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Traditional Agroforestry Models Based on Local Knowledge in the Mount Mutis-Timau Highlands,Timor Island, Indonesia

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ABSTRACT

The adoption of local knowledge in land management is a fundamental aspect that determines the success of managing agroforestry systems to support food security and improve community welfare. This study aims to examine the application of local community knowledge in managing owned land using an agroforestry model. Data were collected through a series of systematic stages, including in-depth interviews with respondents who were heads of households and community leaders, direct observation of the land, and literature studies related to agroforestry patterns. A descriptive analysis using a qualitative approach was conducted to obtain important information regarding the actual conditions observed. The results show that the construction of local knowledge is determined using space by intervening with various plants on a plot of land. The crop planting intervention consisted of three models: intercropping, annual/plantation plants as a fence dividing the land, and forestry plants separated from agricultural/plantation plants. Farmers in Ajaobaki and Fatumnasi Villages choose seasonal crops (corn and beans) to meet food needs, plantation crops (*Aleurites moluccana* (L.) Willd, *Citrus reticulata*, *Persea americana*, *Artocarpus heterophyllus*, and *Mangifera indica*) to increase income and ecological functions, and forestry crops (*Casuarina junghuhniana*, *Eucalyptus urophylla*, *Tectona grandis* L.f, and *Gmelina arborea*), which provide both economic and ecological benefits. Planting a combination of plant types on land can indirectly anticipate climate change and, on the other hand, can improve community welfare and protect the environment in the area.

Introduction

Humans, as social beings, think about how to manage their lands. The ability to think produces various actions in the context of adaptation to fulfill life needs, conduct social interaction, and implement traditional dry land management techniques. Dryland areas have dry climates with low amounts of rain (2,000 mm/year) and main obstacles, such as limited water and low soil fertility [1]. Dryland, as a physical medium, has been a source of income for communities with limiting factors, such as water, which can be seen as the main challenge in managing such types of land. Water scarcity, as the limiting factor, has not been seen as an obstacle by the communities but as the main driving factor in managing the lands using traditional knowledge inherited from their ancestors. Dry land has been considered by the people of East Nusa Tenggara as physical capital, which is widely available and used as the main defense base in meeting life needs, especially the fulfillment of food needs. Dry land with various limiting factors has encouraged communities to manage land adapted to the characteristics of the land and climate, as found in the highlands of the Mutis Timau Mountains.

The Mutis Mountain area is 938 m above sea level, and the villages of Ajaobaki and Fatumnasi are among the villages around Mount Mutis. Ajaobaki Village is in the North Mollo District and has an area of 544 ha [2], and Fatumnasi in Fatumnasi District has an area of 3,497 ha [2]. Most of the area consists of dry-land farms. Dry

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land with hilly topography dominating the area has proven to provide hope to the community to maintain its existence and sustainability in its management. This requires the community to manage land with various considerations, especially climatic factors, so land management can be carried out intensively, effectively, and efficiently. Modal and resource limitations have encouraged the community to manage lands by introducing various types of seasonal and annual plants and animal feed on the same piece of land over the same period. The pattern used by the community is called agroforestry; although theoretically, it has just been introduced, it has been practiced by the community in the past [3], the integration of trees, agricultural plants, and animals into the agroforestry system can improve soil fertility, reduce erosion, improve water quality, improve biodiversity, improve aesthetics, and sequester carbon.

Agroforestry is an effort to optimize land use with various types of commodities for management and utilization in the community [4]. Agroforestry is increasingly recognized as an important agroecological practice that can balance the ability of farm families to meet their food and income needs with sustainable management and biodiversity conservation while contributing to climate change adaptation and mitigation [5]. Agroforestry is one of the latest developments in the forestry sector related to an integrated interdisciplinary scientific approach to sustainable land use and tree management on agricultural land for various purposes [6]. Agroforestry is an integrated approach to sustainable land use systems (traditional and modern), in which there are interactions between ecological and economic components (timber plantations or forests with seasonal or perennial tree crops, livestock, or fisheries inside or outside forest areas) [7]. Agroforestry is a system that suits the needs of communities in their land use systems [8], can increase the productivity of forestland [9], restore land quality [10], provide economic benefits to the local community [11,12], and promote food security [13]. Agroforestry helps village communities optimize land use through economic, ecological, and sociocultural functions [14]. Management practices are key to providing total ecosystem service quality [15].

To increase productivity, an agroforestry management model based on local knowledge construction in the highlands of Mount Mutis, which has a dry climate and limited land, has encouraged the community in this region to manage land with diverse types of plants without considering plant spacing. A community of farmers has a small area of land and plants of various plant species. The small area has pushed farmers to fulfill their various needs (food, firewood, carpentry, animal feed, and non-wood forest products) with an agroforestry model. Land management with traditional agroforestry requires knowledge of choosing the right types of plants and silvicultural treatments to obtain optimal results. Maintaining optimum light, water, and nutrition for various species is the key to a successful agroforestry system [16]. Local agroforestry is closely related to cropping patterns, spatial planning, plant biodiversity, and limited land productivity, which have implications for communities [4]. The community in the area manages their lands and farms by conducting specific dry land plant-planting interventions, without considering planting spacing.

However, the community has knowledge construction that states that the more plants planted, the more production and land protection from floods and erosion during the rainy season. Traditional or local knowledge is an epistemological system comprising close links between knowledge, place of residence, and spirituality [17]. The relationship between a community's knowledge, place of residence, and spirituality is a unity that forms the construction of the community's thinking in managing land, including the use of space in gardens (*lele*), by combining various types of plants. Therefore, the study of spatial use in agroforestry gardens (*lele*) from the perspective of local knowledge in Ajaobaki Village and Fatumnasi Village is important for the management of agroforestry systems in eco-geographical conditions with natural resource potential and identical land elsewhere. This research aims to determine local community knowledge regarding the utilization of owned garden spaces in dryland areas. The urgency of this research is to formulate dry land management policies using local knowledge, which has been proven effective in maintaining community food security.

Materials and Methods

Study Area

This research was conducted in the highlands of Mount Mutis, especially in the village of Ajaobaki, District of Mollo Utara and Fatumnasi Village, Distrik of Fatumnasi, and Regency of South Central Timor, from May to July 2021 (Figure 1). Ajaobaki Village and Fatumnasi Village are located in the Mutis Timau landscape at 938 meter above sea level (masl), with predominantly hilly topography. This location was chosen considering that the community owns all gardens and always combines various types of plants, such as crops, forestry plants, and forage plants, in the same lands.

