Urban farmer communities empowerment through the climate village program in Sleman, Yogyakarta

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Abstract. The conversion of agricultural land for residential and commercial use is a severe problem faced by the Sleman District Government. As an urban area where the need for farm products is getting higher, Sleman, on the contrary, is suffering from the availability of agricultural land. Utilization of homestead land optimally is one way to maintain foodstuffs' availability in downsizing groundwater resources due to climate change and green land conversion. This study explains urban farmer community empowerment through the Climate Village Education in Pendowoharjo Village, Sleman. The empowerment was done under the triple helix model framework, consisting of Janabadra University, village government, the village-owned company called Bumdes Amarta, and an urban farmer community, namely the Tanjung Lestari Women Farmers Group. Activities in the climate village program are the design of rainwater harvesting equipment called IPAH (Rainwater Harvesting Installation), infiltration wells and dead-end channels called rorak, training, and mentoring to use IPAH as well as training in viticulture and hydroponic systems, and optimization of households waste management system, the core business of Bumdes. Indicators of the success and sustainability of the climate village program are the increased number of IPAH facilities, infiltration wells, and rorak; the increased number of residents harvesting and utilizing rainwater, the increased number of female farmer group members who actively use their yards for vegetable cultivation with viticulture and hydroponic system, as well as the increased income of Bumdes from household waste management business.

1. Introduction
Climate change has developed into a global problem. If the planet does not commit to taking drastic action to rebuild its relationship with nature, climate change could become a recipe for disaster for the world's population. According to the Intergovernmental Panel on Climate Change (IPCC), the global surface temperature has increased by 1.35°C and is projected to grow by 1.5-2°C within the next 30 years. The rising temperature of the planet raises the likelihood of climate-related hazards such as flooding, landslides, extreme weather, crop shortages, habitat loss, increased sea level, and deterioration...
of human health standards. Indonesia, whose area consists of islands, is vulnerable to the direct consequences of climate change, which have primarily manifested themselves in the form of hydrometeorological disasters [1].

To address climate change, Indonesia developed the Climate Village Program (ProKlim) in 2012, focusing on community empowerment to implement local efforts to enhance resistance to the impact of climate change and reduce carbon emissions [2, 3]. The Ministry of the Environment and Forestry (KLHK) created this initiative. The Climate Village Program is a national-scale initiative directed by the Ministry of Environment and Forestry to increase community and stakeholder engagement to strengthen adaptive capacity to the effects of climate change, minimize greenhouse emissions, and recognize climate change adaptation and mitigation efforts that have been made to improve the welfare of society. The practical application of ProKlim is governed by Minister of Environment and Forestry Regulation No. 84 of 2016 on The Climate Village Program, which contains the program's major components, terms of the proposal, evaluation, and program category. Additionally, the Ministerial Agreement states that ProKlim should be established and enforced at the lowest administrative level, at RW or Hamlet, and the highest organizational level, at Kelurahan or Village.

Located at the Sleman District, specifically at the foot of Mount Merapi, Pendowoharjo is a village with abundant natural resource potential. Most of the livelihoods are traditional farmers that plant Salak. Pandowoharjo has its environment to adapt climate change in generating revenue for the village. Pendowoharjo is a classic urban area problem. The village consists of 17 hamlets, which keep society’s social spirit as shown by working together in various village activities. As men are the breadwinner who focuses on their main farming activities, there exist women group farmers, namely Tanjung Lestari, who concern household farming for family food security.

As stated earlier, the conversion of agricultural land to non-agricultural land is a classic problem in every urban area, impacting agricultural production [4, 5]. Therefore, the optimal use of yardland may become a solution for the demand for agricultural products, especially for food security in a family. Planting various types of suitable plants can meet family food availability, reducing expenses [6]. There is a positive relationship between variations in yards and food security; the higher the variation in the use of yards, the higher the level of family food security. Some constraints on the use of yardland are that plant cultivation must pay attention to how watering is carried out. Aquaculture must pay attention to water availability and several other obstacles, namely season, pests/diseases, and technical management skills [7].

