Legacy of ideas of the Javanese Community in the cultivation of medicinal plants in anticipation of climate change in Indonesia

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Abstract. Climate change is an unavoidable consequence of global warming, which is believed will have a broad impact on numerous aspects of life, especially for mountain communities. Changes in rainfall patterns, increased frequency of extreme climate events, along rising air temperatures and sea levels are some of the serious issues faced by the global community. Mountain communities have their local wisdom for dealing with climate change. The huge impact of climate change requires an active effort to anticipate the widespread effects using mitigation and adaptation strategies. This research investigates the legacy of ideas of the Javanese mountain community in anticipating climate change. The research method is qualitative and uses an explorative approach to examine how the legacy of ideas of the Javanese community, combined with local potential, is used as a strategy for anticipating climate change. The research results show that the cultivation of medicinal plants based on ancestral heritage is used as an anticipation strategy for dealing with uncertainties in climate and weather. Since ancient times, mountain communities have believed that the cultivation of medicinal plants in mountain regions offers an alternative source of subsistence if other food and vegetable crops fail to thrive. Medicinal plants are not only consumed by the local community but can also be sold since they are believed to have a relatively stable price and a clear consumer market. They can be consumed by all segments of the community, for stamina, to treat diseases, and also for beauty, and to promote domestic harmony.

1. Introduction
Communities with their own local wisdom have existed in human civilization since ancient times. This wisdom is the positive behaviour shown by human beings in their interaction with nature and the surrounding environment and may be sourced from religious values, customs, the advice of ancestors, or the local culture that has developed naturally within a community, enabling them to adapt to the environment around them [1]. Climate change is an unavoidable, some of the effects of climate change that are already apparent are: (a) a rise in air temperature in all regions of Indonesia, albeit at a slower rate than in subtropical regions; (b) a decrease in rainfall in southern parts of Indonesia and an increase
in rainfall in northern parts of the country [2]. The climate change taking place at the present time is in fact a natural phenomenon that has already displayed a very high level of extremity and is causing increasingly adverse social and economic effects [3].

Boer and Kolopaking [4] state that adaptation to climate change is a form of planned adaptation. This adaptation can be carried out as a response to the effects of climate change, in particular the unpredictable climate variations that impact life systems, including natural aspects, such as food sources, ecosystem, health, as well as the human aspect. The understanding that agriculture in mountain regions is less stable than agriculture in lowland regions, according to Yuliati [5], and the ongoing ecological damage in highland areas, according to Hefner [6], have served as triggers for the vulnerability of farmers in mountain regions. This vulnerability is made worse by the climate variations taking place. Vulnerability to climate change, according to the definition of IPCC [7] is the degree to which a system cannot survive because of the effects of climate change, including extreme climatic events and climate variations. This vulnerability to climate change is influenced by adaptive capacity, sensitivity, and exposure to climate change.

The legacy of ideas of the Javanese community includes utilizing efficacious plants as the basic ingredients for herbal medicine, which is not only beneficial for maintaining good health but also for curing various illnesses and diseases. Traditional medicine and medicinal plants are used widely by the middle and lower segments of the community, in particular for preventative, promotive, and rehabilitative purposes. In the past, some researchers have said that the general view of various ethnic communities in rural areas of Indonesia, and even in the whole of Southeast Asia, is that the cause of illness is not only explained by rational medical reasoning, namely the influence of natural elements or factors, but is also related to the belief system of the community, or mystical influences [8–11].

In addition, the cultivation of medicinal plants by farmers on the slopes of Mount Lawu is also used as an anticipation strategy for dealing with climate change. The knowledge of the local people about medicinal plants is usually acquired orally, passed down from one generation to the next. Therefore, a decline in the use of the local language and a lack of interest among the young generation in learning about local knowledge from their elders, accompanied by the fact that many members of the older generation die without passing on their own local knowledge to the younger generation, can lead to an erosion in local knowledge [10,12].