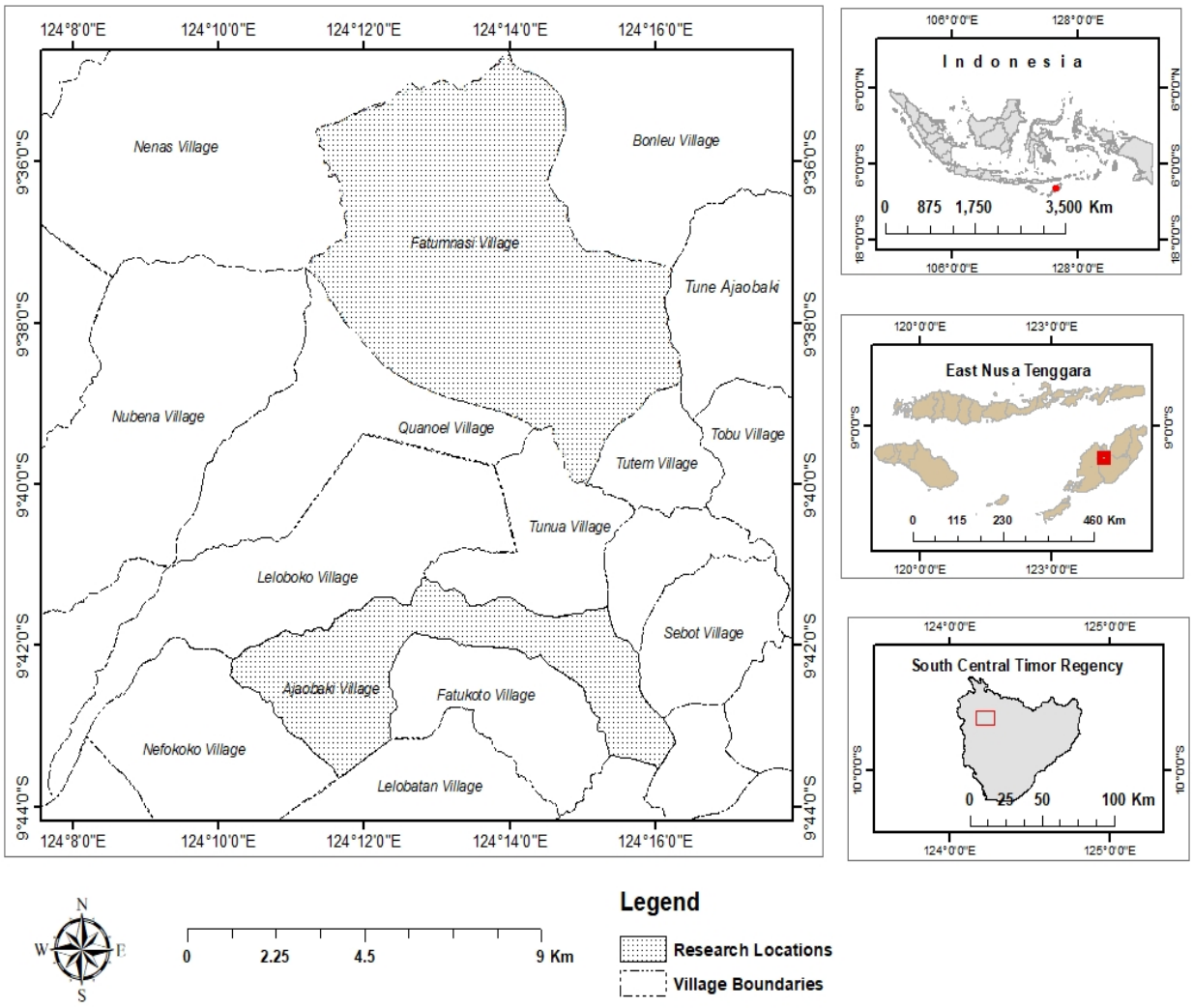

Figure 1. Research map.

Data Collection

This study was qualitative and used a descriptive approach. Descriptive research frequently involves analyzing and examining the state of natural objects, referred to as qualitative research. The primary features of this research method include the researcher's direct field participation, observational role, actor categorization, phenomenon observation, recording in an observation book, avoidance of variable manipulation, and emphasis on natural observation [18]. Respondents were selected purposefully (according to the research objectives) from communities that developed agroforestry models on their land. In this research, we chose 41 people from farmers who developed agroforestry models, community leaders, traditional leaders, village government leaders, and employees of the South-Central Timor Regency Forest Management Unit who lived and worked in Ajaobaki and Fatumnasi Villages. In detail, we selected elements from the community that developed agroforestry: 15 people in each village, five people representing community leaders, traditional leaders, village government figures from each village, and one employee of the forest management unit whose support area was in the two villages. The selection of respondents considered the community, traditional leaders, and government figures who knew, understood, and applied traditional agroforestry models on their land.

Interviews, observations, literature studies, and documentation were conducted to obtain the desired data. The strength of the interview is that it maximizes the interview process in a way that carefully studies the interests of actors, and it can help a researcher carry out more robust methods of researching human-environment relations [19]. Disclosing hidden interests in the interview process requires rigorous preparation and a careful approach. The interviews were conducted with selected respondents regarding their knowledge

of utilizing space in the garden, dynamics of land use, history of their gardens, and land use patterns. The interviews were conducted from morning to evening in homes or gardens when meeting the respondents. The timing of the interview from morning to evening was adjusted according to the availability of time and whereabouts of the respondents. In this study, most of the interviews were conducted from the afternoon until the evening because, in the morning, the people were usually in their gardens and returned to their houses in the afternoon. Sometimes, interviews were conducted in gardens if the respondents were willing to give their time to be interviewed in their gardens.

If the interviews were undertaken in gardens, observations were also conducted to understand the types of plant species planted (agricultural, plantation, forestry, and animal feed plants), planting patterns, and shape of the farm. In-depth interviews were conducted with key figures to obtain data on the history and dynamics of land management. Interviews were also conducted to verify and validate the information provided by the selected respondents. Interviews and observations were conducted to obtain primary data, while a literature study was conducted to obtain secondary data (supporting evidence). The literature study was intended to gather references related to gardens (traditional agroforestry) in journals, books, reports, village profiles, the District of Mollo Utara, the District of Fatumnasi in Number 2022, and the Regency of South Central Timor in Number 2022. Documentation regarding all stages of the research was also undertaken in the form of pictures taken from the fields, research journals, scientific media, internet, and other media to strengthen the literature reviews.

Data Analysis

Data analysis began by examining the results of interviews with respondents, observations, literature studies, and documentation. The activities in a qualitative research analysis are carried out interactively and continuously until completion, including data reduction, data presentation, and drawing of conclusions [20]. Data reduction emphasizes classifying data so that a conclusion can be drawn. Data reduction was conducted to make it easier for researchers to retrieve the data obtained when needed and to assist in assigning codes to certain aspects. Data presentation is a method of collecting data or information in an organized manner that makes it possible to draw conclusions and take action. While verification is intended to produce valid conclusions, reviewing a conclusion by re-verifying the notes taken during the research and looking for patterns, themes, models, relationships, and similarities is better. The results of the qualitative analysis are presented in a descriptive narrative manner.

