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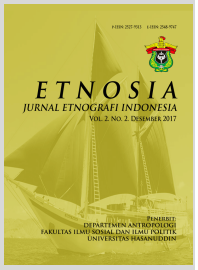


# Performing Toraja rice ritual, communicating biodiversity on YouTube: A study of conservation on rice landrace

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**ABSTRACT**

*The proliferating public interest in conservation can be explored by monitoring what people say and what people do on social media platforms. YouTube is one of the resources for digital conservation studies as the users are allowed to archive and share content. Meanwhile, network visualization provided by computer software is powerful for preserving vernacular languages since text (s) tagging is one of the main processes in gaining data. The present study aims to answer research questions using a transdisciplinary approach to sociology, ethnobotany, and communication science. Thus, this research enquires; (a) how might conservation of Toraja rice landraces be practiced continuously? (b) What are the current forms of conservation that have been developed and accepted as Toraja socio-cultural activities? (c) How do social media platforms, such as YouTube, contribute to rice landrace conservation efforts? (d) What are the social implications of conservation education through social media? In order to answer the above questions, six different research methods were employed, namely, observations, in-depth interviews, mapping the distribution of rice landrace varieties in six fields of studies, and calculating the Index of Cultural Significance on rice accessions for practicing conservation rice landrace. Digital conservation and conservation culturomics were also measured using NodeXL and the API for visualizing the graph of YouTube videos' network and calculating the frequency of words' occurrence according to search string Toraja rice ritual. The outcome of the*

*study indicates the current forms of conservation by cultivating and consuming rice landrace varieties in everyday life and ritual, as well as preserving rice and agriculture images in wood carving motifs, folk song, and folk dance. The digital conservation efforts are demonstrated by archiving and broadcasting rice rituals on YouTube videos. Users were contributing to participatory culture by preserving vernacular language and promoting agricultural innovations in digital conservation ecosystems and environmental communication, by increasing the frequency of word occurrences in the Toraja language in hashtags on YouTube videos.*

## 1. Introduction

Landraces, germplasm, protected regions, vernacular taxa, and ethnobotany were observed widely through scientific journal publications (Raggi, Caproni, and Negri 2021 ; Shikari et al. 2020), particularly in ethnobotany. Ethnobotany, first coined by John William Harshberger, recorded systematic plant use by distinct cultures as a source of food, currency, tools of war, medicine, dyes, textiles, construction materials, and clothing (Fuller 2013). Meanwhile, Google Trends has figured out that the COVID-19 has enhanced favorable trends in public knowledge of nature-related subjects for six topics: forest, birds, nature, biodiversity, gardening, and vegetable plots (Rousseau and Deschacht 2020).

The success of biodiversity conservation has relied on public support (Burivalova, Butler, and Wilcove 2018). According to Fuller (2013), different disciplines can contribute to modern ethnobotany by supplying changing relationships between people, culture, and plants. Meanwhile, biodiversity, according to DeLong (1996), is "a state or attribute of a location or area that particularly refers to the variation within and among living creatures, assemblages of living organisms, biotic communities, and biotic processes, whether naturally occurring or modified by humans". By then, how to boost public interest in conservation biodiversity? Recently, the interactive features of social media have enable the transmission of information among scientists, activists, policymakers, markets, and citizens (Gerbaudo and Treré 2015 ; Kadoda and Hale 2015). Stephen Mills, a wildlife filmmaker, remarked in 1997 that there was a basic conflict between sustaining the myth of nature with an enthusiastic audience or the disagreeable news, yet crowds dropped down (Jones et al. 2019). Therefore, conservation using various digital media is essential for further investigation.

Documenting and archiving natural landscapes and biodiversity in museums and herbariums have evolved into popular digital platforms like Netflix shows and games. Nature, human, and machine interactions through digital games (e.g., Pokémon) encourage conservation movements (Fletcher 2017) and foster ecological literacy (Callahan et al. 2019). Netflix nature documentary, *Our Planet*, was released in April 2019, narrated by Sir David Attenborough. According to Jones et al. (2019), several conservation success stories, such as the international moratorium on whaling and the recovery of the Arabian oryx, are featured in every episode of *Our Planet*.

Public contributions to the using of common digital technology have aided scientists in their hypothetical testing (von Konrat et al. 2018). In order to improve environmental

knowledge and support the sustainable use of ecosystems and natural resources, meaningful public interaction with science and research is required (Kelly, Fleming, and Pecl 2018). Meanwhile, public engagement in conserving biodiversity has been co-existing in local contexts, such as vernacular culture and vernacular religions. Merriam-Webster Dictionary defined vernacularity as: "a vernacular language, expression, or mode of expression: an expression or mode of expression that occurs in ordinary speech rather than formal writing; …a common name of a plant or animal as distinguished from the Latin nomenclature of scientific classification…". In this article, vernacular language refers to *Basa Toraya* (Toraja language) that is appropriated and appeared in the search string of rice rituals.

Scholars focused on social media as a platform for expressing collective affinities with their culture. To this extent, Rice et al. (2016) observed social media as a human interaction in which people produce and share information and ideas in virtual communities and networks. Couldry (2005) argued that 'media', specifically those central media (primarily television, radio, and the press, but also film and music, and increasingly computer-mediated communication via the Internet) through which we imagine ourselves to be connected to the social world. Couldry (2005) stated there are three broad approaches to the term 'ritual' in anthropology: 1) habitual action (any habit or repeated pattern, whether or not it has a particular meaning); 2) formalized action (for example, the regular and meaningful pattern by which a table is laid for food in a particular culture); and 3) action involving transcendent values (such as the Holy Communion, which in Christian contexts is understood as embodying a sense of direct contact with the ultimate value, God). Then, our further inquiry is to address the way YouTube as a social platform reflects cultural memory.

In terms of reconnecting the public with rituals, YouTube is essential for this purpose for reminiscing the past. For example, YouTube memorial videos, according to Pentaris (2014), are tributes that are expressed through social and ritual aspects of society. However, the concept of the media ritual contributes to a better understanding of the role of social media in the cultural practices around celebrity death (Burgess, Mitchell, and Münch 2019). Media and communication rituals have crucial social roles in sociological and anthropological terms, such as reproducing and reinscribing the present social order (Couldry 2005). This article featured contemporary rice rituals according to field study, interviews, and YouTube videos, as categorized: 1) various rice landrace-based offerings during *manta'da* (['to ask'], a ritual for feeding the ancestors' spirits, asking for blessings, and giving thanks to the ancestors (Yamashita 1978). This ritual is performed by clans at the sacred sites; 2) stages of cultivating rice landrace; and 3) remembering memories of rice landrace. One feasible way to increase engagement with biodiversity might be to increase people's emotional attachment to nature and particularly to wildlife (Hanisch, Johnston, and Longnecker 2019). Toraja has various traditions that involve rice during the rituals, which are recorded, archived, uploaded, and broadcasted on YouTube. We pursued this study according to research questions (RQ) as follows: 1) How might conservation of Toraja rice landraces be practiced continuously?; 2) What are the current forms of conservation that are developed and accepted as Toraja socio-cultural activities?; 3) How do social media

platforms, YouTube for instance, contribute to conservation efforts in rice landraces? and 4) What are the social implications of conservation education through social media?

## 2. Method

- **Study Area**

  Study areas in Tana Toraja regency were four *lembang* (village): Pongbembe, Tumbang Datu, Siammang, and Ollon, and four *lembang* in Toraja Utara regency: Tondon Matallo, Sa'dan Pebulian, Buntu Tallunglipu, and Dassiriri. General descriptions of the study areas are described in Table 1 as follows.