This research about the importance of local wisdom in anticipating climate change is approached using the habitus theory. Habitus is defined as the mental or cognitive structure the actor uses to deal with social life [13]. Habitus consists of thoughts, beliefs, interests, and understanding of the surrounding world, created from knowledge passed on through family, culture, and education [14]. Bourdieu considers social reality to be a typology of space, containing various kinds of the arena - for politics, art, culture, education, economy, religion, and so on. Local knowledge, or local wisdom, plays a role in anticipating climate change. According to Juhadi et al. [15], local wisdom can be defined as local ideas that are wise, have good value, and are embedded in and followed by members of a community. The local wisdom adhered to by a particular community has a positive impact on the way the community handles and responds to any disaster they may encounter. Traditional knowledge of indigenous culture can offer insight that is beneficial for management in response to global climate change [16].

Based on these facts, this research was conducted to explain and understand the steps taken in anticipation of climate change, as well as the adaptation and mitigation strategies implemented by farmers in mountain regions, based on the legacy of ideas of the Javanese community in the cultivation of medicinal plants on the mountain slopes, in anticipation of climate change.

2. Research method
This research is a qualitative study supported by quantitative data, based on a paradigm of constructivism [17]. The qualitative approach chosen in connection with a constructivist paradigm relies on grounded research and phenomenology to view the researcher’s constructive interpretation of the meaning of the occurring phenomena and to explore the legacy of ideas of the Javanese community on the slopes of
Mount Lawu, combined with local potential as an anticipation strategy for dealing with climate change [17–18]. The researcher carried out an observation to investigate the local wisdom of mountain farmers, and this formed the primary data for explaining the problems faced in anticipating climate change. The research locations selected were Panekan District in Magetan Regency and Jatiyoso District in Karanganyar Regency, to obtain the necessary data and information, taking into consideration the fact that these areas still hold a wealth of local wisdom implemented in the cultivation of medicinal plants as a means for anticipating climate change.

The research uses two kinds of data, namely primary and secondary data. The primary data was acquired directly by the researcher from the respondents through interviews and through observation of the farmers who cultivated the medicinal plants (key informants) and the people who consumed the medicinal plants (regular informants). The secondary data was the data already available, obtained from various academic books, journals, mass media, and the internet, related to the problem addressed in the research. In order to obtain complete and accurate data from the informants, the steps taken by the researcher in the collection of data included observation, in-depth interviews, and focus group discussions [19–21]. The research used non-participant observation, in which the researcher simply observed, without becoming directly involved in the activities taking place [22]. The researcher carried out observation only at the time of collecting data about the problem addressed in the research. The researcher used the technique of non-participant observation to observe and witness first-hand the situation in the field in order to gain a broader picture of the problem being researched. The results of the observation were recorded in the form of field notes, to facilitate the researcher’s explanation of the data obtained from the results of the interviews. In the data collection, the tools used by the researcher included stationery and a camera for taking pictures related to the research. The research was conducted in March–April 2021. The data analysis followed the stages of analysis introduced by [23], in which the data analysis uses an interactive model and the data presentation is sequential and interactive. The data analysis included three related sub-processes, namely data reduction, data presentation, and verification.

