JPPIPA 10(5) (2024)

Jurnal Penelitian Pendidikan IPA

Journal of Research in Science Education

http://jppipa.unram.ac.id/index.php/jppipa/index

Today's Shifting Cultivation and its Impact on Forest and Environmental Damage in Routa, Konawe, Southeast Sulawesi

Sarlan Adijaya[1*]

[1] Department Antropologi, Universitas Halu Oleo, Indonesia.

Received: January 25, 2024
Revised: April 12, 2024
Accepted: May 25, 2024
Published: May 31, 2024

Corresponding Author:
Sarlan Adijaya
rambuwawi@gmail.com

DOI: 10.29303/jppipa.v10i5.7087

Abstract: This article is intended to explore and analyze some of the impacts of shifting cultivation to the forest environmental degradation in Routa today. This study uses a combination of qualitative and quantitative research approaches, especially with the rational equation methods where the results of statistical calculations are then culturally interpreted. The results of this study indicate that current shifting cultivation has contributed greatly to the increasing damage to the forest environment and decreased hydro-urologic functions of forests in Routa as well as other ecological functions, including conversion of primary and secondary forest land to shifting cultivation areas, restoration of areas ex-shifting cultivation that are ongoing slower than usual, increased surface water flow, increased erosion, and sedimentation, increased local air temperature and decreased humidity and the potential for large carbon losses.

Keywords: Damage; Environmental; Forest; Moving cultivation

Introduction

Shifting cultivation, shifting agriculture, or slash and burn agriculture in English corresponds to the terms shifting cultivation, rotary cultivation, slash and burn cultivation, shifting field agriculture, swidden farming, slash and burn farming, and swidden agriculture. In several places, other terms are also known, namely jhum (India), Bhasme or Khoriya (Nepal), kaingin (Philippines), and chena (Srilanka) (Lynch & Talbott, 2001). However, these terms refer to more or less the same meaning, namely an agricultural system in a forest area whose core activities include cutting, burning and planting (Murhaini & Achmadi, 2021; Santoro et al., 2020; Yurike et al., 2021).

Rambo (1983) suggests that "swidden agriculture is a system in which the farmer cuts a plot of land in the forest, allowing the vegetation to dry and then burns it before planting a crop". Meanwhile, Seavoy (1973) defines "Shifting cultivation is commonly defined as clearing trees and then cultivating this land for one or more years before abandoning it in favor of other patches". If Rambo emphasizes the practice of logging, drying, burning, and planting from shifting cultivation, Seavoy focuses more on the practice of felling trees and cultivating the land for several years before abandoning it.

Slightly different from Rambo and Seavoy above, Zakaria et al. (2014) says that shifting cultivation is a form of land use that is often associated with traditional communities in or around forests that live in relative isolation. Shifting cultivation is characterized by a recycling pattern of land use rather than the types of plants produced on the land (Laskar et al., 2021; Pandey et al., 2022; Reang et al., 2022) in question, and slash-and-burn techniques are often used. Meanwhile, White (1983) states that in general there are four characteristics of cultivation, namely that it is carried out on arid tropical land; using elementary agricultural techniques without using tools except axes; occurs in communities with low population density, and in communities with low levels of consumption. Gurou emphasizes the traditional and subsistence nature of shifting cultivation practices (Mathur & Bhattacharya, 2024).

How to Cite:
Adijaya, S. (2024). Today's Moving Cultivation and its Impact on Forest and Environmental Damage in Routa, Konawe, Southeast Sulawesi. *Jurnal Penelitian Pendidikan IPA*, *10*(5), 2612–2620. https://doi.org/10.29303/jppipa.v10i5.7087

Meanwhile, Koentjaraningrat (1990) states that shifting cultivation is carried out in an area in the forest or savanna that is cleared (cut down and burned), and planted one to three times a year. Then the land is left for a long time (10-15 years) so that it becomes forest again. After that, the former forest was opened or processed as in the initial cycle. Koentjaraningrat places more emphasis on the cyclical aspect of shifting cultivation practices. Meanwhile, Ribeiro Filho et al. (2013) said that there are three basic phases of the practice of shifting cultivation, namely the logging or clearing phase, the processing and planting phase, and the phase of resting or leaving the former area of shifting cultivation for a while. As he said: "…the basic phases of shifting cultivation system are the following (1) conversion, (2) cultivation, and (3) fallow."

In contrast to the views above which tend to position shifting cultivation as an environmentally friendly practice and which is primarily aimed at obtaining paddy fields, on the other hand, shifting cultivation in Routa is aimed more as an effort to obtain cultivated land. This situation is expected to encourage an increase in the potential for deforestation and environmental damage due to shifting cultivation. Even though it is known that all this time with the system shifting cultivation, which is considered environmentally friendly and subsistence, has often been considered a cause of deforestation (including (Chen et al., 2023; Magalhães, 2023; Zhang et al., 2002).