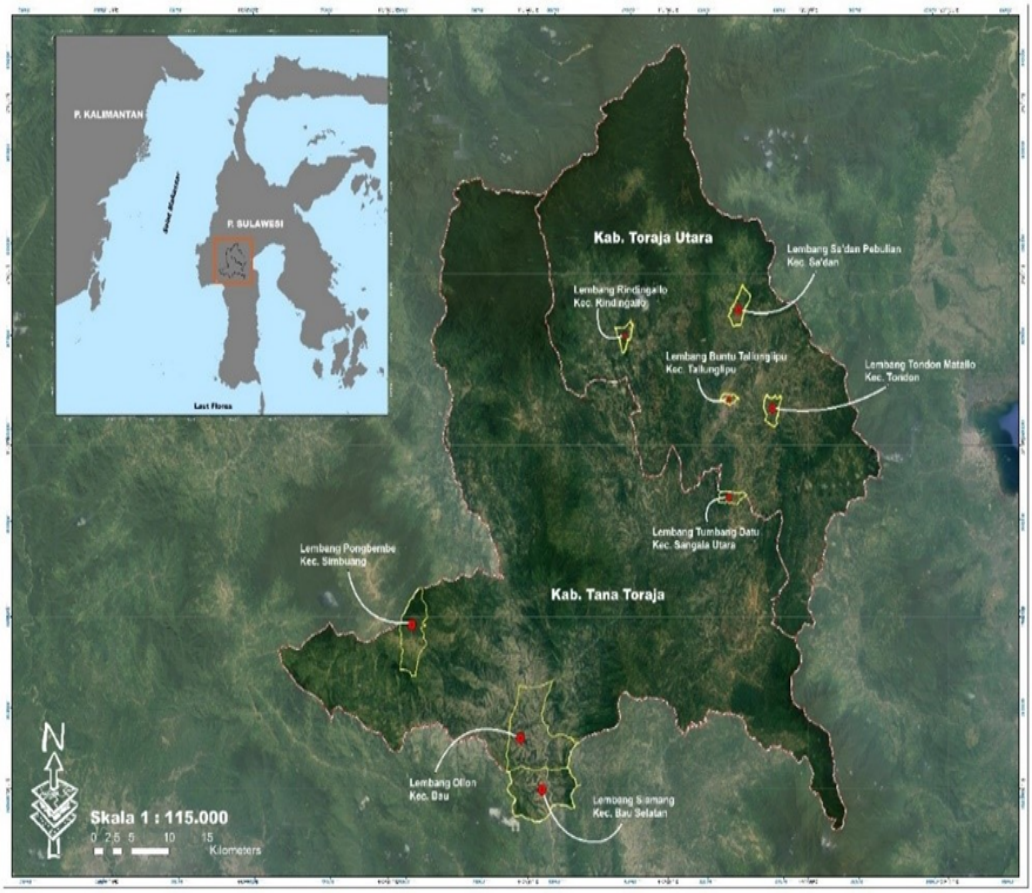



Figure 1. Map of the study areas

Table 1. General characteristics of the study areas

| Village/Size | Location/ Altitude | Population | Religions | Plantation areas (Mha) |
|---|---|---|---|---|
| Pongbembe (Simbuang)/ 17,41 km² | 119°31′47.91″ east (E) and 3°11′6.76″ south (S)/Between 1300 to 2000 masl | 925 | Catholic Moslem Protestant *Aluk To Dolo* (Toraja ancestral religion) | • 107 ha of rainfed rice fields<br>• Harvested area of rice 1454 Mha, maize 18 Mha, sweet potato 2 Mha<br>• Planted area of coffee 753 Mha, cacao 333 Mha, clove 104 Mha ([BPS] Badan Pusat Statistik Kecamatan Simbuang 2018) |
| Tumbang Datu (Sangalla' Utara)/3,85 km² | 119°54′25.56″ E and 3°3′1.76″ S/between 750 masl to 1100 masl | 7639 | Catholic Protestant *Aluk To Dolo* | • Rainfed rice fields, 78 ha<br>• Rice field area village irrigation 15 ha, rice field wetland 93 ha (BPS Kecamatan Sangalla' Utara 2018) |
| Siammang (Bau Selatan)/ 33,40 km² | 119°41′3.92″ E and 3°19′56.66″ S/between 150 masl and 1200 masl. | 1,008 | Moslem Protestant | Available data for Bonggakaradeng Subdistrict:<br>• Red bean harvested area is 14 ha, long bean 25 ha, hot chilli 30 ha,<br>• Arabica coffee planted area is 271 ha, and Robusta coffee planted area is 240 ha. (BPS Kecamatan Bonggakaradeng 2018) |
| Ollon (Bau)/ 64,79 km² | 119°40′21.70″ E, 3°17′21.04″ S/between 150 masl to 800 masl | 883 | Moslem Protestant | |
| Tondon Matallo (Tondon)/ 9,30 km² | 119°57′26.33″ E and 2°57′51.47″ S/between 800 masl and 1000 masl | 2768 | Catholic Protestant | • Rice field 785 ha<br>• Rice harvesting area was 2,178 ha, maize harvesting area was 2 ha, cassava harvesting area was 2 ha, and chilli harvesting area was 1 ha.<br>• Planted areas of Arabica coffee include 125 ha, Robusta 164 ha (BPS Kecamatan Tondon 2018) |
| Buntu Tallunglipu (Tallunglipu)/ 0,86 km² | 119°55′0.68″ E and 2°56′52.43″ S/between 800 masl and 900 masl | 1,056 | Catholic Protestant | • Rainfed rice field 123 ha<br>• Rice was harvested on 1,320 ha, scallions on 4 ha, and long beans on 3 ha.<br>• Planted areas of Arabica coffee are 20 ha, cacao 55 ha, vanilla 20 ha, and Robusta coffee 13,5 ha (BPS Kecamatan Tallunglipu 2018) |
| Sa'dan Pebulian (Sa'dan)/ 4,56 km² | 119°55′8.56″ E and 2°51′57.51″ S/between 900 masl and 1200 masl | 1,168 | Catholic Protestant | • Rice field area 107 ha, simple irrigated 882 ha, rainfed 307 ha<br>• Rice was harvested on 1,921 ha, maize on 20 ha, cassava on 6 ha, and passion fruit on 5,468 ha. (BPS Kecamatan Sa'dan 2018) |
| Dassiriri (Rindingallo)/ 6,63 km² | 119°46′51.18″ E and 2°53′35.09″ S/between 1000 masl and 1300 masl | 866 | Catholic Protestant | • Harvested areas of rice include 1,130 ha, maize 2 ha, cassava 12 ha, sweet potato 2 ha, hot chilli 17 ha.<br>• Arabica coffee has a planted area of 1,003 ha, while Robusta has 35 ha, cacao has 27 ha, and vanilla has 18 ha (BPS Kecamatan Rindingallo 2018) |

Chang (1976) discovered two types of cultivated rice: *Oryza sativa* from Asia and *Oryza glaberrima*, African rice, which are grown on a limited scale in West Africa. Rice belongs to the Gramineae or grass family, together with wheat, corn, rye, oats, and barley. Rice, a member of the genus Oryza, was first cultivated around 130 million years ago and has since spread as a weed throughout Gondwana and parts of the continents of Asia, Africa, America, Australia, and Antarctica. *O. sativa* and *O. glabberima* are the evolution of food plants from wild rice, which are common in Asia, *O. rufipogon* or *O. nivara*, which are cultivated by O. *sativa*. *O. glaberrima* was domesticated as *O. breviligulata*, then evolved from perennial *O. longistaminata* (Khush 1997). Villa et al. (2005) argued that landraces are dynamic populations of cultivated plants that have a historical origin, a distinct identity, and lack formal crop improvement, as well as being genetically diverse, locally adapted, and often associated with traditional farming systems. Archaeological data is a key element in documenting the origins and spread of rice from its centers of origin throughout much of Asia (Fuller 2011). Migrating people from the Malay Archipelago in the 5th and 6th centuries may have introduced tropical japonica varieties of rice, possibly from Indonesia (Khush 1997 ; Dewar and Wright 1993). Another study of domesticated rice began at least 3,500 years ago through the discovery of rice phytoliths in the Minanga Sipakko site, West Sulawesi (Deng et al. 2020), approximately seven hours by car from Tana Toraja. Nevertheless, there is no further research that has found evidence of the possibility of migration or circulation of ancient rice at the archaeological site with Toraja rice landrace varieties.

- **Methods**

Collecting data was carried out in December 2018 through May 2019, with some research methods. Firstly, to answer, "How might conservation of Toraja rice landraces be practiced continuously?" and "What are the current forms of conservation that are developed and accepted as Toraja socio-cultural activities?", we conducted: (1) field observations, (2) in-depth interviews, (3) mapping the distribution of rice landrace varieties in eight fields of study, and (4) calculating Index of Cultural Significance (ICS) on rice accessions developed by Turner (1988). ICS is defined as "the importance of the role that [a plant] plays within a particular culture"; that is, its use by people. This formula is based on three criteria: (a) quality of use, refers to how often a plant is used on a daily, seasonal, or annual basis; (b) intensity of use scale, based on this frequency, or intensity of use; and (c) exclusivity of use, refers to plants that take precedence over other species for a specific purpose. In this category, plants are evaluated on a three-point scale (2, 1, 0.5), where the highest score is given to preferred species. The formula for calculating the ICS score is:

**ICS = ($q_1$ x $i_1$x $e_1$) $u_1$ + ($q_2$ x $i_2$ x $e_2$) $u_2$... ($q_n$ X $i_n$ x $e_n$) $u_n$**

and 5) satellite image processing to present spatial analysis on changing land covers of rice fields.