Results and Discussion

Results

Characteristics of Respondents

Administratively, Ajaobaki Village is in the North Mollo District, with a population of 1,936 people (958 men, 978 women), an annual growth rate of 0.52%, a population density of 356 people per square kilometer, and a sex ratio of 98. There are 415 heads of household, most of whom work as farmers. On the other hand, Fatumnasi Village is located in Fatumnasi District. It has a population of 1,829 people (899 men and 930 women), a population density of 52 people per square kilometer, and a sex ratio 97. Most residents have an elementary school education and are very strict in managing agroforestry, which is traditionally on their land. Even though they have an elementary school education, residents who often attend counseling and are experienced in land management activities using the agroforestry model have quite a lot of knowledge about cropping patterns in the land and are very decisive in selecting species that provide economic and ecological value.

The number of respondents in this study was 41, consisting of 73.17% males and 26.13% females, with an age range of 30–74 years. The age class was classified from highest to lowest and then divided into 3 classes, namely three age classes: 30–45 years (34.15%), 46–61 years (41.46%), and > 61 years (24.39%). The level of education of the respondents varied, and in general, 63.41% of respondents had elementary school education, 14.63% had junior high school education, 9.76% had high school education, and 12.20% had tertiary education. Most respondents (56.09%) had more than six dependents, 43.90% had less than six dependents, and all were farmers. In general, all respondents manage their farming business by combining various crops, such as agriculture, plantations, forestry, and animal feed, in the same plot of land.

Land Use Dynamics

The Mollo people are known as people cultivate crops on dry land, raise livestock, and always combine various types of plants on their land, which are commonly called *lele* (traditional agroforestry gardens). Land is one of the main factors affecting dryland agricultural production, and the agricultural land managed by farmers remains limited by conventional management [21]. The Mollo people as a society have a triangular concept of life consisting of nature (*mansian*), humans (*muit*), and livestock (*nasi nabua*), which means that humans, forests, and livestock are inseparable units and have an interdependent relationship [22,23], this relationship works synergistically to encourage balanced use of natural resources. When one of these three components is neglected, the community considers management malpractices. This concept has always been embedded in the lives of Ajaobaki and Fatumnasi Village communities, including the management of the *lele*.

Lele (a traditional agroforestry model garden), the physical capital of the community in the highlands of the Mutis Timau Mountains, has historical value in meeting the community's basic needs. The basic needs of a community are essential to life and must be fulfilled to maintain human sustainability and existence. Humans, as social creatures who live in the space of life, need various other resources to build an ecosystem of life whose lives fulfill and need each other. To fulfill various needs in life, humans, as social beings, need land to carry out various expressions in the form of actions. Land, as an essential production factor, plays the role of physical capital that humans utilize with various technological inputs from the traditional knowledge possessed by the community, especially agricultural activities and practices combined with other crops [24]. Agricultural practices are defined as the implementation of locally available resources based on the knowledge and skills of farming households and the use of environmentally harmful inputs.

Knowledge as a source of human thinking is internalized in human actions to manage land with various crop planting interventions in the same plot at the same time. Early construction of knowledge in the community led to the idea that the same piece of land cannot be planted with just one plant type but with various types of plants. This knowledge does not appear as an independent variable but requires other variables that complement each other in the framework of producing various commodities on cultivated land. Other variables included the economic interests of the planted plants and sociocultural interests in the management and utilization of the results. This is inseparable from the subsistence culture adopted by the people on Timor Island in general and in the highlands of Mount Mutis Timau, especially in the villages of Ajaobaki and Fatumnasi. Subsistence culture is a culture in an agricultural system that focuses on cultivating sufficient food for self and family interests.

The subsistence culture that lives and develops in society has deep-rooted moral values and is closely related to how society maintains a balance between life with humans and nature [25]. Therefore, the existing values of subsistence culture must be considered and maintained seriously. Subsistence culture is a source of knowledge that grows and develops in people’s lives, particularly in traditional agroforestry land management. The community's knowledge construction has introduced agroforestry knowledge through practical actions, although it does not know the science of agroforestry. Agroforestry practices offer practical ways to apply specific knowledge and skills to the development of sustainable rural production systems [26]. Agroforestry is recognized as a land-use option, where trees provide environmental products and services.

Lele, a traditional agroforestry system developed by the community in Ajaobaki and Fatumnasi Villages, is planted with various plants, with no regard for plant spacing or competition between plants. Community knowledge affirms that planting various types of plants on one plot of land yields many results, regardless of the productivity of the crops planted. However, Isaac et al. [27] stated that smallholder farmers often develop adaptable agroforestry management techniques to increase and diversify crop production. The communities use land that applies intensive agroforestry practices with a diverse species composition and high tree density [16]. On the other hand, the intensity of villagers' efforts to manage the land is quite high, and they use wood, leaves, branches, and fruits from the applied agroforestry system. The people of Ajaobaki and Fatumnasi Villages have customary knowledge that can be internalized in land-use activities, and rural communities have a wealth of customary knowledge and incorporated trees into production systems on plantation land. Customary knowledge is created through the existence of customary institutions, and according to Pujiono et al. [28], this institution functions as an institution that maintains the sustainability of agroforestry lands through the application of customary laws. If you violate a ban on certain activities, you will be sanctioned customarily.

The people in Ajaobaki and Fatumnasi Villages believe that *lele* has direct benefits for those who have an interest in seasonal and annual crops and animal feed, as well as socio-economic benefits and protection that can be enjoyed on an ongoing basis. From *lele* (traditional agroforestry), the people can obtain agricultural

products, animal feed, firewood, and carpentry wood both for their use and for sale to increase the household economy, on the other hand, they can protect the land from erosion and landslides. Agroforestry is useful for protecting the environment and is generally related to ecosystem services, including enriching the soil [25], carbon sequestration, improving ecosystem service regulation and biodiversity [29], and increasing productivity and profitability [30,31]. The dynamics of land use in the traditional agroforestry model in Ajaobaki and Fatumnasi Villages can be explained historically with empirical land dynamics that have three models: 1) intercropping planting patterns between forestry plants and agricultural and animal feed crops regardless of spacing, 2) planting patterns using forestry plants as fences, and 3) planting patterns with clear separation between forestry and crops.

Land Use Model/Pattern

Land use dynamics in agroforestry gardens were developed from the previous slash-and-burn system for yield-oriented land management. Before becoming a garden with an agroforestry model, the land was initially plains and shrubs. Towards the end of the dry season, the community cuts down trees and shrubs and burns them when dry; during the rainy season, the community plants seasonal crops such as *Zea mays*, *Arachis hypogaea* L., *Manihot esculenta*, and *Cucurbita moschata*. Before planting, the community performed a traditional ritual to ask the God of the heavens and God of the earth to take care of the plants so that they would produce good results later and be protected from pests, diseases, and drought. After planting seasonal crops, the next step was for the community to introduce various types of annual crops (forestry and fruits such as *Casuarina junghuhniana*, *Eucalyptus urophylla*, *Tectona grandis* L.f, *Gmelina arborea*, *Swietenia macrophylla*, *Artocarpus heterophyllus*, *Mangifera indica*, *Citrus reticulata*, and *Persea americana*) to be planted on their land.