This research aims to explore the fading nature of environmental friendliness and the increasing potential for deforestation and environmental damage due to shifting cultivation today in Routa, Konawe Regency, Southeast Sulawesi Province, using a combination of qualitative and quantitative approaches, especially the rational equation method, where the results of mathematical calculations are then interpreted culturally.

Method

This research with a combination of qualitative and quantitative approaches was carried out in Routa, Konawe, Southeast Sulawesi over a period of six months between 2018 and 2019—as a further study of my previous research regarding changes in goals, orientation, and priorities of shifting cultivators in Routa from lowland rice to farmland.

Data collection was carried out by combining interviews, observation, and measurement. Those who participated in this research included former sub-district heads, former village heads, former forestry officers, and shifting cultivator farmers in Routa. Data analysis is carried out from the beginning to the end of the research or from the time the data is obtained in the field (Endraswara, 2003).

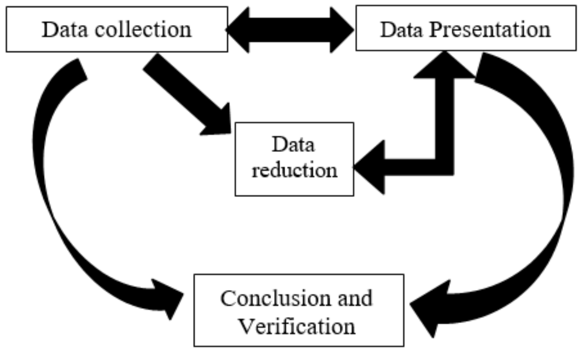

Figure 1. Components of interactive model data analysis (Agus, 2006; Huberman & Milles, 1992)

Data that has been collected through interviews, observations, and measurements is classified according to type and described in a holistic-integrative manner analyzed using the rational equation method, and interpreted culturally.

Result and Discussion

Fading Environmentally Friendly Concepts and Behaviors in Shifting Cultivation

Initially, shifting cultivation in the Tolaki community and also in Routa was recognized as a form of environmentally friendly forest use (Adijaya, 2000). These environmentally friendly qualities include: First, there is the concept of mohoto owuta, namely a ceremony to ask permission from the forest authority (sangiano andoolo) to avoid disasters, field crops not being attacked by pests, and the forest can immediately be reforested if it is abandoned in the future. Sangiano andoolo is currently roughly equivalent to the Ministry of Forestry or Forestry Service—the forest authority institution with the authority to grant permits for forest processing and utilization (Affandi et al., 2021).

Second, there is a lag and cycle in opening up cultivation areas, namely 10 years for anahoma, 20 years for laliwata, and 30 years for osambu. This pause and cycle can directly provide an opportunity for trees to grow again, the growth of soil humus, which means it can increase soil fertility and most importantly, it can slow down the rate of new forest clearing. Third, avoid steep forest areas (mosila) and prefer relatively flat forest areas (mondape) with the consideration that rice seedlings can be washed away by rainwater, and the soil is less fertile and energy efficient. As is also known, the rate of surface water in steep forest areas is higher compared to relatively flat forest areas. The surface water rate determines the level of erosion caused by soil erosion by rainwater (Sun et al., 2021; Xu & Zhang, 2020);

Fourth, at the land clearing stage (mosalei and monduehi), not all trees will be cut down, namely large trees, banyan trees, and trees growing along rivers will be left; large trees will be left as shelter as well as to save energy, banyan trees will not be disturbed because they are believed to be the residence of jinns (owali), and trees around rivers will remain left because they are a source of water needed by the fields, and; Fifth, mekere, namely cleaning around the shifting cultivation area that will be burned so that the fire does not spread and cause forest fires (sheep); 6) the practice of planting various types of plants using hetero-culture principles, including 71 varieties of grain, corn, and vegetables. Shifting cultivation in the past was mainly aimed at planting various types of rice fields and that is why the Tolaki community is known for the mondaweako ceremony.

Currently, along with changes in the goals of cultivators, they have shifted from trying to obtain paddy fields to farming land, so they no longer carry out the mohoto owuta ceremony better known as mo'oli when starting shifting cultivation activities. Several cultivators I met in Walandawe, Tetenggowuna, and Tundundete only said that they had heard the term, while some older people said that they knew of such ceremonies, but now never do them anymore.

Shifting cultivation in Routa also no longer recognizes the terms fallow and rotary. Shifting cultivation areas that have been cleared forever will no longer be abandoned (Bell et al., 2020; Herrmans, 2020). After the harvest season is over, if they have enough money then the area is planted with pepper, but if not then it is only planted with what is available, such as cashew nuts as a temporary or marker crop. There are times when the former farming area is sold, and then the farmers move to Routa looking for a new location to open as a farming area the following year. According to the shifting cultivators there, it is no longer possible to just leave the former farming areas without planting anything, at least with one or two cashew trees as markers. The reason given is that currently, many people are looking for land, so as not to let the land that was used as a shifting cultivation area be taken by other people - just as the land that was used in their parents' previous farming area was taken by other parties.