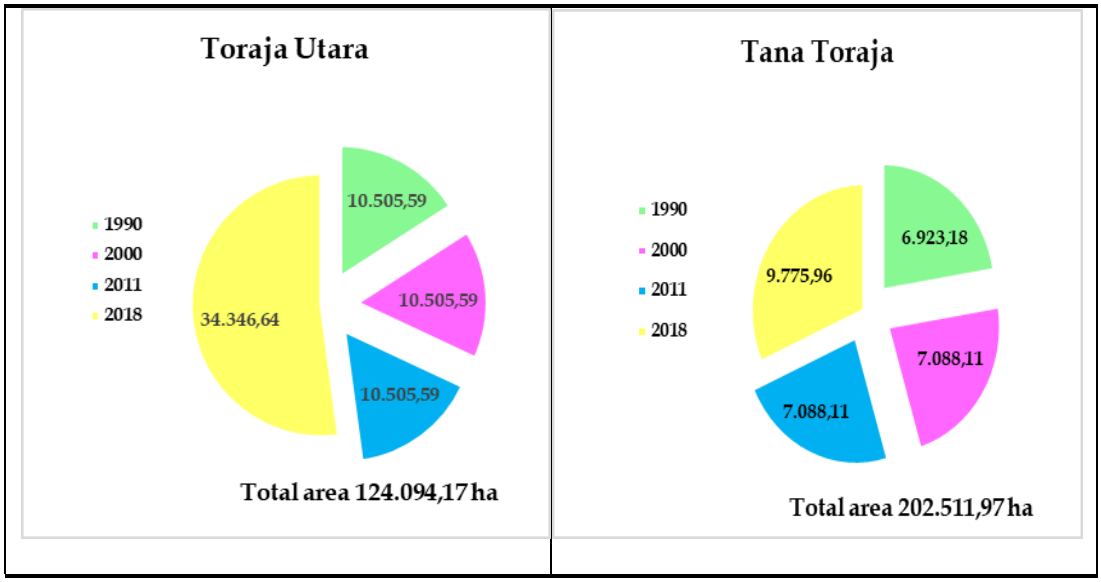



Chart 1. Rice fields (in hectares) change in five time series.

Generally, geotagging is the process of identifying locations in the form of cities or open/closed spaces based on coordinate points, namely longitude and latitude. We identified land-use changes to supply information on rice fields, as a crucial problem for planners and policymakers (Saing, Djainal, and Deni 2021).

Secondly, using Network Overview for Discovery and Exploration in Excel (NodeXL and Application Programming of Interfaces (APIs) to answer, "How do social media platforms, YouTube for instance, contribute to the conservation efforts in rice landraces?" and "What are the social implications of conservation education through social media?". This digital method was conducted on June 16, 2021, to visualize graphs of YouTube video networks and calculate the frequency of word occurrences according to search strings for the Toraja rice ritual. We searched YouTube videos related to rice rituals performed by *Aluk To Dolo* believers, either in Tana Toraja or Toraja Utara. Digital methods were conducted to search tags "ritual aluk pare todolo", "musim panen tanam" (season planting harvesting), "padi Toraja" (rice Toraja). The PageRank algorithm in Google determines the most important page on the web, based on its position in the web's network (Hansen et al. 2020). Page et al. (1999) and Cebolla (2021) argued that a high PageRank score means that a process is directly linked to other important processes in the network with a high degree of centrality. Five tools mostly preferred by experts were Node XL, Gephi, UCInet, MuxViz, Mathematica, SNAP, StatNet, NetMiner, Pajek, NetworkX, and LibSNA (Iacobucci et al. 2017; Majeed et al. 2020). Centrality indices of PageRank offered by Mathematic, NetMiner, NodeXL, and SNAP. NodeXL input supports a wide range of formats (Iacobucci et al. 2017). NodeXL provided excel format data of YouTube. Each YouTube video contains four primary components: the Thumbnail of the video, the Title of the video, the keywords (also known as tags), and the description of the video. The meta-level features are constructed using the Thumbnail, Title, and Keywords (Hoiles, Aprem, and Krishnamurthy 2016).

Digital conservation presented data from online sources and camera trap images, and trends interaction human-nature interaction. Conservation culturomics is a strictly quantitative analysis based on word frequency counts and linguistic change over time, image data, access statistics, and similar metrics of digital salience (Ladle et al. 2016 ; Correia et al. 2021). Some of these service providers make data available only to authorized users, whereas others provide it publicly. Previous studies used APIs to extract large amounts of behavioral data (Sohail et al. 2021 ; Tran et al. 2021). This article contributed to how social media is defined by research from different scientific and non-English backgrounds, also elaborating on the use of social media in different cultural contexts (Aichner et al. 2021). The aim of this content analysis is to stand for biodiversity-related to rice rituals and informatics of tagged vernacular language in YouTube videos. Keyword extraction is defined as an activity that automatically finds a set of terms that best describe the subject of a document. The availability of vernacular languages on YouTube helps the target audiences, such as native speakers and researchers (Moriarty and Pietikäinen 2011). Tagging vernacular languages in YouTube videos also contributes to inclusive policy in the agriculture system.

## 3. Result and discussion

- ***RQ1. How might conservation of Toraja rice landraces be practiced continuously?***

Rice has intrinsic values of strength and growth, coolness, vitality, softness, and moistness. The value of rice quantity refers to wealth, good fortune, and potency. Toraja's world view was centered on *tallu lolona* (three shoots of life), including humans (*lolo tau*), animals *(lolo patuoan)* and plants *(lolo tananan),* and *a'pa' tauninna* (four tembuni) encompassing the complexity of the rituals and humbling oneself before God. Rice prescriptions and rituals are attached in *aluk pare*, as part of *aluk tananan* in *lolo tananan* (Sandarupa 2014). Previous studies on Toraja used various terms to refer to *aluk* (prescriptions, Hollan (1988), *pare*: rites agraries (Koubi 1975), rice ritual (Tsintjilonis 2000) or the ritual cycle associated with cultivation (Waterson 2009). Tsintjilonis (2000) states that plant rituals also apply to protect and strengthen crop yields, for example, corn and cassava. Michel (2006) and Rappaport (2020) stated that in 1945, the Indonesian government obliged citizens to adhere to official religions, excluding *Aluk To Dolo*. Recently, the transmission and preservation of rice knowledge and value has passed down from the older to the younger generations by cultivating rice landrace varieties for daily consumption and rituals. Some of the rice rituals are still continuously practiced today, despite the performers' being Christians or Catholics. Here, practicing rice rituals as part of vernacular religion is coexisting with the way of life.

> *"Obviously, the ancestors initiated aluk panaungan annual ritual which is performed by to bara' ('the great'), to parengnge' (priest-leader), to minaa ('the one who knows'), and village leaders. This communal ritual is performed in sacred places, pedatuan (a site for medatu), penammuan (a site for memmamu), pa'buaran (a site for ma'bua' [ritual of thanksgiving for the crops] [ Sandarupa 2015 ]) … 1) Manglullu': trampling, treading, and beating the rice, and offering a small chicken in the house. The best days for sowing seeds are calculated by*

*loan banne (arranging the time for sowing the seeds according to village deliberations and astrology). Some impermissible things can be done if the seeds have been sown in the nursery, including not opening the door to the grave and not putting the dead body into the tomb. Forbidden to sow the seeds during three allo pasa' (local market days: pasa' Bombongan, Pasa' Makale, and Pasa' Sule Kalambe;), (2) Offering piong or pokon (boiled-glutinous rice, wrapped in bamboo leaves) on nursery beds before mangambo' (sowing the seeds). Mangambo' also known as dibabo bo'bo'i. Babo means putting rice on top of the pot. The offering is placed on a dike in the nursery withouta an invocation or word (Koubi 2008). Every activity must offer pesung (offerings), a symbol of the relationship between gods and humans; 3) After the seeds have been sown in the nursery, rice seedlings are transferred to be planted on the rice fields. The ritual of ma'popennuaka' is performed to strengthen seedlings' roots. Women are not permitted to plant seedlings during menstruation... Any meat that brought from the ritual of death should not be brought into the fields, with the exception of roasted meat as an offering at the rice fields. Rice will not flourish…There are rice fields that were planted with sandalwood. Large rice fields and a ritual performed…offered a pig... When the rice grains appeared, pemali to eat chicken eggs, sweet potatoes, and banana; 4) Messussun or messun carried out after the grains appeared, for protecting from pests and diseases; 5) Ma'parapa', medatu (offering a cock on a hill for blessing the rice plants), ma'ta'da or manta'da; 6) Mepare (harvesting). Harvested rice is brought to pangrampa' (special site for drying harvested rice) for mangallo (drying under the sun). In the past, each tongkonan (big family) had a pangrampa' and rice field(s). There is also a ritual for weeding pangrampa'; 7) ma'taa litak (distributing harvested rice to pariu [labour], to ma'uma [rice field owner], and all volunteers), then manglemba' (carrying the rice on shoulder) to the house; 8) Manglika' (storing sheaves of grain into alang [granary]) by offering chicken and piong; 9) Ma'belundak or ma'karirik (cooking belundak or karirik [boiled sticky rice which is wrapped in young sugar palm [Arenga pinnata Merr.] leaves, rolled like a small tube), for offering in the end of rice ritual…". (Interview, M, 5 February 2019, Makale).*