3. Research results and discussion

3.1. Local wisdom of mountain farmers related to medicinal plants

Javanese culture asserts that everything present in this world is essentially part of a single unity of life, and human life is closely connected to the world of the cosmos. The macrocosm is related to spirituality and mystery while the microcosm is concerned with reality and physical existence. The purpose of life is to find and create harmony and balance between the life of the macrocosm and microcosm. In former times, the Javanese used myth as a medium for transferring local wisdom. Some examples of myths related to medicinal plants are: (1) the moringa plant (Moringa oleifera), which is believed to have the power to defeat ghosts or spirits, not excluding warriors with supernatural powers who usually acquired their strength with the help of such spirits; (2) the jasmine flower, the scent of which is believed to indicate the close presence of a supernatural being. The jasmine flower is also believed to have the ability to treat fever and headaches; (3) the sapodilla tree, also known as sawo becik (‘all good’). According to myth, planting a sapodilla tree in front of the house brings good fortune and favour to the person who plants it. The reason for this myth is due to the numerous health benefits of the sapodilla fruit, which include lowering cholesterol; (4) the tamarind tree, which is generally planted at the side of the road to give shade. The wood of the tamarind tree is believed by some people, especially the Javanese, to have magical powers and to bring good fortune. The black wood at the core of the tree is referred to as galih asam, and is thought to safeguard against evil spirits and black magic. This dark wood is usually sought after for use in making an “heirloom” such as the sheath of a dagger (keris) or a ceremonial baton. Heirlooms made from this dark core of a tamarind tree are believed to have magical powers that make them only suitable to be used by a leader with the heart of a “warrior priest” (satriya pandhita); (5) the flower of the white champaca, which is often associated with mystical matters, not least because of its powerful scent. In Javanese tradition, this flower, which is also known as magnolia,
is one of the flowers that must always be present in any Javanes ritual ceremony. Aside from its ritual use, the white champaca flower, which belongs to the Magnoliaceae family, is also frequently used as a traditional medicine for treating fever, yeast infections and irregular menstruation, cough, sore throat, bronchitis, and infection of the urinary tract.

3.2. Cultivation of medicinal plants in anticipation of climate change

Local farmers interpret climate change as a condition that presents a significant threat to their crop cultivation. According to farmers, there are a number of indicators of climate change: (1) more extreme rainfall during the rainy season; (2) long dry spells, affecting the farmland; (3) heavy rains and strong winds, usually from the south, blowing down trees and causing landslides; (4) extreme temperatures, usually in the months of July or August, causing young plants to wither and die; (5) conditions in which it is difficult to predict the beginning of the rainy season and the dry season; (6) in some cases, the rainy season continues almost all year long, causing many plants to rot from disease. Traditional communities regard plants or crops not only as a beneficial food source but also as a medium for removing or deterring negative forces that may cause disease.

| Table 1. Types, characteristics, and roles of medicinal plants in anticipating climate change. |
|---|---|---|---|
| **Type of Medicinal Plant** | **Characteristics and Role in Adaptation to Climate Change** | **Part Used** | **Use** |
| Ginger | Grown in the place of staple crops because of their high economic value. Can be planted in yards, in rainfed land, also grows well in the shade, and can survive all year round. | Tuber | Used to treat nausea and vomiting, stomach ache, vertigo, menstrual pain, and joint pain. Prevents the growth of cancer cells in the colon and can assist with weight loss. |
| Turmeric | Can be planted in yards, rainfed land (can survive in conditions where there is an inadequate water supply), and also grows well in the shade (in between annual crops). | Tuber | Used to treat indigestion, liver problems, skin conditions, heart disease and stroke. Prevents colon cancer, promotes healthy nerve function, kills viruses, and lowers blood pressure. |
| Moringa | Believed to deter evil spirits. Can survive on sandy soil, withstand the sun’s heat, and grows all year round. | Leaf | Lowers blood sugar |
| Noni (Morinda) | Grown as a cover crop to prevent landslides during the rainy season, thrives on unproductive land, grows well and produces fruit all year round. | Fruit | Prevents infection, prevents high blood pressure, cures inflammation of the stomach and heals ulcers of the small intestine. Contains anti-cancer properties and helps treat jaundice. |
| Skunkvine (Paederia foetida) | Used as mulch to maintain soil moisture during the dry season. | Leaf | Contains numerous antioxidants, believed to cure bloating. |
| Cat’s whiskers (Orthosiphon aristatus) | Used as mulch to maintain soil moisture during the dry season. | Leaf | Used to treat kidney disease, inflammation of the bladder, and gout. |
| Betel | Absorbs toxic gases around crops, absorbs the sun’s heat during the dry season to maintain cool surrounding air. | Leaf | Heals wounds, fights diabetes, lowers cholesterol, promotes oral health, contains antiseptic and anti-inflammatory properties, and cools the skin. |
| Lemon basil | Used to form a hedge around people’s homes, grows well in all seasons. | Leaf | Increases appetite and heals scratches to the skin. |
| Ground cherry (Physalis) | Survives all year round and thrives on unproductive land. | Fruit | Cures hepatitis, malaria, rheumatism, dermatitis, asthma, and even cancer. |
| Soursop | Grows well and bears fruit all year round, and produces large amounts of oxygen | Leaf | Kills toxins in the body, lowers cholesterol, used to treat gout and ovarian cysts. |
Fruit