Avoid steep forest areas (mosila) and prefer relatively flat forest areas (mondape). Currently, the considerations often used by shifting cultivators in Routa are the distance between the location and the village, the former shifting cultivation area of their parents being the priority, and not the former shifting cultivation area of other cultivators' parents (Bamba & Munandar, 2023; Burgers, 2023). In short, the land is still empty of owners, it is not so important whether the land is on a height or a slope.

Practically all of the trees in the swidden cultivation area have been cut down except for one or two trees that have been left for no apparent reason. Large trees will be cut down because the wood can be processed and sold, banyan trees will also be cut down because in the future they will disturb the plants and become a place for jinns to live. Likewise, trees along the river/river will also be cut down because the land on both sides of the river is very fertile.

Cleaning around areas of shifting cultivation that will be burned (mekere) so that the fire does not spread out and cause forest fires (sheep) is still known by several farmers, even though it is no longer done specifically. This is related to the fact that shifting cultivation currently tends to be carried out individually with the distance between one farmer and another being quite far. There are only a few cultivators whose farming areas are neighbors.

Apart from cultivation which tends to be done individually, the burning process is also carried out in stages, so that it does not cause large flames. Burning in stages is also based on the consideration that the fire will not be too big so it will be easy to tame. This is also a logical consequence of the practice of shifting cultivation which is no longer carried out en masse as in the past - so that even though the fires are large, many people are guarding the area around the plantation area that is being burned (Zhichkina et al., 2021).

Currently, shifting cultivators in Routa, both those in Bininti, Walandawe, and Tetenggowuna, only grow swidden rice. Other crops such as corn and vegetables, like shifting cultivation in the past, were only planted occasionally and by some farmers. Knowledge about field rice varieties is also very limited, namely: pae luale rice, pae ndudu, pae bio, pae nda'ora, pae wulumata, pae pinetangge, pae mokohori, pae anggowa, paedai bongo, paedai kopia, and paedai mo'olo and paebiu.

The varieties of field rice mentioned above are very few compared to the number of varieties of field rice grown by farmers in the past, namely 71 types, namely: pae sanggula, pae gangga, pae ikulak, pae ndolatoma, pae ndunggelaa, pae nggalaru, pae kuni, pae rema, pae lunggulahi, pae ana-ana, pae tinangge, pae luwu, pae terae, pae ndo ando'olo, pae wuna, pae solo, pae ndobandoeha, pae tanu, pae ndalibana, pae mbosio, pae tanggesalaka, pae luale, pae bombo, pae ndo lasolo, pae ndinoto iku, pae ndo wawo'epo, pae ndopele'oa, pae ndombirito, pae rowu, pae ndolatodi, pae Rumorapu, pae Tanda, Pae Tonggehi, Pae Ndolarombo, Pae Ndo'ue, Pae Wulubeke , pae ue, pae meteo'olu, pae dara, pae lawondi, pae talunda, pae lo'io, pae ndauba, pae bou, pae wila ndokonawe, pae ngguluri, pae ule-ule, pae nggambuka, pae hao, pae ura, pae datu, paedai bugisi, paedai salome, paedai ndowatu, paedai mbasitemba, paedai rambubeke, paedai nggaluku, paedai beke, paedai meteo'olu, paedai wulo, paedai pepani, paedai gata, paedai ndanggerema, paedai uramandili, paedai nggalaru, paedai mesaraha, paedai wanggole, paedai manggasa, paedai rumbuko, paedai sawota and pae biu (Taridala & Adijaya, 2002).

The fading environmentally friendly conception and behavior among shifting cultivators mentioned above indirectly contributes to the forest and environmental damage in Routa (de Oliveira et al., 2021), including First, the disappearance of the mohoto owuta or mo'oli ceremony means that shifting cultivators no longer see the relationship between humans and the natural environment as a whole. The natural environment, in this case, the Routa wilderness, is more likely to be seen as an object to be exploited without mercy. As a result, they indiscriminately target all forest areas and all trees in agricultural areas without considering other functions of the existence of these forest areas and trees. The disappearance of this ceremony also shows that Sangiano Andoolo's status as forest ruler is no longer recognized and therefore shifting cultivators do not feel the need to ask permission first.

Second, the loss of the concept of fallow means that former shifting cultivation areas no longer have the opportunity to grow back as forests as before. Wilderness or former farming areas in the past that have been reforested, transformed into farming areas, turned into gardens, or abandoned with one or two trees planted on it and/or then sold to another party. The loss of the cycle (rotary) concept means that shifting cultivators in Routa continue to hunt for new forest areas to open as shifting cultivation areas. As is known, in the past the shifting cultivators in Routa were only cultivated in the Watulawu, Polihe, and Bininti areas but now they have shifted to the Walandawe, Tetenggowuna, and Tundundete areas. In the long term, this situation will cause further depletion of forest areas.