Tammu and van deer Veen (2016) described some of Toraja rice landrace varieties in Kamus Toraja-Indonesia (Dictionary Toraja-Indonesia): *Pare Barri, Pare Barri Busa, Pare Bulaan, Pare Bongi-bongi, Pare Datte', Pare Kombong, Pare Lallodo, Pare Mandoti, Pare Sikolong, Pare Kua', and Pare Kasalle* (Pare Dolo). Bieshaar (1926) reported some conditions of agriculture in Toraja: 1) four granaries lined up; 2) people replaced rice with maize during mourning; 3) methods of growing rice in the highlands, which are carried out during the rainy season in December; 4) transplanted seedlings after sowing for two months from the nursery to a larger rice field; 5) men cultivated soil by using shovels and women helped to plant; 6) weeded rice fields twice; and 7) harvesting after five or three-six months of planting, as a characteristic of the rice landrace. Limbongan and Djufry (2015) compared harvesting time of some Toraja landraces: *Pare Bau'* 157,60 days, *Pare Kombong* 165,60 days, *Pare Lea* 173,40 days, *Pare Ambo'* 134,00 days, and *Pare Lallodo* 155,40 days.

Land cover changes in Chart 1 were obtained using satellite data processing. This chart shows the number of rice fields in Tana Toraja has increased since 1990 to 2018. This trend was also found in Tana Toraja Utara. Although the number of settlement areas is also increased in both regencies, it does not have a significant effect on the area of rice fields. The area of water bodies and secondary forests in each regency has also not been much reduced, so rainfed rice fields can still be watered from water resources. Toraja culture identified three categories of *uma* (rice field) land tenure: 1) *uma nene'* (rice

fields belonging to ancestors), namely rice fields that are jointly owned by a large family bilaterally. This ancestral rice field may not be sold, bought, or handed over to others. *Uma nene'* consists of *uma garonto*' ('root' rice fields or early rice fields owned by *tongkonan*), *uma tongkonan* (rice fields belonging to tongkonan) and *uma mana*' (heirloom rice fields), and *uma dianna* (saved rice fields). The owner of the *uma mana'* can be traced back to the 25th generation. *Uma dianna* may be sold to another person, according to the agreement of the members of the tongkonan family. The harvest from the ancestral fields is divided among family members and can be consumed by certain members in a ceremony; 2) privately owned rice fields can be divided into: 1) newly processed rice fields (*uma digaraga*) and 2) purchased rice fields (*uma pangalli*). These rice fields are usually privately owned and can be traded. These types of rice fields are according to uma categories in Minanga, Tana Toraja (Yamashita 1982). *Tongkonan* owns the property of land, which consists of 1) *kombong tongkonan* (dry land, for example fields) which can be used directly by tongkonan members, and 2) *kande tongkonan* (wetland in the form of rice fields) (Lintin 2016). The complexity of the rice field ownership system could be the reason why the area of rice fields in Tana Toraja and Toraja Utara has not decreased significantly, apart from the explanation of land conversion from fields to rice fields.

- **RQ2: What are the current forms of conservation that are developed and accepted as Toraja socio-cultural activities?**

This recent article particularly presented consuming rice landrace varieties and *aluk pare* (rice prescriptions) in *manta'da* ritual. *People performed it* at the front of rock graves. All offerings are placed facing to *kalambunan* (the west), which represents mortuary rites. We highlighted rice landrace varieties to make the main offerings, *indo' pesung*, as shown in Figure 2 and Chart 2. *Indo' pesung* contained various rice-based offerings, scraps of certain parts of pig, and was poured with *tuak* (alcohol beverage, made of sap tapped from sugar palm [*Arenga pinnata*]). We did not attend and directly see this *manta'da* ritual due to the procedures for obtaining research permits at the provincial, district, sub-district, and *lembang* (village) levels. The ritual has been performed, but the research permits have not been issued yet. However, we used several research methods to present the values, meanings, symbols of rice, as we interviewed the performers, also observed the sacred sites for this ritual in Tumbang Datu. We also used a digital method by presenting photographs of this ritual. YouTube videos of *manta'da* were also attached in this article to complete the description of *aluk pare* of *indo' pesung*.

Figure 2. (A) The performers of *manta'da*; (B, C, D) Preparing rice to cook the offerings; (E, F) Opening wrappers of the cooked rice-based offerings, G) Popped rice to spread over *indo' pesung*, the main offering; (H) Arranging, *indo' pesung*, as shown in Chart 2; (I) Lifting up *indo' pesung* to put on the altar for the spirit of ancestors. Other offerings were *pangngan* (beetle nut chewing): seed of *kalosi* [Areca catechu] wrapped in *daun bolu* [leaves of Piper betle L.] and sprinkled with *kapu' suso* (burned snail [Melanoides tuberculata] shell), *daun sambako'* [Nicotiana tabacum], and money. Photo credit: Ivan Roma Manukrante, 2016; Selfina Ruru' Gallaran, 2020.

Chart 2 showed various rice-based offerings as follows: A banana leaf was put first as a plate for the offering. Next, *bo'bo' unta'* (yellow porridge) is spread on the surface of a banana leaf. Followed by three *kalussung lotong* in the centre, made of black glutinous or non-glutinous rice. All *kallussung* are rice mixed with grated coconut and wrapped in banana leaves, which form a cone. Next, *belundak lotong* made of black glutinous rice. All the *belundak* were glutinous rice mixed with grated coconut and wrapped in woven young palm leaves, tied with one other belundak. Then *kalussung lea*, *pare pulu' lea* (red glutinous rice). Followed by *belundak lea* and *katupa' busa* made of pare *pulu' kombang* (white glutinous *kombong*). *Katupa'*, packed rice inside a diamond-shaped container of woven palm leaf pouches. Next, *kalussung busa*, made of white glutinous rice, and *belundak busa* also made of white glutinous rice. *Katupa'* riri is made of white glutinous rice that has been coloured with turmeric. *Belundak riri*, made of white glutinous rice added with turmeric to get yellow, then *la'pa'*, pounded red glutinous rice, wrapped in banana leaf, formed a rectangular shape. *Kambatu* made of pounded red glutinous, flat rectangles wrapped in banana leaf. All these offerings are boiled. *Piong roro*, pounded red glutinous, cooked in the bamboo tube. *Ra'tuk*, roasted red glutinous, was sprinkled on the surface of all these offerings. Glutinous rice is culturally preferred as a staple food (Fuller and Castillo 2016 ; Sattaka, Pattaratuma, and Attawipakpaisan 2017). At each of the four sacred sites, four times of *manta'da* were performed. Descendants offer *indo' pesung* in different numbers, depending on how many ancestors will be "encountered". Each *indo' pesung* is served with four *anak pesung* (additional pesung). *Anak pesung* also served on banana leaf, with scraps of pork, and the rice-based offerings of *indo' pesung*. Interviewees identified these varieties of rice as "glutinous" and "rice color", except for the vernacular name of "*Pare Pulu' Kombong*".

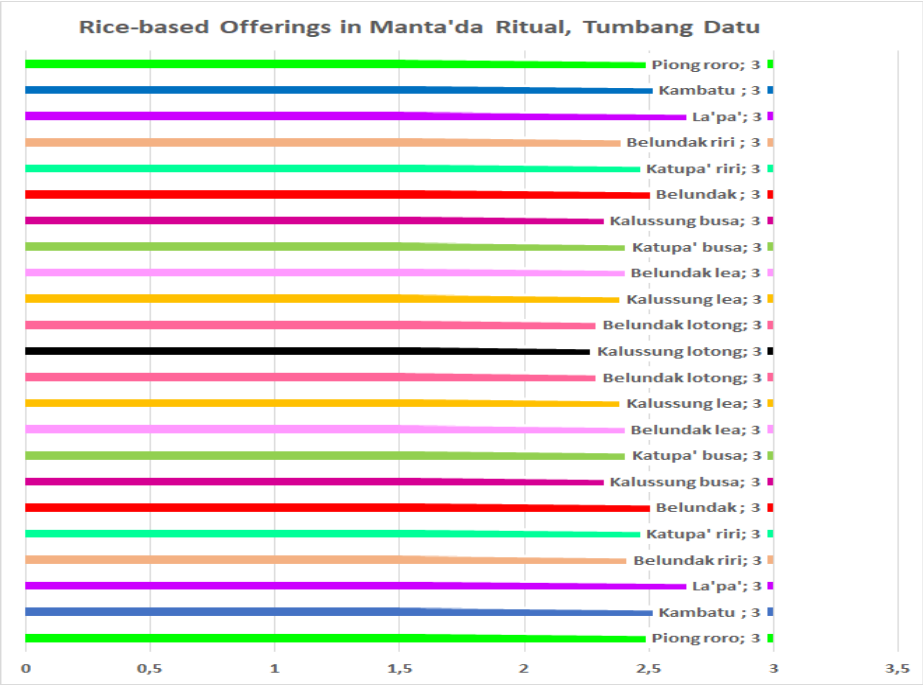



Chart 2. Various rice-based offerings of *indo' pesung*.
Distinct colours represented each type and the number of offerings.