Pandowoharjo has its village-owned business company named Bumdes Amarta. The Bumdes main business is household waste management that consists of sorting solid waste and selling valuable and recyclable waste, and producing fertilizer/compost from household waste. The village business unit reflects the village's environmental awareness to adapt to climate change in generating revenue for the village. Bumdes faces several problems in managing its business. First, the huge volume of residue (unsold waste) due to the limited number of sorter causes more expense to be paid to Environment Agency called DLH. Bumdes has to pay retribution to the DLH to dispatch residue from the Amarta’s sorting point to the Piyungan final disposal site called TPA. Every week, an average of 1-time dispatching of residual disposal by DLH garbage trucks. The more residue, the more frequent the dispatching, and the greater the cost of retribution. Second, the number of field technical personnel is limited, unable to sort and process waste into compost optimally. Time-consuming to pick the recyclable waste from compost ingredients are high. Recyclable waste such as plastic bottles, paper boxes, and paper must be sorted according to color and pressed with foot manually in a wood presser as part of valuable packaging waste before selling. The packaging itself needs spaces to dispatch.

This article aims to explain urban farmer community empowerment through the Climate Village Education in Pendowoharjo, Sleman. The commission was done under the triple helix model framework, consisting of government, academics, and critical communities. Therefore the empowerment program consists of Janabadora University, village government, Bumdes, and Farmers Group. This article provides detailed explanation activities to be done by academicians from the university to empower the
community to increase household income in an environmentally sustainable manner. The activities designed include socialization, providing prototype tools, training how to use the tools, and determining performance indicators of each activity. In other words, this paper discusses how environmental issues such as climate change can be mitigated (at the very least) by collaborative activities in the triple helix.

Some studies seek to report empowering activities under the triple helix model. The empowered community is varies ranging from the coconut farmers community in Kulon Progo [8], a dryland farm community in Gunung Kidul [9], a cocoa farmer in Nias [10], the community around forest [11], and coffee farmer community in Semendo highland [12]. This article contributes to the existing literature by discussing women farmer groups’ empowerment and optimization of Bumdes in the village climate program or ProKlim.

As stated earlier, there are three parties involves in the triple helix model [13]. The academics and the empowered community have been elaborated on above. In this study, the government in the triple helix refers to the village apparatus that actively support the empowered community, and The Ministry of Research Technology and Higher Education provides funding. As illustrated in Figur 1, the empowerment programs were financed through a community service financial scheme, namely Village Partner Development Program (VPDP).

![Figure 1. The research framework of the study](image-url)
2. Methods
The primary objective of this study is to examine ProKlim's application from the standpoints of group empowerment and sustainability. Accordingly, a qualitative research approach was selected for this study to analyze the activities taken by the university’s personnel. The qualitative approach was determined to be sufficient for the study, which investigates "what is happening" in particular situations involving resilience and empowerment in urban/rural development. Additionally, the qualitative analysis allowed the clarification of "what was incorrect or inappropriate" and the definition of "what should the involved parties do" in response to the process phase [14]. Additionally, this relational approach is accurate when examining phenomenology studies involving individuals, organizations, and communities, such as ProKlim.

The author has undertaken an in-depth interview and assessment at both study locations to gather information on ProKlim practices, group participation, restricting causes, and performance. Besides the primary data, this research also collects information from secondary data derived from a literature-based approach. The library-based data deems necessary to confirm the results of the field study.

3. Result and discussion

3.1. Stages in community empowerment through ProKlim education
This empowerment program is carried out in three stages: socialization, training, and implementation [6]. The first stage is introducing the program to partners and target groups. This activity was carried out at the village level, together with all village and hamlet or padukuhan officials, and held at the Pandowoharjo Village Meeting Hall.

The second stage, training, is carried out by placing participants as educational subjects while the tutor acts as a facilitator. Those who actively learn are the participants, so in practice, theoretical material is only given as an introduction, followed by suitable material, discussion, and brainstorming. At this stage, introduced to target groups about the rainwater harvesting system for yards with vertical garden and hydroponic farming systems for vegetable crops.

This activity is a form of education by providing knowledge and skills to the target group on rainwater harvesting techniques and cultivating vegetables using vertical gardens and hydroponic systems. Activities started from the manufacture of IPAH installations, wells, infiltration channels, vertical and hydroponic media cultivation. Then proceed with hydroponic plant seeding, selecting plant types, preparing for planting, providing nutrients to plants and automatic nutrient watering, making organic nutrients, controlling pests and diseases, plant maintenance techniques, and liquid fertilizer nutrients.