Third, one of the functions of shifting cultivation is as a hetero culture, namely providing a variety of plants that grow both grains in various varieties, vegetables, and tubers. Apart from functioning as food, these growing plants also have an ecological function, namely temporarily replacing the function of the forest as a groundwater absorber. Apart from that, another function is to minimize the potential for erosion in shifting cultivation areas which can occur during the rainy season. With the minimal number and types of plants planted, the function of fields as a groundwater buffer (hydro-organological) to replace the actual function of forests, cannot run well. This situation is also made worse by the fact that not always the entire shifting cultivation area is planted with paddy.

Fourth, damage to springs and rivers. Shifting cultivators in Routa are currently cutting down trees leaving nothing, including those growing along both sides of the river. Sometimes the felled trees are deliberately directed towards the river trunk and small trees, wooden branches, and twigs are all thrown into the river body. This kind of phenomenon is often found in small rivers. One that experiences conditions like this is the Tetenggowuna River, which is usually called the ulualaa or upstream river. This river flows throughout the year and is connected to the Wataraki River which flows through Lalomerui Village. Currently, the river water is no longer flowing well and is filled with tree trunks and wooden branches in the river body. In the long term, the function of this river as a source of clean water for residents in Tetenggowuna and Lalomerui has the potential to disappear, leaving only the river trunk.

Increased Potential for Forest Damage

The change in the purpose of cultivators from swidden rice to swidden land directly puts significant pressure on the existence of forest areas in Routa. This pressure originates from 1) the re-activation of several residents in the practice of shifting cultivation which they had abandoned for a long time; 2) there is mobilization of residents to enter forest areas, especially in areas where shifting cultivation has occurred in the past, and; 3) the more intensely they carry out forest clearing.

First, the presence of migrants from the South to Routa has stimulated residents to return to farming. A number of these residents have long left their jobs as shifting cultivators and prefer to pursue other jobs both inside and outside Routa. They returned to focus on opening farming areas in addition to working on previously existing cocoa and pepper plantations, also because they were driven by concerns about losing the opportunity to acquire land (Adijaya, 2021).

The phenomenon of several residents turning to shifting cultivation began to occur in 2012 and 2013 but then reached its peak in 2016 until now. This phenomenon of residents returning to active farming is especially true in the Routa area. When they returned to active farming, they not only opened up areas of former shifting cultivation that had been abandoned for a long time but also opened up new forest areas. Another factor in their return to shifting cultivation is the calculation that if they focus on opening a new field of one or two hectares, the money will be IDR 10,000,000 to IDR. 20,000,000 already in hand, rather than continuing to work as a laborer, you definitely won't be able to get that amount of money.

Second, there is the mobilization of residents to enter forest areas, especially in areas that were formerly shifting cultivation areas in the past, as has happened in New Mopute from 2018 to the present. No half-hearted forest area they claim is 4000 hectares. This means that

4000 hectares of forest area could potentially experience damage. Even though I doubt that they would be able to cultivate such a large forest area in its entirety, it does not rule out the possibility that it could happen. For example, plots of land that have become their share and have been bagged with SKT and then sold to other people, such as migrant residents from the South or North Konawe who are more tenacious in gardening.

Third, in the last 5 years, the intensity of opening new forest areas by residents in Routa to shift cultivation has increased compared to previous years. In the previous 5 year period, residents in Routa only opened shifting cultivation every 3 years to 5 years. After that, they focus on working the land into cocoa or pepper plantations, while doing other jobs such as working at a lumber or resin company.

The opening of new fields is becoming more frequent, with residents opening areas for shifting cultivation at least once every two years (Grogan et al., 2013). There are also some residents, especially those who are young and have money, who open shifting cultivation areas every year. The average annual land clearing is between one and two hectares. The more intensive residents in Routa open areas for shifting cultivation, this directly increases the pressure on forest areas. This means that the rate of forest destruction will continue to increase from year to year and will be faster compared to the previous 5-year period.

From the descriptions above, quantitatively it is impossible to obtain an exact figure for the potential for forest damage due to changes in the goals, orientation, and main priorities of cultivators moving from paddy fields to cultivated land. However, the figures can be roughly stated as follows: Routa Village covers the Routa, Polihe, and Bininti areas covering an area of 200 hectares. This figure was obtained based on calculations that one-third of households in Routa Subdistrict, totaling 121 RT, have been intensively opening new fields of at least 1 hectare per year in the last 5 years.

