0183      | 0.0109      | 0.0000       | 3.2402     | 0.0000     |
| 2  | Mustard         | 0.0245    | 0.0463    | 0.1363   | 0.0491      | 0.0000      | 0.0000       | 27.8076    | 0.0000     |
| 3  | lettuce         | 0.0189    | 0.0272    | 0.1466   | 0.0270      | 0.0000      | 0.0000       | 11.7307    | 0.0000     |
| 4  | Tomato          | 0.0057    | 0.0057    | 0.0377   | 0.0075      | 0.0014      | 0.0000       | 3.2027     | 0.0000     |
| 5  | Pak choy        | 0.0025    | 0.0030    | 0.0127   | 0.0047      | 0.0008      | 0.0000       | 2.1225     | 0.0000     |
| 6  | Eggplant        | 0.0056    | 0.0053    | 0.0930   | 0.0120      | 0.0032      | 0.0000       | 0.3153     | 0.0000     |
| 7  | Chili Pepper    | 0.0057    | 0.0068    | 0.0991   | 0.0403      | 0.0018      | 0.0000       | 11.4428    | 0.0000     |
| 8  | Celery          | 0.0010    | 0.0030    | 0.0167   | 0.0025      | 0.0000      | 0.0000       | 0.3679     | 0.0000     |
| 9  | Spinach         | 0.0030    | 0.0075    | 0.0747   | 0.0403      | 0.0078      | 0.0000       | 3.0617     | 0.0000     |
| 10 | Cabbage         | 0.0036    | 0.0042    | 0.0181   | 0.0066      | 0.0012      | 0.0000       | 3.0226     | 0.0000     |
| 11 | Chayote         | 0.0120    | 0.0051    | 0.0342   | 0.0094      | 0.0062      | 0.0000       | 3.0771     | 0.0000     |
| 12 | Red spinach     | 0.0149    | 0.0075    | 0.0775   | 0.0403      | 0.0078      | 0.0000       | 4.6299     | 0.0000     |
| 13 | Red Chili       | 0.0012    | 0.0015    | 0.0213   | 0.0087      | 0.0004      | 0.0000       | 2.4616     | 0.0000     |
| 14 | Cauliflower     | 0.0016    | 0.0019    | 0.0080   | 0.0029      | 0.0005      | 0.0000       | 1.3335     | 0.0000     |
| 15 | Leek            | 0.0043    | 0.0043    | 0.0085   | 0.0021      | 0.0017      | 0.0000       | 0.4694     | 0.0000     |
| 16 | Broccoli        | 0.0007    | 0.0026    | 0.0242   | 0.0027      | 0.0009      | 0.0000       | 1.8349     | 0.0000     |
| 17 | Cucumber        | 0.0024    | 0.0122    | 0.0732   | 0.0098      | 0.0000      | 0.0000       | 0.1708     | 0.0000     |
| 18 | Mint leaves     | 0.0005    | 0.0005    | 0.0025   | 0.0015      | 0.0003      | 0.0000       | 0.0867     | 0.0000     |
| 19 | Bean            | 0.0007    | 0.0054    | 0.0379   | 0.0008      | 0.0004      | 0.0000       | 0.1490     | 0.0000     |
| 20 | Basil Leaf      | 0.0003    | 0.0003    | 0.0016   | 0.0010      | 0.0002      | 0.0000       | 0.0555     | 0.0000     |
| 21 | Long Beans      | 0.0061    | 0.0022    | 0.0896   | 0.0006      | 0.0004      | 0.0000       | 0.0213     | 0.0000     |
| 22 | Shallot         | 0.0004    | 0.0002    | 0.0010   | 0.0010      | 0.0002      | 0.0000       | 0.0611     | 0.0000     |

**Note:**
PROTCNT (Protein); FAT (FAT); CHOAVLDF (Carbohydrate); FIBTG (Fiber); CA (Calcium); FE (Iron); ZN (Zinc); VA_RAE (Vitamin A); THIA (Vitamin B1); RIBF (Vitamin B2); NIA (Niacin eq.); VIT_B6 (Vitamin B6); FOLATE (Folic acid); VIT_B12 (Vitamin B12); VIT_C (Vitamin C); VIT_D (Vitamin D)
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