At the time of harvesting, the first crop is given to the church during weekly service as a thanksgiving offering to God (God of Heaven). When perennial plants were 3 to 5 years old, space utilization for annual crops decreased because most of the space in the garden was covered by the plant canopy. Such conditions require people to modify the garden space by pruning the annual plants. The community managed the pruning results to increase the diversification of animal feed, and some of it was left on the soil surface until it was weathered to add soil nutrients, which are very useful for plants. Community knowledge states that the presence of earthworms indicates that an area is fertile and suitable for agriculture. The presence of soil macrofauna, such as earthworms, facilitates the decomposition of organic matter and helps increase soil fertility [32]. The presence of soil litter and decomposed organic matter can provide nutrients that can increase soil fertility.

Annual crops are the beginning or forerunners of the plants grown in gardens (traditional agroforestry). This process continued throughout the year with the same pattern. The tradition of clearing garden land by slashing and burning continues today, and the community manages the land by hoeing it to turn over the soil. The community has the traditional knowledge that when plowing soil, the remaining ash and topsoil are buried in the ground. This will bring fertility back to the planted plants because all the organic matter on the soil surface will be buried, and the decomposition process will occur by bacteria and microbes in the soil. Scientific knowledge related to slash-and-burn indicates that these activities can kill microorganisms and soil decomposers that help soil fertility. The application of local wisdom in agricultural practices through slashing and burning could threaten the survival of local microorganisms and soil decomposers, which are beneficial to soil fertility [33]. However, the "slash-and-burn" culture persists in the community.

When planting, farmers not only seasonal crops but also annual crops, such as forestry crops (*Eucalyptus urophylla*, *Casuarina junghuhniana*, *Tectona grandis*, and *Gmelina arborea*) and plantations (*Citrus reticulata*, *Artocarpus heterophyllus*, *Psidium guajava* L., *Sysygium aqueum*, *Areca catechu*, *Persea americana*, and *Mangifera indica*). Of the several tree-level annual crops grown by farmers in Ajaobaki and Fatumnasi Villages, the most dominant, with the highest level of vegetation density, was *Aleurites moluccana* (L.) Willd, followed by *Casuarina junghuhniana*, *Gmelina arborea*, and *Mangifera indica*. Knowledge of the community (farmers) postulates that by planting woody plants, the need for carpentry wood for building houses and firewood will always be available. Similar to plantation crops, in addition to meeting economic needs through the fruits they produce, the leaves have additional benefits for soil fertility, and the trees have an ecological function in preventing flooding and erosion hazards. In addition, the community has an argumentative view that the leaves of planted trees can add nutrients when decomposition occurs.

Other knowledge in the living space of the people in the Ajaobaki and Fatumnasi Villages is that planting woody plants can protect the land from flooding and erosion and store water in the soil. The knowledge of this community is in harmony with the knowledge of the state, which has the construction of thinking that planting trees has the benefit of protecting the land from ecological problems. When the knowledge of the

community and the state is matched to become an ecological unit in an environmental ecosystem, it can provide a sustainable living space for the benefit of people's welfare and environmental sustainability, which is adaptive and in harmony with nature. Community knowledge, which combines various types of plants, especially legumes, and non-legumes, is an economic strategy for preventing crop failure. This finding aligns with Ngongo et al. [33] and the traditional agricultural practices of West Timor farmers, which suggest that cultivating a combination of leguminous and non-leguminous crops serves as an economically viable strategy to address farmers' food crop requirements while mitigating the risk of crop failure.

From the perspective of the plant structure formed in the dynamics of land use in community gardens, there were various constituent strata, with the highest stratum formed by forestry plants (*Casuarina junghuhniana*, *Eucalyptus urophylla*, *Tectona grandis* L.f, *Gmelina arborea*, *Swietenia macrophylla*) and several plantation crops such as *Aleurites moluccana* (L.) Willd and *Cocos nucifera*. In the medium stratum, plantation crops such as *Citrus reticulata*, *Psidium guajava* L., *Sysygium aqueum*, *Areca catechu*, *Persea americana*, *Mangifera indica*, *Musa paradisiaca* L., *Carica papaya* L., and mulberry were dominated, while in the low stratum, the constituent components were dominated by seasonal crops (*Zea mays*, *Arachis hypogaea* L., *Ipomoea batatas*, *Manihot esculenta*, beans, and vegetables) during the rainy season and weeds (*Synedrella nodiflora*, *Ageratum conizodies*, *Canna indica*) and *Pennisetum purpupoides* during the dry season. In general, the profile of the appearance of the dynamics of land use in gardens (traditional agroforestry) during the dry season is shown in Figure 2, whereas pictures of the structure of the plant species that make up the rainy season are not available because the research was conducted during the dry season. During the rainy season, the open space shown in Figure 2 was used by farmers to plant seasonal crops, such as *Zea mays*, beans, *Manihot esculenta*, and *Ipomoea batatas*. During the dry season, the remaining plant types included forestry plants, plantation plants, *Manihot esculenta*, and *Ipomoea batatas*.

Description:
1. Annual plant
2. Fruit plant
3. Space for managing seasonal crops
4. Animal feed plants:

Figure 2. Structure of plant types comprising agroforestry gardens in the dry season.

The dynamics of agroforestry land use are divided into three groups based on stand components: old, medium, and young stands [34]. In old stands, there are no other types of plants other than woody plants because the space in the land is covered by the canopy of woody plants. The medium stands were dominated by fodder and fruit trees, whereas the young stands were dominated by food and fodder species. Therefore, from a model perspective, the pattern of spatial use in the garden in Ajaobaki and Fatumnasi Villages through the intervention of various types of crops, seasonal plants, annual plants, and fodder on one plot of land fits the intercropping pattern, annual crops (forestry and plantations) as fences, and a planting pattern that separates annual crops and crops. The people of the Ajaobaki and Fatumnasi Villages manage their garden (*lele*) land by adhering to local wisdom values (a culture of cooperation in work, traditional rituals, rules, and restrictions on managing their gardens). Local wisdom serves as a guideline for communities to utilize resources from generation to generation, and through local wisdom, communities have survived resource crises [35]. Moreover, local wisdom is synonymous with traditional knowledge [36,37].

Inter cropping pattern

Intercropping, in this explanation, focuses on the pattern of combining various types of plants in one plot of land (garden), with no regard for plant spacing or competition (nutrients and light) between plants. Farmers in Ajaobaki and Fatumnasi Villages planted forestry crops (*Eucalyptus urophylla*, *Casuarina junghuhniana*, *Gmelina arborea*, *Swietenia macrophylla*, and *Tectona grandis* L.f), plantation crops (*Aleurites moluccana* (L.) Willd, *Citrus reticulata*, *Psidium guajava* L., *Musa paradisiaca* L., and *Areca catechu*), and seasonal crops (*Zea mays*, *Arachis hypogaea* L., *Ipomoea batatas*) (Figure 3). Plant species were selected on the basis of their land suitability for various types of crops that were often planted by the community, forestry plants that were compatible with plants that grew in the local forest area, and plantation crops that were suitable for the local climate. When forestry and plantation crops became taller and their crowns widened, space for the introduction of seasonal crops decreased. Limited land conditions encouraged people to undertake pruning to make room for seasonal crops, although the yield productivity tended to decrease as forestry and plantation crops developed.