Furthermore, Lalomerui Village, with the potential for forest damage covering an area of 165 hectares, is based on calculations that one-third of the households in Lalomerui Village, totaling 101 RTs, have been intensively opening new fields of at least 1 hectare per year in the last 5 years, and; Walandawe Village has the potential for forest damage covering an area of 165 hectares, based on calculations of all 33 RT households in Walandawe Village, who have been intensively opening new fields at a minimum of 1 hectare per year in the last 5 years.

If we refer to the Forest Area inventory report of PT. SCM in 2012 in Routa where the number of standing trees per hectare was 286 individuals or 260.40 cubic meters per hectare, meaning that every year the number of standing trees lost due to the clearing of forest areas for shifting cultivation was 30,316 individuals or 27,602 cubic meters. In the last 5 years, the number of standing trees lost was 151,580 individuals or 138,010 cubic meters. Meanwhile, for the pole category, there are 778 individuals per hectare or 82,468 individuals every year and 412,340 individuals in 5 years. The sapling category is 2,475 individuals per hectare or 262,350 individuals each year and 1,311,750 individuals in 5 years. Furthermore, for the seedling category, there are 4 individuals per hectare or 424 individuals every year and 2,120 individuals in 5 years.

Decreasing Forest Hydro-Orological Functions and Other Ecological Functions

The opening of forest areas for shifting cultivation areas covering an area of 530 hectares in the last 5 years (Morton et al., 2020) or 106 hectares each year has the potential to cause several environmental impacts, especially related to the hydrological function of forests as a groundwater regulator, including: increasing the volume of runoff water, sedimentation rate, and erosion potential. Another impact is an increase in average air temperature, a decrease in air humidity which will affect the thermal comfort index due to forest clearing and burning activities as well as the potential for carbon loss from lost forests.

From the data above it can be seen that the highest runoff water volume for the 15-year rain return period with maximum rainfall of 222.65 mm and rain intensity of 79 mm/hour, the results obtained were that the initial baseline before land clearing was 98.17 cubic meters per second and after land clearing it increased to 144.25 cubic meters per second. This means there is an increase of 46.08 cubic meters per second. In a year the volume of water runoff due to shifting cultivation is 4,884 cubic meters or 24,422 cubic meters in 5 years. The sight of running water flowing over the ground surface is very common, especially during the rainy season. Rainwater that falls to the ground flows quite fast and things

This can be seen in areas around houses, on roads, and in shifting cultivation areas. This water flow will become more rapid and abundant in volume when the water flows meet each other and form one main current (Hammer & Bastian, 2020). In shifting cultivation areas located on sloping areas, running water like this often causes rice seedlings to be lifted and swept away by the water from their holes. Rice planted in high-altitude areas (rodo osu) then moves and grows in valley areas (lela wuta), as a result, the rice plants in high-altitude areas look sparse and conversely in valley areas they look very dense.

Based on the data above, it can be seen that the average erosion prediction is 489.39 tonnes per hectare per year. This means that the erosion that can be caused by opening shifting cultivation areas in Routa every year is 51,875.34 tons or 259,376.7 tons in 5 years. This erosion rate is quite high and of course, this not only has the potential to damage the environment but can also cause the failure of shifting cultivation businesses. Field land that has just been opened and planted with rice is very fertile soil with lots of humus in it. However, with a high level of erosion, the humus can leave with the rainwater and leave behind barren, barren land. The loss of humus from shifting cultivation areas causes rice plants not to grow well, something like this is often found in areas with extreme slopes (Roy et al., 2023).

Furthermore, the predicted sedimentation rate during land clearing activities for shifting cultivation is 253.82 tonnes per hectare per year, or an increase of 177.28 tonnes per hectare per year from the initial level of 76.54 tonnes per hectare per year. This means that in one year there is an increase in the sedimentation rate of 18,791.68 tons or 93,958.4 tons in 5 years. The initial average erosion rate was 369.75 tonnes per hectare per year and after land clearing it became 1,226.09 tonnes per hectare per year or an increase of 856.34 tonnes per hectare.

Culturally, sedimentation is more or less the same as the term mud (kedo), namely wet soil deposits resulting from the erosion process during the rainy season which settle in areas with low surfaces, including below the surface of rivers or the sea. This kind of phenomenon is often encountered, especially during the rainy season. The higher the level of sediment contained in the water, the more cloudy (mopuro) the appearance of the water.

In shifting cultivation areas in the valley areas, mud deposits are often found carried by the flow of many small rivers that flow in the middle of shifting cultivation areas. If this kind of situation occurs shortly after clearing a field, then shifting cultivators usually choose to ignore it and not plant it. However, if this happens after planting field rice, then usually the field rice plants will be buried in mud and even if they still survive, the farmers will have difficulty harvesting them.

Clearing land using a land clearing system for shifting cultivation locations will cause the land to be cleared of vegetation, which will change the temperature and humidity of the air. Vegetation plays an important role in maintaining changes in air temperature and humidity. The essence of land-clearing activities is cutting down vegetation including trees, poles, bushes, and undergrowth.