Here the ICS is equal to the sum of individual ''use'' values from 1 ton, with *n* representing the last use described; the values of 1 through *n*, consecutively. For each ''use'' given, q = quality value, i = intensity value, e = exclusivity value. Central to Turner's formula is the notion that plants can be ranked in importance. Various ICS of high yield and rice landrace varieties have been calculated as follows.

| Accessions | (A) | (B) | (C) | (D) | (E) | (F) | (G) | (H) | ICS |
|---|---|---|---|---|---|---|---|---|---|
| **High Yield Varieties (HYVs)** | | | | | | | | | |
| Beras Kepala | v | - | - | - | - | - | - | - | 9 |
| Mekongga | v | - | - | - | - | - | - | - | 9 |
| Cisantana | v | - | - | - | - | - | - | - | 9 |
| Pare Pulu' Sapi' | - | v | - | - | - | - | - | - | 9 |
| Sedani | - | - | - | - | - | v | - | - | 9 |
| Marlina | - | - | v | - | - | - | - | - | 9 |
| Bogor | - | - | - | - | - | v | - | - | 12 |
| Inpari 46 | v | - | - | - | - | - | - | - | 21 |
| Ciliwung | v | v | - | - | - | - | - | - | 16 |
| Sentani | v | - | - | - | - | - | - | - | 25 |
| Pare Seko | - | - | - | v | - | - | - | - | 25 |
| Mansur (Mangsur) | - | - | - | v | - | - | - | - | 50 |
| Pare Jawa (pulu')/ kombong/bau' | - | - | - | v | - | - | - | - | 50 |
| Samarata | v | - | - | - | - | - | - | - | 50 |
| Sarti | v | - | - | - | - | - | - | - | 50 |
| Pare Kate' (Pare Bela') | - | v | - | - | - | - | - | - | 50 |
| Mansur Putih | - | | v | - | | v | - | - | 50 |
| **Rice Landrace Varieties (RLVs)** | | | | | | | | | |
| Pare Lomben | - | - | | - | - | | v | - | 44 |
| Pare Urang | - | - | v | - | - | v | | - | 4,5 |
| Pare Kasalle | - | - | | - | - | v | | - | 19 |
| Pare Ikko' Lea (Puru' Datte') | - | - | v | - | - | v | v | - | 16 |
| Pare Rogon | - | - | v | v | - | - | - | - | 32 |
| Pare Pulu' Nakka' | - | - | - | - | - | v | v | - | 32 |
| Pare Palapa | - | - | - | - | - | - | v | - | 32 |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Pare Pulu' Kaloko' (Pare Seba) | - | - | v | - | - | - | - | - | 32 |
| Pulu' Bongi-bongi | - | - | v | - | - | - | v | - | 32 |
| Pare Tanduk | - | - | - | v | - | - | v | - | 46 |
| Pare To' (Tu') | - | - | - | - | - | v | - | - | 25 |
| Pare Ambo' | - | - | v | v | - | - | - | - | 74 |
| Pare Pulu' uban | - | - | - | - | - | - | v | - | 48 |
| Pare Pulu' Kaloko' (Ikko' Seba) | - | - | - | v | - | - | - | - | 48 |
| Pare Bau' | - | - | v | - | - | - | - | - | 50 |
| Pare Baine | - | - | - | - | - | - | v | - | 70 |
| Pare Dewata (Pare Tarrung) | - | - | - | v | - | - | v | - | 70 |
| Pare Boang Kamiri | - | - | - | - | - | - | v | - | 56 |
| Pare Pulu' Kupa | - | - | - | - | - | - | v | - | 48 |
| Pare Tongoran | - | - | - | - | - | - | v | - | 48 |
| Pare Lallodo | - | - | v | v | - | - | - | - | 48 |
| Pare Lotong | - | - | - | - | - | v | - | - | 24 |
| Pare Pulu' Kombong | - | - | - | v | - | v | - | - | 58 |
| Pare Pulu' lotong (Lallodo) | - | v | - | - | - | | - | - | 16 |
| Pare Pulu' busa | - | v | - | - | - | v | - | - | 29 |
| Pare Bua Banga | - | - | - | v | - | - | - | - | 4,5 |
| Pare Lea (Pare Rarang) | - | - | - | v | - | - | - | - | 28 |
| Pare Seko | - | - | - | v | - | - | - | - | 58 |
| Pare Bintoen | - | - | - | - | - | - | v | - | 22 |
| Pare Jawa (Pulu')/ Kombong/Bau' | - | - | - | v | - | - | - | - | 58 |
| Pare Barri (mararang & mabusa) | - | - | v | - | - | - | - | - | 58 |

Table 1. Availability rice varieties: (A) Buntu Tallunglipu, (B) Rindingallo, (C) Tondon Matallo, (D) Sa'dan Pebulian, (E) Siammang, (F) Tumbang Datu, (G) Pongbembe, (H) Ollon, (ICS) Index Cultural Significance

We compared some characteristics of these villages. Farmers are cultivating landraces for daily consuming, storing, or sharing and circulating. Meanwhile, farmers in Dassiriri and Buntu Tallunglipu prefer HYVs to tackle challenges, such as lacking labour and time-consuming before harvesting. Nonetheless, some glutinous rice and rice landrace varieties were consumed during funeral ceremonies, harvest rituals, or any ritual that involved more people to feed.

> *[Do you consume special rice for certain events?] Yes... ma'pokon (cooking pokon: white glutinous rice mixed with coconut flakes, wrapped in bamboo leaves, and then boiled) ... We used HYVs pare pulu' lotong (black glutinous rice) and pulu' busa (white glutinous rice). We served on thanksgiving at Mangrara Banua (the renovated house of Tongkonan), and during the harvest season (usually twice a year, June, and December), weddings... We also cooked kasube lenten, made of black glutinous rice and white glutinous rice wrapped in bamboo leaves, a kind of burasa' (rice mixed coconut milk, wrapped in banana leaves), belundak (black glutinous and white glutionous rice, mixed to coconout milk, wrapped in sugar palm leaves), piong bo'bo' (cooked glutinous rice into bamboo), deppa kakau (rice cake covered by brown sugar), deppa kaladi or unggus-unggus (pounded black rice, filled brown sugar, wrapped in banana leave)...[Is there any rice landrace cultivated in this village?] Not anymore... We have to wait a long time for the harvest, six months to be exact, while Pare Kate' only four months... There are no seeds...The process of cleaning the grain twice after harvest...The soil here is red and sandy, not suitable for local rice (Interview, Focus Group Discussion, Dassiriri).*

> *[How many grains are stored in the granary now?] Approximately 4,250kg, Inpari 46 and Sarti. I forgot the other varieties. [What variety is stored the most now?] Sarti…. More planted. [Is this grain for sale?] No, only for daily consumption. [Does it taste better?] Yes…pest resistant... [Did you just plant it? Who helped you plant rice seedlings?] There were many people. Some of them were volunteers, and some received saro (payments or rewards for working) ma'tallungleso (a shared rice harvested system which covers: one-third for the rice field owner, one-third for people who cultivate rice field, and one-third for the rice reapers). [How much is the wage for cultivating rice?] IDR 50,000 per day... Glutinous rice is also used for ma'pokon. Pokon distributed by the tongkonan (clan), who performed the higher mortuary ritual (Aluk Rapasan),*

> *to the shepherds and all the relatives who attended the ritual, before ma'pasa' tedong (the process of collecting and displaying all the buffaloes which are to be slaughtered in one place, usually at the place where the funeral ceremony is held). Each buffalo is given a certain title and shouted by the ceremonial leader. The most important buffaloes are 1) balian, representing leadership; 2) bonga, representing torch or light; 3) pudu', representing guardian; 4) todi', as a unifier for maintaining kinship ties; 5) sokko, representing humble person; 6) tekken langi ' buffalo is as a safeguard that reconciles Toraja people over the conflict; and 7) sambao', customary guardians for customary offenses (Tanduk, Maruf, and Suluh 2021). Ma'pasa' tedong followed by ma'pasilaga tedong (buffalo fighting) which leads the buffalo as it is paraded around the place of the ceremony (Interview, F, 20 March 2019, Buntu Tallunglipu).*

Villagers in Ollon and Siammang are cultivating another crop, i.e., red beans and onions since the soil and rocky terrain are tough for rice fertility. RLVs and *aluk pare* recalled in Ollon since the villagers have been cultivating rice and used to be the immigrants who hold collective memories, as attached in the interview.