The third stage is implementation, utilization of the yard with the vertical vegetable garden, and hydroponics starts from seed sowing, media preparation, planting, to plant maintenance. The performance of vertical garden and hydroponic agricultural model activities was carried out by means of a demonstration plot system. The hydroponic model applied is adjusted to the availability of materials and conditions of the house yard. At the same time, the selection of the types of vegetables to be planted is discussed in groups so that in group, various types of vegetables are cultivated. After practicing vertical garden and hydroponic plant cultivation, the program implementation team continues to provide guidance and assistance. For the next stage, the group will do independently by sharing knowledge and skills with other members.

Program implementation is pursued through three main strategies, namely: first, fostering target audiences with assistance as an effort to increase public awareness so that before, during, and after the implementation of the program, residents can independently manage and care for the Rainwater Harvesting Installation, infiltration and dead ends (rorak). Second, pioneering partnerships by establishing cooperative relationships with all related parties, such as the DLH, Rainwater, and River Harvesting Communities. Third, monitoring and evaluation based on program success indicators. Summarizes the activity of the empowerment and the achieved indicators for that three main strategies as shown in Table 1.
Similarly, in the context of Bumdes the socialization was carried out concerning the time length of the business process in sorting the solid waste and the financial consequences of the long sorting time to the volume of waste to be paid to DLH in dispatching to TPA. In this stage, the need for a pressing machine to reduce garbage packing volume is also informed. In the second stage, the training on how to utilize pressing machines was performed on the staff of the Bumdes. The third stage is the implementation of pressing machine usage in the business process of Bumdes in household waste management, as shown in Table 1.

**Table 1. The achievement of community empowerment program.**

| Activity                        | Indicators                                                                 | Result                                                                                                                                       |
|---------------------------------|-----------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------|
| Rainwater harvesting program    | Technology transfer and mentoring: rainwater harvesting.                      | The number of active residents participating in training and mentoring activities is 45 people. The number of people who understand and have adaptation skills to climate change has increased by 30 people (66.66%). |
|                                 | Knowledgeable and the skill of participants on climate villages.             | The number of IPAH facilities, infiltration wells, and *rorak* increased by 27 units from the previous 15 units (80%). The number of people who understand and have adaptation skills to climate change has increased by 30 people (66.66%). |
|                                 | The increase in rainwater harvesting facilities.                            | 25 residents who harvest and utilize rainwater (55.5%).                                                                                     |
| Yard land management assistance program (the empowerment of Farmer Group) | Training and assistance in managing yard land with vertical garden and hydroponics.                                                      | 46 people attended training and mentoring.                                                                                                    |
|                                 | Vertical garden and hydroponic knowledge and skills of participants.         | 32 people (69.56%) members know/skills of vertical garden and hydroponics.                                                                    |
|                                 | Active member.                                                              | 32 persons.                                                                                                                                   |
|                                 | Types of products.                                                          | 25 types of vegetable crops.                                                                                                                  |
|                                 | Number of products.                                                         | 250 kg of vegetable/person.                                                                                                                  |
|                                 | Total asset.                                                                | IDR 40 million.                                                                                                                                |
| Bumdes empowerment              | Number of pressing machine.                                                 | 1 unit.                                                                                                                                       |
|                                 | Number of an employee who can operate the pressing machine.                 | Four-person.                                                                                                                                   |
|                                 | The ratio of pressing plastic waste packaging.                              | 1:8.                                                                                                                                          |
|                                 | The ratio of pressing paper waste packaging.                                | 1:5.                                                                                                                                          |
|                                 | Increased revenue from the time-efficient.                                  | IDR 1.5 million per month.                                                                                                                    |

**3.2. Rainwater harvest installation.**  
As illustrated in Figure 2, the principle in utilizing rainwater is that water is saved in the rainy season to be harvested in the dry season. This installation is distributed to a place that is easily accessible to the
community to be used freely, such as washing hands, washing feet, and a form of education for the district to harvest and utilize rainwater.