The average annual air temperature at the shifting cultivation location is 27.61^{o}C, the average annual air humidity is 76.55%, the average annual Thermal-Humadity Index (THI) is 25.45, and the average Discomfort Index (DI) annual 25.13. The average temperature and humidity mentioned above show that the thermal comfort index in Routa is still quite good. This refers to thermal comfort factors according to (Arifah et al., 2017), including: 1) Air temperature which is the main factor of thermal comfort, although this depends on the characteristics of subjective feelings and behavioral comfort. The thermal comfort standard for the comfortably warm category according to SNI 03-6572-2001 is 25.8°C – 27.1°C, and; 2) Relative air humidity for tropical areas according to SNI 03-6572-2001 is around 40% - 50%. Even though the thermal comfort index in Routa is currently still good, in the long term if logging and burning of forests continues on a massive scale, it is not impossible that this could cause a decline in the thermal comfort index in Routa.

Hot air temperatures (wundoa) are often felt in the dry season or during the day and are often felt at night. In conditions of air temperature like this, residents usually use fans, open the doors and windows of the house, especially during the day, and/or are outside the house more often (gaaa-gaaa). On the other hand, during the rainy season, the air in Routa is quite cold (mokorai), especially when it rains and/or in the middle of the night, the cold air usually becomes even more piercing. For shifting cultivators who spend at night in the middle of the farming area, they often make a campfire in the area around the hut or under the house to warm the surrounding air. Bonfires are usually made from large tree trunks (wata inalahi) or wood stumps (tu'o nggasu) found around the hut.

Another environmental impact due to shifting cultivation in Routa is the potential loss of carbon originating from trees cut down during land clearing. Based on the results of data analysis, it is known that plant biomass is 2,853.07 kg and carbon potential is 168.30 tonnes per hectare. Thus, every year the amount of carbon lost due to shifting cultivation is 17,839.8 tons, and in 5 years it is 89,199 tons. Another calculation regarding potential carbon loss is using the forest-type coefficient. Forest areas such as in Routa are included in the dry land forest type category with a carbon potential of 176.10 tonnes per hectare (Rochmayanto et al., 2014). Based on this, every year the amount of carbon lost is 18,666.6 tons and 93,333 tons in 5 years.

In agricultural areas where the burning process is very good and produces a lot of ash, the soil will become very fertile (Baloch et al., 2024; Shukla et al., 2023). For this reason, farmers usually immediately sow vegetable and corn seeds in the area immediately after burning. This practice is known as porangga awu.

Conclusion

The increasingly waning environmental wisdom in shifting cultivation and the increasing intensity of the opening of shifting cultivation areas in Routa as a logical consequence of changes in the goals, orientation, and main priorities of shifting cultivation from swidden rice and other foodstuffs to swidden land—have had a major impact on increasing forest destruction and declining hydro-orological functions of forests in Routa as well as other ecological functions. Forest damage and decline in hydro-orological functions and other ecological functions mentioned above include: conversion of primary and secondary forest land into shifting cultivation areas, restoration of former shifting cultivation areas which is progressing more slowly than usual, increased surface water flow, increased erosion and sedimentation, there is an increase in local air temperature and a decrease in humidity as well as the potential for large carbon losses.

Acknowledgments
Through this opportunity the author would like to thank all parties for their suggestions and criticisms so that this research can be completed.

Author Contributions
This article was prepared by single author i.e S.A.

Funding
This research received no external funding.

Conflicts of Interest
The authors declare no conflict of interest.

References

Adijaya, S. (2000). *Monda'u dan Kelestarian Hutan: Suatu Kajian Mengenai Sistem Perladangan pada Masyarakat Tolaki di Desa Pamandati*. Fakultas Ilmu Sosial dan Ilmu Politik, Universitas Haluoleo, Kendari. Retrieved from https://shorturl.asia/UFTOZ

Adijaya, S. (2021). *Pohon Kutebang, Padi Kutanam, Tanah Kudapat*. Kendari: CV. Violet Indah Sejahtera.

Affandi, O., Kartodihardjo, H., Nugroho, B., & Ekawati, S. (2021). Institutional analysis of forest governance after the implementation of Law Number 23/2014 in North Sumatra Province, Indonesia. *Forest and Society*, *5*(2), 304–325. https://doi.org/10.24259/fs.v5i2.8755

Agus, S. (2006). Teori dan paradigma penelitian sosial. In *Yogyakarta: Tiara Wacana*. Yogyakarta: Tiara Wacana.