As shown in Table 1, Pongbembe has the highest diversity of rice landraces compared to Tumbang Datu. Both villages are conducting rituals of *Aluk To Dolo*. Almost all HYVs have not been consumed as offerings in ritual. The most cultivated and consumed HYVs are Buntu Tallunglipu (8 accessions), followed by Rindingallo, Sa'dan Pebulian, and Tumbang Datu (3 accessions), and Tondon Matallo (2 accessions). Interviewees in Siammang and Ollon were not cultivating rice since they were surrounded by soil suitability which does not support cultivating rice. Since these varieties need more chemical fertilizers, which will cause the soil of rice fields to become solidified, lose nutrients, and be tough to cultivate. Villagers maintain the legacy of rice seeds from their ancestors, including all the rules and rituals that consume RLVs. Mansur, Pare Jawa, Samarata, Sarti, Pare Kate', and Mansur Putih scored the highest ICS (50) for daily consumption and are cultivated more than other varieties annually. Inpari 46 cultivated in Buntu Tallunglipu has a moderate score as a diet for obesity. Interviewees in Buntu Tallunglipu, Siammang and Ollon have no longer cultivated RLVs, except Pare Joka grains stored by a household for about ten years. The most cultivated and consumed RLVs for daily consumption and ritual are Pongbembe (13 accessions), followed by Sa'dan Pebulian (11 accessions), Tondon Matallo (9 accessions), and Tumbang Datu (8 accessions). A key interview in Tondon Matallo argued that *alang* (carved wooden granary) is only for storing rice landrace grains.

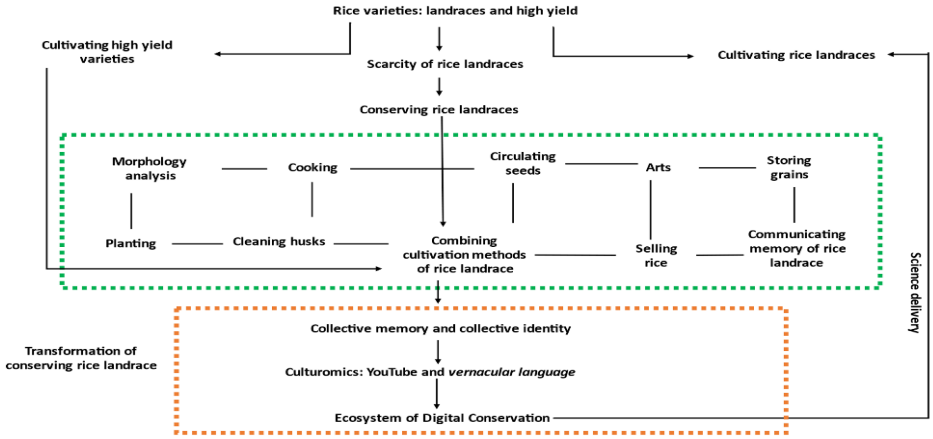



Figure 3. Collective memory and collective identity have been supporting conservation of Toraja rice landrace

Collective memory covers the outcomes of influencing processes, information that individuals have access to, the schemas people use to make sense of the past, and the external symbols or messages that underlie these schemata (DiMaggio 1997). Collective memory can be defined as networking of individual memories that complement each other, which can be added or subtracted in the future through social interactions. The resulting collective memory can be passed down from one generation to the next, and in the end, it can become a cultural artifact produced by society. Maurice Halbwachs (1992) states that the past is always reconstructed and presented in the present. Memory overcomes the temporal and spatial distance between the act of remembering the present and remembering past events. Media plays a role in recording, storing, transmitting, and providing material to support the workings of memory. Memories are constructed by individuals during communication with other individuals in social interactions. Memory is always tied to one social group.

- **RQ3: How do social media platforms, YouTube for instance, contribute to the conservation efforts in rice landraces?**

Due to limited search as we activated API Key, we input 100 search videos with 1,0 levels to include and videos published between: 01/01/2017 and 01/01/2020. We also coded the titles with FFn since the titles were too long to put on the networks and close the visibility on other nodes and vertices. Hence, we adjusted the search string to the keywords "Toraja" and excluded videos that had no relation with the keywords. NodeXL released 438 title videos or vertices and determined PageRank. Videos with the highest PageRank are shown in Table 2 as followed.

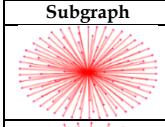
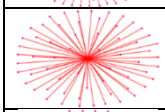
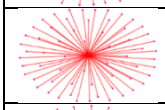
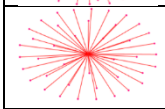
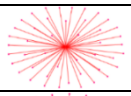
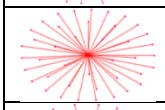
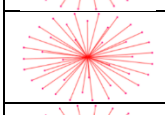
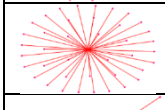
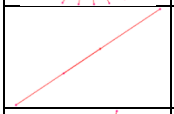
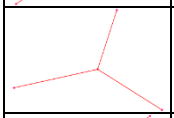
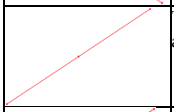
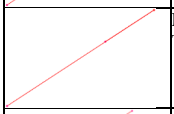
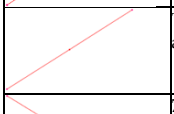
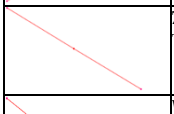
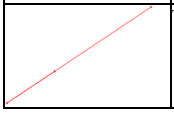
| Subgraph | Title | TC | G | ID | OD | PR | V | C | L | D | CD |
|---|---|---|---|---|---|---|---|---|---|---|---|
|  | Pasar Babi Terbesar di Toraja, Paling Mahal Babi Bertaring - 14 Juta Per Ekor | FF1 | G1 | 0 | 99 | 45,783618 | 7358283 | 4245 | 39570 | 13041 | 2019-09-15 |
|  | Gali Ubi<br>Kayu, Puangbembe Toraja simbuang | FF2 | G4 | 0 | 61 | 28,567534 | 214 | 2 | 25 | 0 | 2020-06-12 |
|  | RITUAL ADAT MENARIK BATU DI TORAJA | FF3 | G2 | 0 | 61 | 27,571616 | 512 | 0 | 2 | 0 | 2019-03-03 |
|  | Suku Toraja | FF4 | G3 | 0 | 54 | 23,951568 | 213 | 0 | 4 | 0 | 2020-04-09 |
|  | RAMBU SOLO' (TORAJA CULTURE) | FF5 | G3 | 0 | 45 | 20,421775 | 1636 | 4 | 16 | 1 | 2018-01-01 |
|  | Learn From Home's Personal Meeting Room | FF6 | G5 | 0 | 41 | 19,378356 | 82 | 0 | 3 | 0 | 2020-08-21 |
|  | MA'ULU UMA \|Tradisi Aluk todolo (Pesta Panen) | FF7 | G2 | 0 | 40 | 18,358482 | 141 | 2 | 10 | 0 | 2020-06-10 |
|  | Penjelasan mengenai salah satu adat Toraja Utara " Rambu Tuka' " | FF8 | G6 | 0 | 40 | 17,858706 | 33 | 0 | 4 | 0 | 2021-02-19 |
|  | KERBAU TERMAHAL DI KURBANKAN PADA PESTA ADAT RAMBU SOLO' TORAJA UTARA INI | FF9 | G6 | 3 | 0 | 1,305359 | 34469 | 13 | 133 | 24 | 2020-12-18 |
|  | Mangriu' Batu (Mesimbuang), Randan Batu, Toraja Utara | FF10 | G6 | 3 | 0 | 1,290707 | 17047 | 2 | 40 | 9 | 2014-09-02 |
|  | Tiga Ekor BAB1 Pilihan untuk Kurban Kepada Leluhur Toraja | FF11 | G3 | 2 | 0 | 0,927286 | 5870046 | 2609 | 9907 | 3851 | 2018-11-01 |
|  | MANTA'DA, RITUAL ADAT ALUK TODOLO DI TORAJA | FF12 | G2 | 2 | 0 | 0,924312 | 469 | 4 | 9 | 0 | 2020-09-18 |
|  | Tiga sekaligus diselesaikan dalam Upacara Rambu Solo' di Toraja | FF13 | G3 | 2 | 0 | 0,91276 | 641766 | 536 | 1150 | 431 | 2017-09-06 |
|  | 7 Ciri Khas Suku Toraja yang Wajib Kamu Tahu | FF14 | G3 | 2 | 0 | 0,91276 | 198763 | 482 | 2613 | 149 | 2019-07-13 |
|  | Wisata Kuburan yang Dikagumi Dunia \| Toraja | FF15 | G3 | 2 | 0 | 0,91121 | 335844 | 106 | 708 | 256 | 2017-07-02 |
|  | TORAJA Berduka ditanah PAPUA | FF16 | G6 | 2 | 0 | 0,906513 | 297109 | 197 | 806 | 106 | 2015-09-18 |

Table 2. Highest PageRank title videos in the network and subgraph images in the network center. TC (Title Code), G (Group), ID (In-Degree), OD (Out-Degree), PR (PageRank), V (number of views), C (number of comments), L (number of likes), D (number of dislikes), CD (Created Date). Out-degree refers to the number of edges (arrows) directed from the vertice (node) in the directed network. In-degree refers to the number of edges directed towards a node. Subgraph images presented the centre of each cluster or group, also the number of out-degree or edges of the node.