In general, farmers in the villages manage their land by combining various types of plants, including forestry plants, agricultural plants, plantation species, and animal feed, without considering plant spacing. During the rainy season, farmers planted their land with seasonal crops such as corn, peanuts, cassava, and sweet potato among plantation crops (*Artocarpus heterophyllus*, *Citrus reticulata*, *Aleurites moluccana* (L.) Willd, *Psidium guajava* L., *Musa paradisiaca* L.), forestry crops (*Casuarina junghuhniana*, *Eucalyptus urophylla*, *Swietenia macrophylla*, *Gmelina arborea, Tectona grandis* L.f), and animal feed crops such as *Pennisetum purpupoides* and *Calliandra calothyrsus*. The planted forestry crops (trees) were native plants in that area because they had higher adaptability than plants from outside the area. Generally, the use of native species is preferred, as they are well adapted to the environment and not at risk as invasive species [38]. Trees provide shade, shelter, energy, food, fodder, and many other goods and services that allow farmlands to prosper [39]. Farmers include trees on agricultural lands because of their economic and ecological interests.

Towards the end of the rainy season, the community harvests seasonal agricultural plants. During the dry season, farmers in the Ajaobaki and Fatumnasi Village harvested plantation crops such as *Citrus reticulata*, *Persea americana*, *Aleurites moluccana* (L.) Willd, *Sysygium aqueum*, *Mangifera indica*, and *Tamarindus indica*. *Musa paradisiaca* L., *Manihot esculenta*, and *Ipomoea batatas* were harvested continuously regardless of the season. On the other hand, farmers manage garden land near water sources during the dry season by planting vegetables in the growing space of harvested seasonal crops. Meanwhile, land far from water sources was abandoned without any processing in the annual plant space. This situation has caused wild plants (weeds), such as *Synedrella nodiflora*, *Ageratum conizodies,* and *Canna indica*, to reproduce profusely. The dynamics of space utilization through the intervention of planting species and harvesting occurred continuously throughout the year. They depended on the local climate, both in the rainy and dry seasons. During the rainy season, the structure and composition of plants in the garden area are forestry plants, estate crops, seasonal crops, and fodder plants. During the dry season, the structure and composition consist of forestry plants, weeds, cassava, plantation crops, and fodder plants with infertile growth conditions due to a lack of water.

Description:
1. Seasonal agricultural plants (*Zea mays* and others)
2. Plantation crops (*Citrus reticulata* and *Musa paradisiaca* L)
3. Forestry plants

Figure 3. Intercropping pattern without spacing.

The community in Ajaobaki and Fatumnasi Village has a construction of knowledge that by combining various plants: 1) it can bring many harvests even though the contribution of the various commodities is very small; 2) harvest can be conducted year-round in agroforestry gardens because the production results from each plant are not simultaneous; 3) garden land is relatively more stable in reducing ecological disasters; 4) prevention of pests and diseases (when pests and diseases attack certain types of plants, other plants will continue to produce); and 5) help the household economy. Lacerda et al. [40] introduced new technologies in traditional agroforestry systems to initiate social, economic, and environmental transformations in farming families involved in participatory research.

Annual plant patterns as hedge plants

In addition to the random intercropping pattern, farmers in Ajaobaki and Fatumnasi Villages also managed their garden land by planting forestry plants on the edge of the land as a barrier to other people's lands. This practical thinking arose when artificial land boundaries that used wood or stones were damaged. The history of garden management with the intervention of planting various types of plants is the same as the intercropping pattern, which begins with land clearing, planting forestry plants on the edge of the land and seasonal, and plantation crops inside the hedges of plants. Farmers planted hedges using various spacings, and the spacing was varied according to their wishes (1 × 1, 2 × 2, 3 × 3, 4 × 4, 5 × 5, and 6 × 6) m, and planted plantation crops such as coconut, *Aleurites moluccana* (L.) Willd, *Areca catechu*, and *Musa paradisiaca* L. Some farmers planted unspaced hedges. Farmers planted seasonal plants without spacing, but various spacings were used when planting plantation crops, such as *Citrus reticulata* (3 × 3 m, 4 × 4 m, and dominant spacing of 5 × 5 m). The use of spacing for plantation crops was subject to state knowledge intervention through agricultural extension workers, with counseling and outreach activities to increase productivity.

The plant insert model between hedgerows and plantations or fruit plants was also found at Spoilbank DAM Bili Bili, Gowa Regency. Fruit plants are expected to provide sustainable economic benefits [41]. The implications of implementing a planting pattern are that farmers can enjoy results throughout the year, and their trees can maintain an environmental balance to avoid the dangers of floods, erosion, and landslides. Plantation crops and fruits, such as *Musa paradisiaca* L., can be harvested throughout the year at a frequency of one harvest or harvested monthly. The main benefit of applying annual plant patterns as hedges is that they create a permanent land barrier between one farmer's garden and another, providing space for annual plants to utilize sunlight and other nutrients to grow and develop to produce productive results, thus making land management easier (Figure 4).

Figure 4. Forestry plants as hedges.

The pattern of forestry plants separated from agricultural and plantation crops

This pattern underlines the separation of forested plants from the seasonal agricultural and plantation plants. The application of this pattern is a modification of the alley-cropping model. Community knowledge is internalized through traditional knowledge, inseparable from the cultural aspects of ecological and economic interests. Ecological interests include the presence of annual plants to protect the land from ecological disasters and support life in the vicinity. Economic interests focus on the aspects of people's welfare and the presence of planted plants that can meet basic human needs, such as food, firewood, carpentry wood, animal feed, and global environmental needs, in the context of climate change mitigation.

Traditional knowledge can reduce people's ability to intervene in planting various types of plants that are adjustable to local climate and culture. To maintain economic and ecological sustainability, farmers manage their land by clearly dividing forestry, seasonal, and plantation crops. Farmers planted forestry crops on land that was relatively infertile for crops and had a steeper topography, whereas flat and sloping areas were planted with seasonal crops and plantations such as *Citrus reticulata*, *Artocarpus heterophyllus*, *Persea americana*, and other plants. In addition, farmers separated the land into the left or right of the space for planting seasonal crops and plantations by planting forestry plants. Planting spaces for forestry plants are usually located on relatively infertile land. Other plantation crops, such as *Aleurites moluccana* (L.) Willd, were planted together with forestry plants in the space designated for forestry plants. *Areca catechu*, *Musa paradisiaca* L., and plantation crops are always in the space for seasonal crops. This type of planting pattern was rarely found in Ajaobaki and Fatumnasi Villages because farmers generally developed these two planting patterns (Figure 5).

The crop patterns developed by the communities in the two villages are almost the same as the research results conducted by Anwar et al. [42] in Oke Kolano Village, Tidore Islands, North Maluku, using modified alley cropping. The Modified Alley Cropping Pattern is a land use pattern where agricultural and forestry plants are planted separately on one land to ensure that the growth of each plant does not harm the other. Implementing the modified alley cropping pattern aims to increase the growth and productivity of each component planted and to avoid or reduce competition for the absorption of nutrients and water from the soil and sunlight [42]. Farmers who apply this pattern consider plant maintenance easier because forestry plants and annual crops are planted separately; therefore, weed control is easier than in other patterns.