![Rainwater Harvest Installation](image)

**Figure 2.** Rainwater Harvest Installation modified [15]

![Infiltration Wells](image)

Source: [16]

(a)  (b)

**Figure 3.** The principle of how infiltration wells work

As illustrated in Figure 3, the basic principle of infiltration wells is to channel and accommodate rainfall to aim that rainwater has a longer residence time on the ground surface so that little by little water can seep into the ground. [16]. One of the water conservation engineering techniques other than IPAH is in the form of a building made in such a way that it resembles a dug well with a depth of 3-4 meters which functions as a place to collect rainwater that falls on the roof of a house or a watertight area and seeps it into the ground [17].

Determination of the location and design of infiltration wells refers to SNI No. 03-2453-2002 concerning Planning Procedures for Rainwater Infiltration Wells for Yardlands [18].

A dead-end channel is a channel that is made to absorb water through trenches in which shallow wells hold water. The construction of channel channels is based on the consideration that if only individual infiltration wells are built in several residents' houses, it will not effectively reduce runoff in all *padukuhan* or village areas as shown in Figure 4.
3.3. Utilization of yardland

Through this empowerment program, a hydroponic installation design was carried out using a solar panel energy system with a power of 150W capable of driving three pumps, each with a capacity of 12VA. Training activities are carried out through demonstrations and hands-on practice preparing seeds and nutrition. To ensure the sustainability of the hydroponic installation management by the Women's Farmer Group, periodic assistance is provided, as shown in Figure 5.

Some of the advantages of developing hydroponic technology, especially in organic vegetables, are as follows; (a) the cleanliness of plants for growth and production is more guaranteed; (b) more practical in its treatment and more controlled pest disturbance; (c) more efficient and efficient use of fertilizers; (d) it is easier to replace dead plants with new plants; (e) does not require a lot of labor; (f) plants can grow faster and cleaner; (g) higher, and continuous vegetable production; (h) the selling price of hydroponic vegetables is higher; (i) several types of plants can be cultivated outside the season; (j) hydroponic plants can be done on limited land or space. While the weaknesses are as follows; (a) requires an expensive upfront investment; (b) requires special skills, especially when making nutritional ingredients; (c) availability and maintenance of hydroponics are complex [19].

The hydroponic method practiced is the NFT (Nutrient Film Technique) method, a hydroponic cultivation method by placing plant roots in a shallow layer of water. The water is circulated and contains nutrients according to the needs of the plants. Nutrition for hydroponic cultivation must contain essential nutrients, namely in the form of macro and microelements. Macro elements consist of C, H, O, N, S, P, K, Ca, Mg. Meanwhile, the microelements are Fe, Mn, Zn, Cu, Co, B, Mo, Cl [20].
3.4. Waste pressing machine

Garbage packaging pressing machines do community empowerment in Bumdes. Paper waste is sorted and collected according to its type and then tied manually using a press in a wooden mold with a trampling system. It is not relatively compressible because it only uses human leg power. Through this program, a press machine has been procured to help workers press mechanically. The results of using the press machine at Bumdes is that the device can press the used material from mineral water bottles from previously packed in 8 sacks to become one sack concise, and for paper waste materials from previously five bundles can be pressed into one bunch.

4. Conclusion

This study aims to explain the empowerment of urban farming communities through Climate Village Education. The empowerment was done with two partners, namely Tanjung Lestari women’s farmer group and village-owned company Bumdes Amarta in Pendowoharjo Village, Sleman. Rainwater harvesting facilities in IPAH, infiltration wells, and dead-end canals (rorak) are the primary means of public education about harvesting and using rainwater for vegetable cultivation in the yard.

Women’s farmer groups understand the principle of adaptation to climate change by implementing environmentally friendly vertical garden and hydroponic vegetable cultivation systems. The optimization of yardland using hydroponic vertical not only serve for family food security but also increases household income. The income generates from the abundance of vegetable production.

Meanwhile, the efficiency of waste management by Bumdes using a manual press machine can reduce residues in landfills. The utilization of the machine may increase the revenue of the village-owned company.