The rice ritual with rice landrace-based offerings is depicted in videos FF1 and FF2.The results of filtering on the YouTube videos network that show 2 videos relevant to rice rituals of 185 videos related to Toraja, do not mean that YouTube as a social media platform has not succeeded in achieving conservation efforts. The *manta'da* ritual in the 2 videos serves as digital data for Toraja local rice conservation, in addition to data from in-depth interviews and field studies that have been described previously. The method and process of using NodeXL as a data collection tool used in this study can be replaced by other methods by further researchers.

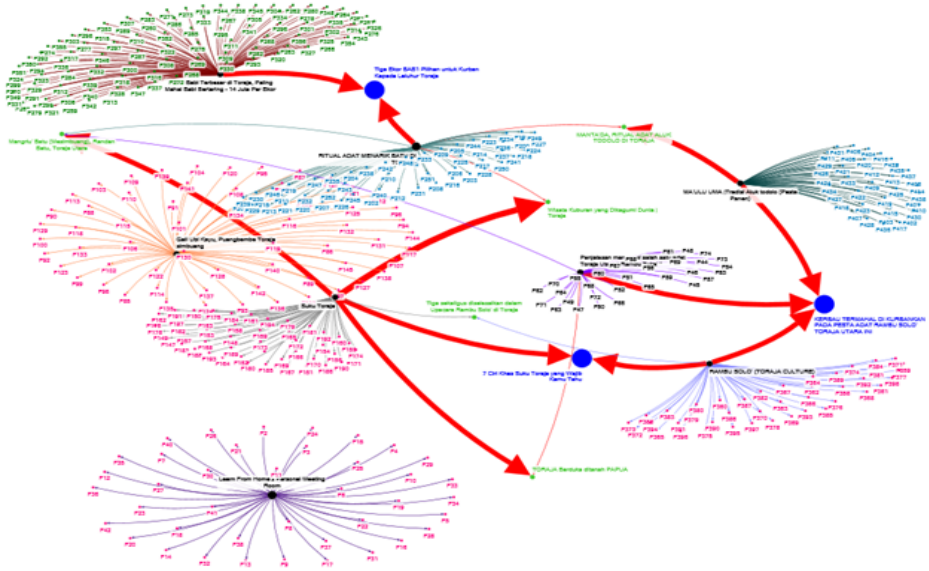


Figure 4. Layout I. The entire network structure of the Toraja rice ritual video. The centrality of the network is determined by the PageRank algorithm. The central edges are depicted in the form of 11 thick red arrows (edges) connected to 3 dark blue circles (vertices). The number of thin arrows consists of 2 red, 1 purple, and 3 grey, which are connected by 5 small green circles.

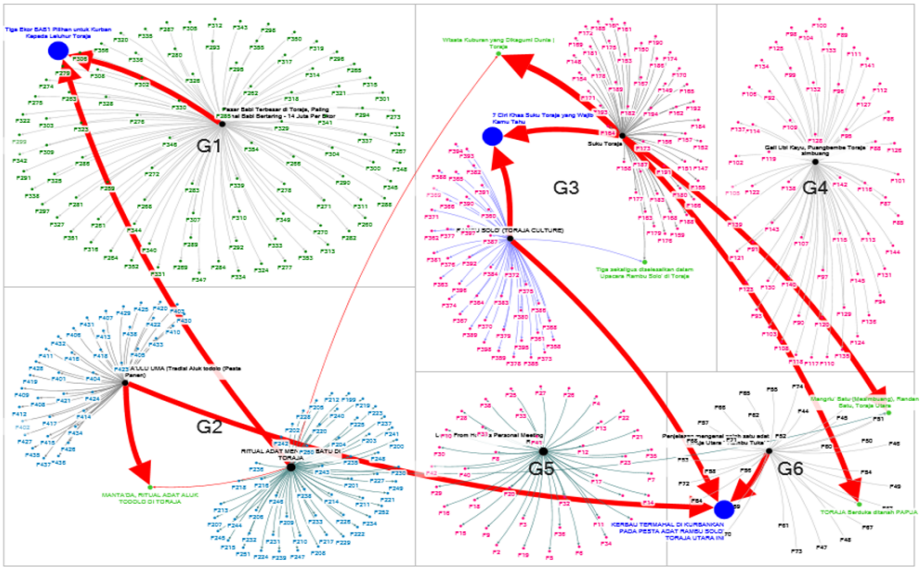



Figure 5. Layout II. The group network (groups or clusters network) consists of 6 groups, which are represented by 6 small black circles.

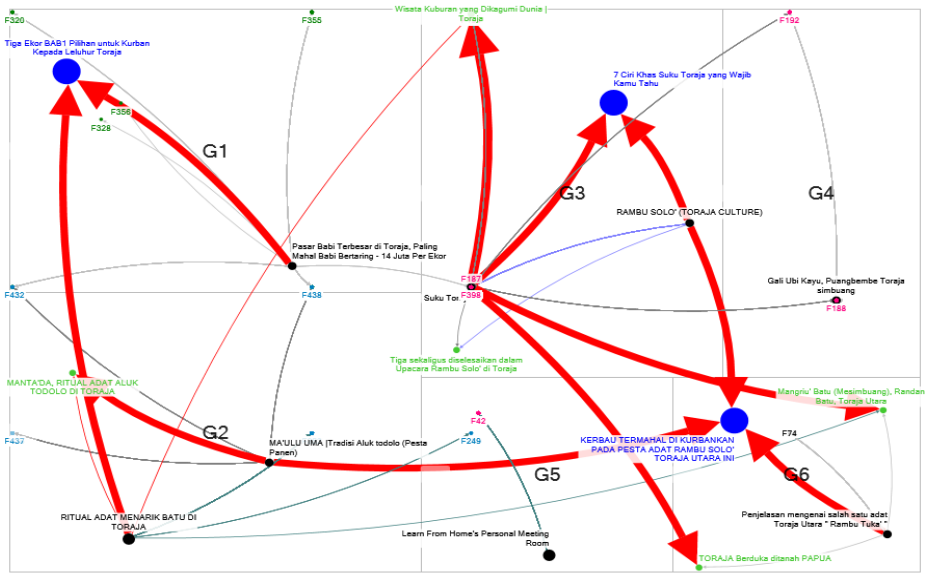



Figure 6. Layout III. The grid layout shows the vertices and edges more clearly. All these network graphic layouts (Figure 4 and Figure 5) are visualized with the Harel-Koren algorithm to describe the directed network map.

As shown on Table 2 and Figure 6, 11 thick red arrows (edges) represented the highest PageRank in the network were: 1 arrow of FF1, 2 arrows of FF3, 4 arrows of FF4, 1 arrow of FF5, 2 arrows of FF7, and 1 arrow of FF8. Followed by 2 thin red arrows of FF3, 1 thin red arrow of FF4, 1 thin purple arrow of FF5, and 2 thin grey arrows of FF8. Thick blue circles were 1 of FF9, 1 of F11, and 1 of F14. 1 for FF10, 1 for F12, 1 for F13, 1 for F15, and 1 for F16 was represented by thin green circles.FF2 and FF6 were central in the group with high PageRank. Nevertheless, both vertices had 0 in-degree (see Table 2).

| Thick red arrows (edges) | Thin red arrows (edges) | Thick blue circles (vertices) | Thin circles green (vertices) |
|---|---|---|---|
| 1: FF1 | 2: FF3 (red) | 1: FF9 | 1: FF10 |
| 2: FF3 | 1: FF4 (grey) | 1: FF5 | 1: FF13 |
| 4: FF4 | 1: FF5 (purple) | 1: FF14 | 1: FF16 |
| 1: FF5 | 2: FF8 (grey) | | |
| 2: FF7 | | | |
| 2: FF7 | | | |
| 1: FF8 | | | |

Table 3. Details of the highest PageRank vertices and edges in the network.