Description:
1. Space for forestry plants
2. Space for seasonal agricultural plants and plantation crops

Figure 5. Separation of forestry plants and seasonal and plantation crops.

Discussion

Land use with traditional agroforestry models in Ajaobaki and Fatumnasi Villages empirically has three models, namely intercropping patterns, forestry plant patterns as fences, and clear separation patterns between forestry plants and annual plants. In each of these models, planting interventions are not based on regular planting distances but based on the wishes of farmers according to local knowledge. Traditional agroforestry, as a source of livelihood for the community, which in its management always prioritizes local knowledge values, is a form of traditional practice to maintain environmental balance and meet the basic needs of the community. Local knowledge is present because of the link between knowledge possessed in a community, place of residence, and spiritual values held by the community [17]. Consciously, farmers do not know what they are doing in managing their dry land as a form of agroforestry practice, and over time, through the intervention of state knowledge, farmers are only realizing this nowadays. The local knowledge of farmers in Ajaobaki and Fatumnasi Villages is very solid in working through a series of actions and activities when managing land in the social community of the Dawan tribe. In managing *lele* fields, farmers always hold firm beliefs in God, both God of the sky (*Uis Neno*) and God of the earth (*Uis Pah*). *Uis Neno* as an almighty

power is described as something that glows, is in the sky, always helps people when they experience difficulties in life, and gives blessings and fortune at work (personal communication with MA) [43].

The people always give thanks and sing songs of praise through prayers to *Uis Neno* so that blessings and fortune in the efforts and works are carried out, as well as punishment if they do not express gratitude to *Uis Neno*. On the other hand, when humans only pay attention and focus on *Uis Neno* and forget about *Uis Pah*, all kinds of disasters will come to them. When humans ignore and do not carry out the traditional ritual process in every activity, *Uis Pah* together with *Pah Nitu* punishes farmers who violate pests and diseases, prolonged heat, reduced production, or crop failure. From the perspective of local knowledge, the Dawan people describe *Uis Neno* as the ruler of the sky and *Uis Pah* with *Pah Nitu* as the ruler of the earth. Belief in the God of Heaven and God of Earth for the Dawan people is something that is carried out with full responsibility, and if it is violated, then all kinds of disasters will affect people's lives. In the axiological dimension, trust in *Uis Neno* and *Uis Pah* with *Pah Nitu* provides value for humans to always obey at work and adapt to the Dawan community environment.

Lele as a place for implementing community knowledge needs to be developed as a basis for food security in rural communities and requires state knowledge intervention in selecting species, especially multi-purpose tree species type of plants, and setting spacing to increase productivity and sustainability. Thus, the presence of state knowledge is very important for strengthening the capacity of farmers and other interventions to improve their welfare. The key factors in adopting an agroforestry system before carrying out further interventions are success in mobilizing farmers, involving farmers, and facilitating farmers' capacity building and/or access to quality tree/agricultural seeds [44]. The *lele* ecological environment must be maintained with eco-centric ethics through ecosystem movement (caring for a comfortable place for all life in the *lele* ecosystem).

Currently, farmers in Ajaobaki and Fatumnasi Villages are starting to adopt an agroforestry system to manage dry land in low, medium, and high-altitude areas. Traditional agroforestry (*lele*) has proven its presence as a source of community food security with various products and as a basis for mitigation and adaptation to climate change. Agroforestry is considered an important adaptation and mitigation strategy for climate change, and the presence of trees contributes to increasing soil fertility through nitrogen fixation and increases the supply of nutrients for crop production [45]. Well-designed and implemented dryland agroforestry can alleviate poverty, provide food security and livelihoods, maintain healthy ecosystems, conserve biodiversity, and reduce greenhouse gas effects through carbon sequestration [46]. Traditional agroforestry has polyculture properties and provides various benefits to society compared to modern agroforestry. The diversity of plant species in agroforestry communities is an effort to avoid single poverty-based production failures while creating environmental balance and food security [28]. Agroforestry systems are key approaches that can be applied to integrated landscape management because they offer a variety of ecological and social benefits [40].

Local community knowledge currently applied in managing traditional agroforestry gardens includes ancestral heritage, personal learning experience, or a combination of ancestral heritage, personal experience, and the exchange of experiences with other farmers. The most valuable local knowledge for managing agroforestry gardens was inherited from the ancestors. These findings align with Kusumawati et al. [47], who stated that managing gardens with an agroforestry system is always based on knowledge passed down from the family (79%), hereditary knowledge combined with learning from and exchanging experiences with fellow farmers (10.5%), and hereditary knowledge combined with personal experience (10.5%). Local knowledge in land management with traditional agroforestry models needs to be maintained because it provides enormous benefits to local communities, such as maintaining the balance and sustainability of nature and strengthening cultural identity. Thus, the village governments of Ajaobaki and Fatumnasi must create policies for traditional agroforestry land management using local knowledge that has proven effective in maintaining community food security, improving the economy, and maintaining environmental balance.

Conclusions

Community knowledge, as a source of thinking in managing garden land, has resulted in various combinations of plant species in a plot of land, such as intercropping patterns, annual crops (forestry and plantations) used as hedges, and annual crops that are separated from seasonal crops. Cropping patterns in the traditional agroforestry model provide economic, ecological, and sociocultural benefits. Economically, traditional agroforestry can increase people's income, and ecologically, it can provide environmental protection

(preventing floods, erosion, and regulating water systems). Sociocultural aspects include the involvement of all workers in the family in managing the garden. In addition, it can build a sense of pride and pass it down to posterity, which in practice is managed according to the customs and culture of Dawan Tribes. When state knowledge as a scientific and practical theoretical source is matched with practical community knowledge, it will support farmers as land managers by combining various types of seasonal crops, multifunctional woody plants, forestry plants, and fodder plants. The management of dry land (*lele*) that always pays attention to conservation, economic, and sociocultural aspects by utilizing the value of local knowledge has beneficial implications for society and the environment. For the community, land management by optimizing the use of space on land with various combinations of annual and seasonal crops can maintain community food security, which can be enjoyed throughout the season, and keep the environment safe, especially for garden lands in hilly and mountainous areas.

Author Contributions

FXD: Conception and design of the study, acquisition of data, analysis and/or interpretation of data, drafting of the manuscript; **FR**: Conception and design of the study, analysis and/or interpretation of data; **YANRO**: Conception and design of the study, acquisition of data, analysis and/or interpretation of data; **YB**: Drafting of the manuscript; **BP**: Drafting of the manuscript; **FSA**: Others (map and collecting data); and **EP**: Critical review.

Conflicts of Interest

There are no conflicts to declare.