Reference

[1] Faedlulloh D, Prasetyanti R and Irawan B 2019 Kampung versus Climate Change: The Dynamics of Community Empowerment through the Climate Village Program (ProKlim) J. Phys.: Conf. Ser. 1424 012055

[2] Ahmed Z, Guha G S, Shew A M and Alam G M M 2021 Climate change risk perceptions and agricultural adaptation strategies in vulnerable riverine char islands of Bangladesh Land use policy 103 105295

[3] Mahmood N, Arshad M, Mehmood Y, Faisal Shahzad M and Kächele H 2021 Farmers’ perceptions and role of institutional arrangements in climate change adaptation: Insights from rainfed Pakistan Clim. Risk Manag. 32 100288

[4] Sun Q, Qi W and Yu X 2021 Impacts of land use change on ecosystem services in the intensive agricultural area of North China based on Multi-scenario analysis Alexandria Eng. J. 60 1703–16

[5] Domingo D, Palka G and Hersperger A M 2021 Effect of zoning plans on urban land-use change: A multi-scenario simulation for supporting sustainable urban growth Sustain. Cities Soc. 69 102833

[6] Yasin S M and Kasim N N 2018 Pemanfaatan pekarangan menjadi kebun sayur produktif di daerah pesisir Di Kecamatan Wara Timur To Maega J. Pengabdi. Masy. 1 1-7

[7] Kuswati 2016 Pemanfaatan Pekarangan Dalam Upaya Ketahanan Pangan Warga Desa Karang Gondang Kecamatan Karanganyar Kabupaten Pekalongan (Yogyakarta: Program Studi Pendidikan Geografi Universitas Negeri)

[8] Mulyono A, Ismanto and Ika S R 2021 Empowering Coconut Farmer Community for Poverty Alleviation in Kulon Progo, Yogyakarta: A Study of Triple Helix Model Proc. 3rd Int. Conf. Banking, Accounting, Manag. Econ. (ICOBAME 2020) 169 96–100

[9] Antriyandarti E, Fajarningsih R U, Agustono, Darsono, Marwanti S, Supardi S, Sutrisno J, Ferichani M, Barokah U, Rahayu W, Ani S W and Khairiyakh R 2018 Poverty alleviation system of dryland farm community in karst mountains Gunungkidul, Indonesia IOP Conf. Ser. Earth Environ. Sci. 200 012062
[10] Sianipar C P M and Widaretna K 2012 NGO as Triple-Helix Axis: Some Lessons from Nias Community Empowerment on Cocoa Production *Procedia - Soc. Behav. Sci.* **52** 197–206

[11] Santika T, Wilson K A, Budiharta S et al 2019 Heterogeneous impacts of community forestry on forest conservation and poverty alleviation: Evidence from Indonesia *People Nat.* **1** 204–19

[12] Bray J and Neilson J 2018 Examining the interface of sustainability programmes and livelihoods in the Semendo highlands of Indonesia *Asia Pac. Viewp.* **59** 368–83

[13] Etzkowitz H 2008 *The Triple Helix: University–Industry–Government Innovation in Action* (London: Routledge)

[14] Alipour H, Vaziri R K and Ligay E 2011 Governance as catalyst to sustainable tourism development: evidence from North Cyprus. *J. Sustain. Dev.* **4** 32–49

[15] Maryono A 2020 *Memanen air hujan (Rainwater Harvesting)* (Yogyakarta: UGM Press)

[16] Kusnaedi 2011 *Sumur resapan untuk pemukiman perkotaan dan pedesaan* (Jakarta: Penebar Swadaya)

[17] Dwi T S M and R M B 2008 A study on artificial recharge well as a part of drainage system and water supply in UHTM [Online] Available: http://core.ac.uk/download/pdf/12007292.pdf.

[18] Badan Standar Nasional Indonesia 2002 Tata cara perencanaan sumur resapan air hujan untuk lahan pekarangan [Online] Available: https://123dok.com/document/qv97m1dy-perencanaan-teknik-sumur-resapan-hujan-untuk-lahan-pekarangan.html

[19] Roidah I S 2014 Pemanfaatan Lahan dengan menggunakan sistem hidroponik *Jurnal Universitas Tulungagung Bonorowo* **1** 43–50

[20] Himatan Faperta Unpad 2018 Nutrisi Organik untuk Hidroponik [Online] Available: http://himatan.ilmutah.unpad.ac.id/nutrisi-organik-untuk-hidroponik/

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