Arifah, A. B., Adhitama, M. S., & Nugroho, A. M. (2017). *Pengaruh bukaan terhadap kenyamanan termal pada ruang hunian rumah susun Aparna Surabaya*. Brawijaya University. Retrieved from https://shorturl.asia/VtojB

Baloch, S. B., Ali, S., Bernas, J., Moudry, J., Konvalina, P., Mushtaq, Z., Murindangabo, Y. T., Onyebuchi, E. F., Baloch, F. B., & Ahmad, M. (2024). Wood ash application for crop production, amelioration of soil acidity and contaminated environments. *Chemosphere*, *357*, 141865. https://doi.org/10.1016/j.chemosphere.2024.141865

Bamba, J., & Munandar, A. (2023). Dahas: Innovations in shifting cultivation by the Dayak of West Kalimantan to fight deforestation and climate change. In *Farmer Innovations and Best Practices by Shifting Cultivators in Asia-Pacific* (pp. 307–328). CABI GB. https://doi.org/10.1079/9781800620117.0015

Bell, S. M., Barriocanal, C., Terrer, C., & Rosell-Melé, A. (2020). Management opportunities for soil carbon sequestration following agricultural land abandonment. *Environmental Science & Policy*, *108*, 104–111. https://doi.org/10.1016/j.envsci.2020.03.018

Burgers, P. (2023). Rotating agroforests: Using shifting cultivation practices to construct a sustainable livelihood. In *Farmer Innovations and Best Practices by Shifting Cultivators in Asia-Pacific* (pp. 794–807). CABI GB. https://doi.org/10.1079/9781800620117.0037

Chen, S., Olofsson, P., Saphangthong, T., & Woodcock, C. E. (2023). Monitoring shifting cultivation in Laos with Landsat time series. *Remote Sensing of Environment*, *288*, 113507. https://doi.org/10.1016/j.rse.2023.113507

de Oliveira, C. R. S., da Silva Júnior, A. H., Mulinari, J., & Immich, A. P. S. (2021). Textile Re-Engineering: Eco-responsible solutions for a more sustainable industry. *Sustainable Production and Consumption*, *28*, 1232–1248. https://doi.org/10.1016/j.spc.2021.08.001

Endraswara, S. (2003). *Metode Penelitian Kebudayaan*. Jogyakarta: Universitas Gajah Mada Press.

Grogan, K., Birch-Thomsen, T., & Lyimo, J. (2013). Transition of shifting cultivation and its impact on people's livelihoods in the Miombo Woodlands of Northern Zambia and South-Western Tanzania. *Human Ecology*, *41*, 77–92. https://doi.org/10.1007/s10745-012-9537-9

Hammer, D. A., & Bastian, R. K. (2020). Wetlands ecosystems: natural water purifiers? In *Constructed wetlands for wastewater treatment* (pp. 5–19). CRC Press. https://doi.org/10.1201/9781003069850-3

Herrmans, I. (2020). Spirits out of place: relational landscapes and environmental change in East Kalimantan, Indonesia. *Journal of the Royal Anthropological Institute*, *26*(4), 766–785. https://doi.org/10.1111/1467-9655.13413

Huberman, A. M., & Milles, M. B. (1992). *Qualitative Data Analysis (trans.) Tjetjep Rohendi*. Jakarta: UI Press.

Koentjaraningrat. (1990). *Beberapa pokok antropologi sosial*. Jakarta: Dian Rakyat.

Laskar, S. Y., Sileshi, G. W., Pathak, K., Debnath, N., Nath, A. J., Laskar, K. Y., Singnar, P., & Das, A. K. (2021). Variations in soil organic carbon content with chronosequence, soil depth and aggregate size under shifting cultivation. *Science of the Total Environment*, *762*, 143114. https://doi.org/10.1016/j.scitotenv.2020.143114

Lynch, O. J., & Talbott, K. (2001). *Keseimbangan Tindakan: Sistem Pengelolaan Hutan Kerakyatan dan Hukum Negara di Asia dan Pasifik (terjemahan)*. Jakarta: World Research Institute & Elsam.

Magalhães, T. M. (2023). Trees in agricultural landscapes maintain soil organic carbon following miombo woodland conversion to shifting cultivation. *Geoderma*, *429*, 116241. https://doi.org/10.1016/j.geoderma.2022.116241

Mathur, I., & Bhattacharya, P. (2024). Perception of agroforestry practices and factors influencing adoption among shifting cultivators in Tripura, India. *Forests, Trees and Livelihoods*, *33*(1), 23–41. https://doi.org/10.1080/14728028.2023.2286022

Morton, O., Borah, J. R., & Edwards, D. P. (2020). Economically viable forest restoration in shifting cultivation landscapes. *Environmental Research Letters*, *15*(6), 64017. https://doi.org/10.1088/1748-9326/ab7f0d

Murhaini, S., & Achmadi. (2021). The farming management of Dayak People's community based on local wisdom ecosystem in Kalimantan Indonesia. *Heliyon*, *7*(12). https://doi.org/10.1016/j.heliyon.2021.e08578

Pandey, D. K., Dobhal, S., De, H. K., Adhiguru, P., Devi, S. V., & Mehra, T. S. (2022). Agrobiodiversity in changing shifting cultivation landscapes of the Indian Himalayas: An empirical assessment. *Landscape and Urban Planning*, *220*, 104333. https://doi.org/10.1016/j.landurbplan.2021.104333

Rambo, A. T. (1983). *Conceptual approaches to human ecology*. Honolulu, HI: East-West Environment and Policy Institute.