Contains fiber that helps meet daily fiber requirements.

Tree sorrel
(Averrhoa bilimbi)
Grows well and bears fruit all year round, and can withstand extreme temperatures.

Fruit

Increases insulin production in the body.

Green chiretta
(Andrographis paniculata)
Grows well all year round and can withstand pests and disease.

Leaf

Boosts immunity, heals sinusitis infections and improves digestive health.

Curcuma
Grows well all year round, can withstand pests and disease, and extreme climate and weather.

Rhizome

Enhances kidney function, has anti-inflammatory properties, helps treat digestive problems, reduces joint inflammation, increases stamina, heals the common cold.

Lemongrass
Grows well all year round, can withstand pests and disease and extreme climate and weather.

Stem

Helps maintain healthy teeth, fights free radicals, detoxifies the body, increases red blood cells, assists with weight loss.

Aloe vera
Grows well all year round, can withstand pests and disease, absorbs toxic gases around crops and can survive in extreme climate and weather conditions.

Stem

Helps promote healthy hair, eliminates acne, used to treat heart attacks, diabetes, sore throats, constipation, and numerous other illnesses.

Data source: analysis of primary data through observation and interviews

The research results show that the cultivation of medicinal plants based on the legacy of Javanese ancestors is an anticipation strategy for dealing with uncertainties in climate and weather (Table 1). Since ancient times, the cultivation of medicinal plants and herbs in mountain areas has been viewed as an alternative strategy for anticipating climate change (Table 2). This is in line with Nyong et al. [24] and Yin et al. [25] that Incorporating indigenous knowledge can add value to the development of sustainable climate change mitigation and adaptation strategies that are rich in local content, and planned in conjunction with local people.

Table 2. Steps for anticipation of climate change in the Lawu Mountain Community.

| Category of Anticipation | Steps of Anticipation | Description of Anticipation |
|--------------------------|-----------------------|------------------------------|
| Anticipation related to plant cultivation | Replace cultivation of vegetables with the cultivation of medicinal plants | Grow medicinal plants that are relatively safe from pests and disease caused by climate change |
| | Use a multiple cropping system for vegetables and medicinal plants | Continue to plant vegetables but with the implementation of semi-modern cultivation techniques using mulch and sprinkler irrigation technology |
| Anticipation related to livelihood | Look on the mountain slopes for parts of plants/trees that can be used as materials for traditional medicine | Farmers who usually earn a living solely from farming their land also start looking for parts of plants or trees with medicinal properties that have high economic value |
| | Work as farmhands in other areas not affected by climate change | During certain seasons, farmers work as farmhands in lowland areas where they can continue their plant cultivation, because of the extreme climate change affecting their own area |
| Anticipation related to food consumption | Cut down on consumption of food purchased from outside the area | In certain seasons, there is widespread crop failure in mountain regions as a result of climate change, so people must buy staple foods from outside their own area |
| | Replace consumption of certain foods with local foods that are widely available | Carry out diversification of local foods in anticipation of crop failure |

Data source: Analysis of primary data through in-depth interviews
3.3. Adaptation and mitigation strategies of Lawu Mountain farmers to deal with climate change

Table 3. Adaptation strategies of Lawu Mountain community to deal with climate change.