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References

1. Heryani, N.; Rejekiningrum, P. Pengembangan Pertanian Lahan Kering Iklim Kering Melalui Implementasi Panca Kelola Lahan. *Jurnal Sumberdaya Lahan* **2019**, *13*, 63–71.
2. Statistics of Timor Tengah Selatan Regency. *Mollo Utara Subdistrict in Figures 2022*. Statistics of Timor Tengah Selatan Regency, Timor Tengah Selatan, ID, 2022;
3. Nair, P.K.R.; Nair, V.D.; Kumar, B.M.; Haile, S.G. Soil carbon sequestration in tropical agroforestry systems: a feasibility appraisal. *Environmental Science and Policy* **2009**, *12*, 1099–1111, doi:doi.org/10.1016/j.envsci.2009.01.010.
4. Njurumana, G.N.; Octavia, D. Conservation Species of NTFPs Through Agroforestry for Community Livelihoods in Sikka, East Nusa Tenggara. *Journal of Sylva Indonesiana* **2020**, *3*, 1–16..
5. Nair, P.K.R.; Garrity, D. *Agroforestry – The Future of Global Land Use Advances in Agroforestry*, 1st ed.; Springer: Dordrecht, Netherland, 2012, ISBN 978-94-007-4676-3.
6. Glover, E.K.; Ahmed, H.B.; Glover, M.K. Analysis of Socio-Economic Conditions Influencing Adoption of Agroforestry Practices. *International Journal of Agriculture and Forestry* **2013**, *3*, 178–184.
7. Octavia, D.; Suharti, S.; Murniati; Dharmawan, I.W.S.; Nugroho, H.Y.S.H.; Supriyanto, B.; Rohadi, D.; Njurumana, G.N.; Yeny, I.; Hani, A.; et al. Mainstreaming Smart Agroforestry for Social Forestry Implementation to Support Sustainable Development Goals in Indonesia: A Review. *Sustainability* **2022**, *14*, 1–30, doi:doi.org/10.3390/su14159313.
8. Desmiwati, D.; Veriasa, T.O.; Aminah, A.; Safitri, A.D.; Hendarto, K.A.; Wisudayati, T.A.; Royani, H.; Dewi, K.H.; Raharjo, S.N.I.; Sari, D.R. Contribution of agroforestry systems to farmer income in state forest areas: A case study of Parungpanjang, Indonesia. *Forest and Society* **2021**, *5*, 109–119, doi:doi.org/10.24259/fs.v5i1.11223.

9. Suryanto, P.; Widiyatno; Prianto, S.D.A.; Permadi, D.B.; Affianto, A.; Adriana. Compatibility of Private Agroforestry Management and Managing Forest with Community Program in Central Java, Indonesia. *Journal of Management and Sustainability* **2013**, *3,* 178–185, doi:doi.org/10.5539/jms.v3n1p178.
10. Mulyono, A.; Suriadikusumah, A.; Harriyanto, R.; Djuwansah, M.R. Soil quality under agroforestry trees patterns in upper Citarum watershed, Indonesia. *Journal of Ecological Engineering* **2019**, *20*, 203–213, doi:doi.org/10.12911/22998993/93942.
11. Sudaryanto; Variasa, T.O. Shade-grown coffee under fruit trees in highland forests as part of an environmental village restoration. *E3S Web of Conferences* **2018**, *74*, 1–6, doi:doi.org/10.1051/e3sconf/20187409005.
12. Kamaluddin, A.K.; Tamnge, F.; Tamrin, M. Contribution of Agroforestry to the Plant Communities and Community Welfare in Ternate. *Advances In Engineering Research* **2020**, *194*, 23–25, doi:doi.org/10.2991/aer.k.200325.005.
13. Wulandari, C.; Budiono, P.; Yuwono, S.B.; Herwanti, S. Adoption of agro-forestry patterns and crop systems around register 19 forest park, Lampung province, Indonesia. *Jurnal Manajemen Hutan Tropika* **2014**, *20*, 86–93, doi:doi.org/10.7226/jtfm.20.2.86.
14. Prasetyo, B.D. Agroforestri Kaliwu di Sumba: Sebuah Tinjauan Sosiologis. *Jurnal Penelitian Sosial Dan Ekonomi Kehutanan* **2016**, *13*, 189–199, doi:doi.org/10.20886/jsek.2016.13.3.189-199.
15. Cerdán, C.R.; Rebolledo, M.C.; Soto, G.; Rapidel, B.; Sinclair, F.L. Local knowledge of impacts of tree cover on ecosystem services in smallholder coffee production systems. *Agricultural Systems* **2012**, *110*, 119–130, doi:doi.org/10.1016/j.agsy.2012.03.014.
16. Hani, A.; Indrajaya, Y.; Suryanto, P.; Budiadi. Dryland agroforestry practices in Menoreh Hills, Kulon Progo. *Agrivita*. **2016**, *38*, 193–203, doi:doi.org/10.17503/agrivita.v38i2.416.
17. Remmington, G. Transforming tradition: The aflaj and changing role of traditional knowledge systems for collective water management. *Journal of Arid Environments* **2018**, *151*, 134–140, doi:doi.org/10.1016/j.jaridenv.2017.10.003.
18. Wekke, I.S.; Mappasere, S.A.; Suyuti, N. *Metode Penelitian Sosial: Pendekatan Kualitatif*; Penerbit Gawe Buku: Yogyakarta, ID, 2019; ISBN 978-623-92088-4-4.
19. Maryudi, A.; Krott, M. Local Struggle for Accessing State Forest Property in a Montane Forest Village in Java, Indonesia. *Journal of Sustainable Development* **2012**, *5*, 62–68, doi:doi.org/10.5539/jsd.v5n7p62.
20. Bungin, B. *Analisis Data Penelitian Kualitatif: Pemahaman Filosofis dan Metodologis ke Arah Penguasaan Model Aplikasi*; PT. Raja Grafindo Persada Jakarta, ID, 2003; ISBN 9794219312.
21. Njurumana, G.N.; Ginoga, K.L.; Octavia, D. Sustaining farmer's livelihoods through community forestry in Sikka, East Nusa Tenggara, Indonesia. *Biodiversitas* **2020**, *21*, 3786–3796, doi:doi.org/10.13057/biodiv/d210846.
22. Budiman, I.; Fujiwara, T.; Harada, K.; Sato, N. Customary forest managements and its challenges in East Nusa Tenggara, Indonesia: An implication of constitutional court decision 2012. *Jurnal Manajemen Hutan Tropika* **2021**, *27*, 69–79, doi:doi.org/10.7226/jtfm.27.2.69.
23. Njurumana, G.N.; Kaho, N.R.; Iswandono, E.; Huky, S.S.W.; Mooy, B.Z.; Fatmawati, F.; Kian, D.A.; Nomeni, Y.F. The livelihood challenge of forest honey bee farmers amidst COVID-19 pandemic in Mutis, Indonesia. *Forest and Society* **2021**, *5*, 526–542, doi:doi.org/10.24259/fs.v5i2.11556.
24. Zeweld, W.; Huylenbroeck, G.V.; Tesfay, G.; Azadi, H.; Speelman, S. Impacts of socio-psychological factors on actual adoption of sustainable land management practices in dryland andwater stressed areas. *Sustainability* **2018**, *10*, 1–23, doi:doi.org/10.3390/su1009296.
25. Ngaji, A.U.K.; Baiquni, M.; Suryatmojo, H.; Haryono, E. Sustaining subsistence culture in Mamar agroforestry management in West Timor, is it possible? *E3S Web of Conferences* **2020**, *200*, 3–7, doi:doi.org/10.1051/e3sconf/202020002023.
26. Alao, J.; Shuaibu, R. Agroforestry practices and concepts in sustainable land use systems in Nigeria. *Journal of Horticulture and Forestry* **2013**, *5*, 156–159, doi:doi.org/10.15740/has/ijfci/7.1/126-131.
27. Isaac, M.E.; Dawoe, E.; Sieciechowicz, K. Assessing local knowledge use in agroforestry management with cognitive maps. *Environmental Management* **2009**, *43*, 1321–1329, doi:doi.org/10.1007/s00267-008-9201-8.