Reang, D., Nath, A. J., Sileshi, G. W., Hazarika, A., & Das, A. K. (2022). Post-fire restoration of land under shifting cultivation: A case study of pineapple agroforestry in the Sub-Himalayan region. *Journal of Environmental Management*, *305*, 114372. https://doi.org/10.1016/j.jenvman.2021.114372

Ribeiro Filho, A. A., Adams, C., & Murrieta, R. S. S. (2013). The impacts of shifting cultivation on tropical forest soil: a review. *Boletim Do Museu Paraense Emílio Goeldi Ciências Humanas*, *8*, 693–727. Retrieved from https://www.scielo.br/j/bgoeldi/a/Y9jrKvTfVhr75RpKVjLPqFH/?lang=en

Rochmayanto, Y., Wibowo, A., Lugina, M., Butarbutar, T., Mulyadin, R. M., & Wicaksono, D. (2014). Cadangan karbon pada berbagai tipe hutan dan jenis tanaman di Indonesia. Yogyakarta: PT. Kanisius.

Roy, P., Pal, S. C., Chakrabortty, R., Saha, A., & Chowdhuri, I. (2023). A systematic review on climate change and geo-environmental factors induced land degradation: Processes, policy-practice gap and its management strategies. *Geological Journal*, *58*(9), 3487–3514. https://doi.org/10.1002/gj.4649

Santoro, A., Venturi, M., Bertani, R., & Agnoletti, M. (2020). A review of the role of forests and agroforestry systems in the FAO Globally Important Agricultural Heritage Systems (GIAHS) programme. *Forests*, *11*(8), 860. https://doi.org/10.3390/f11080860

Seavoy, R. E. (1973). The shading cycle in shifting cultivation. *Annals of the Association of American Geographers*, *63*(4), 522–528. https://doi.org/10.1111/j.1467-8306.1973.tb00945.x

Shukla, B. K., Gupta, A., Gowda, S., & Srivastav, Y. (2023). Constructing a greener future: A comprehensive review on the sustainable use of fly ash in the construction industry and beyond. *Materials Today: Proceedings*. https://doi.org/10.1016/j.matpr.2023.07.179

Sun, L., Zhou, J. L., Cai, Q., Liu, S., & Xiao, J. (2021). Comparing surface erosion processes in four soils from the Loess Plateau under extreme rainfall events. *International Soil and Water Conservation Research*, *9*(4), 520–531. https://doi.org/10.1016/j.iswcr.2021.06.008

Taridala, Y., & Adijaya, S. (2002). *Pranata hutan rakyat*. Yogyakarta: Debut Press.

White, B. (1983). Agricultural involution and its critics: twenty years after Clifford Geertz. *ISS Working Paper Series/General Series*, *6*, 1–39. Retrieved from https://repub.eur.nl/pub/18760/wp6.pdf

Xu, E., & Zhang, H. (2020). Change pathway and intersection of rainfall, soil, and land use influencing water-related soil erosion. *Ecological Indicators*, *113*, 106281. https://doi.org/10.1016/j.ecolind.2020.106281

Yurike, Y., Yonariza, Y., & Febriamansyah, R. (2021). Patterns of forest encroachment behavior based on characteristics of immigrants and local communities. *International Journal of Engineering, Science and Information Technology*, *1*(4), 84–89. https://doi.org/10.52088/ijesty.v1i4.175

Zakaria, R. Y., & Soehendera, D. (2014). Menghitung Kembali Kontribusi Perladangan Berpindah dalam

Proses Penyusutan Kawasan Hutan di Indonesia. *Antropologi Indonesia*. Retrieved from https://shorturl.asia/VDSb8

Zhang, Q., Justice, C. O., & Desanker, P. V. (2002). Impacts of simulated shifting cultivation on deforestation and the carbon stocks of the forests of central Africa. *Agriculture, Ecosystems & Environment*, *90*(2), 203–209. https://doi.org/10.1016/S0167-8809(01)00332-2

Zhichkina, L. N., Nosov, V. V, Zhichkin, K. A., Kudryavtsev, V. V, Abdulragimov, I. A., & Burlankov, P. S. (2021). Forest fires and forestry firefighting organization. *IOP Conference Series: Earth and Environmental Science*, *677*(5), 52123. https://doi.org/10.1088/1755-1315/677/5/052123