| Production Activities | Climate Change | Effect of Climate Change | Local Adaptation Strategies | Implementation of Adaptation Strategies |
|-----------------------|----------------|-------------------------|----------------------------|----------------------------------------|
| Cultivation of Vegetables | Long rainy seasons and high levels of rainfall | Decrease in production of certain vegetable types: chilies, cauliflower, carrots, and green beans | Adaptation of farming and agribusiness systems, especially planting patterns, plant types and varieties, and tillage systems | Development of drainage systems and regulation of planting patterns. Development of multiple cropping and mixed cropping on a single area of land to reduce the risk of crop failure |
| | Irregular seasons: long dry seasons and high temperatures | Decrease in vegetable production | Adaptation and development of agricultural infrastructure | Development of water-saving vegetable cultivation and construction of check dams for long-term benefits |
| Cultivation of Medicinal Plants | Long rainy seasons and high levels of rainfall | Moisture level too high causing the onset of pests and disease, causing fruit to rot and a decrease in production | Reduction of trees that provide shade Increased pruning Construction of drainage channels Eradication of pests and disease using pesticides | Organization of optimal plant distance Maintenance of clean plantations Construction of drainage channels adapted to the conditions of the cocoa plantation Eradication of pests and disease using biological methods |
| | Irregular seasons: long dry seasons and high temperatures | Plants experience a water shortage causing a decrease in production | Cocoa farmers do not yet have adaptation strategies to overcome long dry periods | Development of agroforestry systems Implementation of multiple cropping patterns with other useful kinds of plants Plating of cultivars that can withstand drought |

Data source: Analysis of primary data through in-depth interviews

Table 4. Mitigation strategies of Lawu Mountain Community to deal with climate change.

| Production Activities | Climate Change | Effect of Climate Change | Local Mitigation Strategies | Implementation of Mitigation Strategies |
|-----------------------|----------------|-------------------------|----------------------------|----------------------------------------|
| Spatial division by the community | Long rainy seasons and high levels of rainfall Irregular seasons: long dry seasons and high temperatures | Changes in the area function | Application of cultivation technology such as planting of varieties, and land and water management with a lower level of greenhouse gas emission | Spatial division that refers to the interests of production and conservation in a proportional manner |
| Traditional conservation area | Long rainy seasons and high levels of rainfall. Irregular seasons: long dry seasons and high temperatures | Changes in function of the traditional conservation area | Preservation of the existence of customary government institutions | Recognition of communal rights over community land Recognition of local culture |

Data source: Analysis of primary data through in-depth interviews.
In the context of the households of farmers living on the slopes of Mount Lawu, efforts to adapt to climate change are made in a number of aspects, related to livelihood, food, and health. Adaptation (Table 3) in the aspect of livelihood is directed more towards farmers’ efforts to adapt their farming activities as well as shifting to other kinds of activities when they can no longer rely on farming. Adaptation in the aspect of food is related to efforts to meet their food needs, which tend to fluctuate, especially in the households of farmers with low assets, including farmhands. In the aspect of health, adaptation is related to conditions of sanitation, both in the household environment and the community. This is in line with Smit and Wandel [26], who write that at community level, greater exposure and sensitivity to climate change causes the community to experience a higher level of vulnerability, but if the adaptive capacity is good, this vulnerability can be reduced. The consequence of this is that a community has the ability to withstand the effects of climate change if its adaptive capacity is good (Table 4).

4. Conclusion
The climate change taking place on the slopes of Mount Lawu is a natural phenomenon that has displayed a very high level of extremity and is causing increasingly adverse social and economic effects. Mountain communities possess their own local wisdom for anticipating, adapting, and developing mitigation strategies in the face of climate change. The cultivation of medicinal plants based on the legacy of Javanese ancestors is an anticipation strategy for dealing with uncertainties in climate and weather. The myth was used by these ancestors as a medium for transferring local wisdom. The local wisdom that is a legacy of the ideas of Javanese ancestors is believed to offer an alternative for the local community to use in anticipation of climate change.

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