28. Pujiono, E.; Raharjo, S.A.; Njurumana, G.; Prasetyo, B.; Rianawati, H. Kajian aspek ekologi, ekonomi dan sosial model-model agroforestri di Nusa Tenggara Timur. In Prosiding Seminar Nasional Agroforestri 2013 "Agroforestri Untuk Pangan dan Lingkungan Yang Lebih Baik", Malang, Indonesia, 21 May 2013.
29. Kay, S.; Rega, C.; Moreno, G.; den Herder, M.; Palma, J.H.N.; Borek, R.; Crous-Duran, J.; Freese, D.; Giannitsopoulos, M.; Graves, A.; et al. Agroforestry creates carbon sinks whilst enhancing the environment in agricultural landscapes in Europe. *Land Use Policy* **2019**, *83*, 581–593.
30. Fernandez-Nunez, S.; Castro, M. *Management of Agroforestry Systems: Ecological, Social and Economic Approaches*; Instituto Politécnico de Bragança: Braganca, Portugal, 2016; ISBN 978-972-745-169-2.
31. Rigueiro-Rodríguez, A.; Mosquera-Losada, M.R.; Fernández-nuñez, E. Afforestation of agricultural land with *Pinus radiata* D. Don and *Betula alba* L. In New Spain: Effects on soil pH, understorey production and floristic diversity eleven years after establishment. *Land Degradation and Development* **2012**, *23*, 227–241, doi:doi.org/10.1002/ldr.1072.
32. Dawoe, E.K.; Quashie-Sam, J.; Isaac, M.E.; Oppong, S.K. Exploring farmers' local knowledge and perceptions of soil fertility and management in the Ashanti Region of Ghana. *Geoderma* **2012**, *179–180*, 96–103, doi:doi.org/10.1016/j.geoderma.2012.02.015.
33. Ngongo, Y.; Basuki, T.; Derosari, B.; Hosang, E.Y.; Nulik, J.; Dasilva, H.; Hau, D.K.; Sitorus, A.; Kotta, N.R.E.; Njurumana, G.N.; et al. Local Wisdom of West Timorese Farmers in Land Management. *Sustainability* **2022**, *14*, 1–21, doi:doi.org/10.3390/su14106023.
34. Benu, Y.; Pobas, M. Pola Penggunaan Lahan dan Komponen Penyusun Agroforestri Hutan Lindung Mutis Timau. *Partner* **2020**, *25*, 1424–1434.
35. Ferry, D.; Ramdani. Local Wisdom Community in Efforts to Conserve Indigenous Forests of Nenek Lino Hiang Tinggi and Nenek Empat Betung Kuning in Kerinci District. *Jurnal Hutan dan Masyarakat* **2021**, *13*, 30–48, doi:doi.org/10.24259/jhm.v13i1.11163.
36. Rosyadi. Sistem Pengetahuan Lokal Masyarakat Cidaun – Cianjur Selatan Sebagai Wujud Adaptasi Budaya. *Patanjala: Jurnal Penelitian Sejarah Dan Budaya* **2014**, *6*, 431–446.
37. Ferry, D. Local Wisdom-Based Water Resources Conservation for Environmental Sustainability. *Scientiae Educatia* **2019**, *8*, 220–230, doi:doi.org/10.24235/sc.educatia.v8i2.2538.
38. Suárez, A.; Williams-Linera, G.; Trejo, C.; Valdez-Hernández, J.I.; Cetina-Alcalá, V.M.; Vibrans, H. Local knowledge helps select species for forest restoration in a tropical dry forest of central Veracruz, Mexico. *Agroforestry Systems* **2012**, *85*, 35–55, doi:doi.org/10.1007/s10457-011-9437-9.
39. McNeely, J.A.; Schroth, G. Agroforestry and biodiversity conservation – traditional practices, present dynamics, and lessons for the future. *Biodiversity and Conservation* **2006**, *15*, 549–554.
40. Lacerda, A.E.B.; Hanischff, A.L.; Nimmo, E.R. Leveraging traditional agroforestry practices to support sustainable and agrobiodiverse landscapes in Southern Brazil. *Land* **2020**, *9,* 1–19.
41. Suryanto, H.; Prasetyawati, C.A. Model agroforestri untuk rehabilitasi lahan di Spolibank DAM Bili-Bili Kabupaten Gowa. *Bulletin Eboni* **2014**, *11*, 15–26, doi:doi.org/10.20886/buleboni.5029.
42. Anwar, K.; Melati, R.; Salatalohy, A. Studi pemanfaatan lahan dengan sistem agroforestri di Desa Ake Kolano Kecamatan Oba Utara Kota Tidore Kepulauan. *Jurnal Bioedukasi* **2013**, *1*, 101–105.
43. Dako, F.X. Pengelolaan Hutan Lindung Mutis Timau dengan prinsip kehutanan sosial. Dissertation, Universitas Gadjah Mada, Yoyakarta, 2020.
44. Brown, S.E.; Miller, D.C.; Ordonez, P.J.; Baylis, K. Evidence for the impacts of agroforestry on agricultural productivity, ecosystem services, and human well-being in high-income countries: A systematic map protocol. *Environmental Evidence* **2018**, *7*, 1–16, doi:doi.org/10.1186/s13750-018-0136-0.
45. Coulibaly, J.Y.; Chiputwa, B.; Nakelse, T.; Kundhlande, G. Adoption of agroforestry and the impact on household food security among farmers in Malawi. *Agricultural Systems* **2017**, *155*, 52–69.
46. Syano, N.M.; Wasonga, O.V.; Nyangito, M.; Kironchi, G.; Egeru, A. Ecological and socio-economic evaluation of dryland agroforestry systems in East Africa. *Ruforum* **2016**, *14*, 525–535.
47. Kusumawati, I.A.; Mardiani, M.; Purnamasari, E.; Batoro, J.; Noordwijk, M.; Hairiah, K. Agrobiodiversity and plant use categories in coffee-based agroforestry in East Java, Indonesia. *Biodiversitas* **2022**, *23*, 5406–5411, doi:doi.org/10.13057/biodiv/d231051.