Table 3 showed that a video may be represented by one or more edges, as also shown by the numbers of out-degree in Table 2. Table 2 displayed title videos 'FF1', 'FF2', 'FF3', 'FF4', 'FF5', 'FF6', 'FF7', 'FF8', 'FF9', 'FF10', 'FF14', 'FF15', and 'FF16' did not show the rice ritual of Toraja. Nevertheless, those videos were important vertices as the 'starting point' for users to head to videos F11 and F12, which contained scenes of the rice ritual in *manta'da*. Both titles, FF11 and FF12, were formatted in 1080 pixels, which was the maximum resolution for YouTube High-Definition videos. The authors added similar descriptions without narrations on videos. Hence, combining field studies and

digital methods is contributing best practices to conducting digital conservation and conservation culturomics.

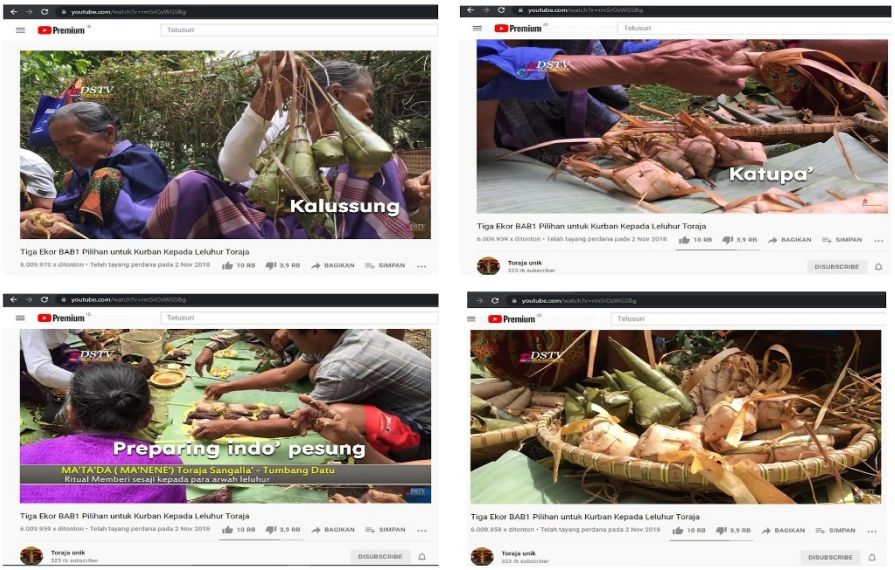



Figure 7. This FF11 video is 33:28 minutes long and shows some various rice-based offerings (See Chart 2). Photo credit: screenshoot from TorajaUnik (2018)

YouTube video data analysis also requires manual analysis to determine if the video title matches the video content, tags, and description. Digital visual content researchers also need to ensure the quality of the video with a standard resolution that can display the scene (image) being analysed, as well as the narration in the form of text or sound that complements the video description. NodeXL also visualized a graph of the YouTube video network, as shown in Figure 4, Figure 5, and Figure 6.

- **RQ 4. What are the social implications of conservation education through social media?**

Of185 videos were identified and added to the excel sheet for visual graph and network analysis. Furthermore, we combined methods of digital conservation, as NodeXL provided profiles of YouTube videos that contained landraces used in rice rituals. Cultural salience is investigated through patterns and frequency of words in vernacular language. As we combined digital conservation and conservation culturomics by NodeXL, the vernacular language was revealed and analysed as a means of preserving cultural saliences in rice landrace biodiversity. The frequency of words by keyword in the search string is presented as follows.

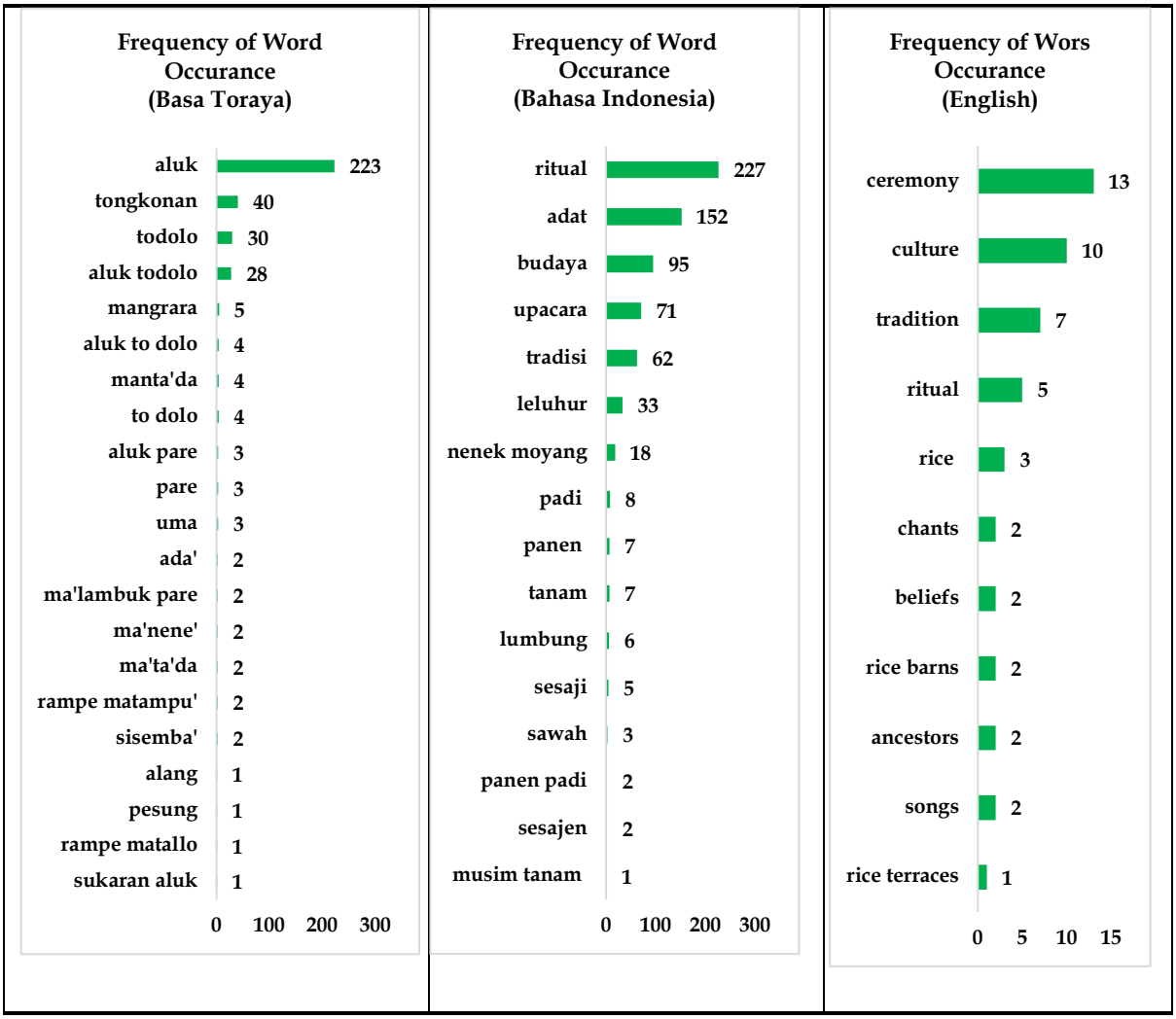



Chart 3. Frequency of occurrences rice-ritual tags by language. *Ritual* (ritual), *adat* (established custom), *budaya* (culture), *upacara* (ceremony), *tradisi* (tradition), *leluhur* or *nenek moyang* (ancestors), *padi* (rice), *tanam* (plant), *lumbung* (granary), *sesaji* or *sesajen* (offering), *sawah* (rice field), *panen padi* (rice harvesting), *musim tanam* (planting season), *aluk* (ritual, prescription), *tongkonan* (house of clan, or clan), *todolo* sometimes written *to dolo* (leluhur), *aluk to dolo* (Toraja ancestral religion), *mangrara* (rites of ordination or consecration for house of tongkonan), *manta'da* or *manta'da* (rituals of asking for blessings and welfare of the ancestors), *aluk pare* (rice ritual padi, or prescription of cultivating rice), *pare* (rice), *uma* (rice field), *ada'* (something that is taught), *ma'lambuk pare (pounding rice), ma'nene'* (annual grave pilgrimage), *sisemba'* (kick-fighting festival after rice harvest), *alang* (granary), *pesung* (offering), *rampe matallo* (ritual of life for humans, animals and plants. Performed in the east of *banua tongkonan*), *sukaran aluk* (level of rule implementation. i.e., ritual).

According to the conservation culturomics approach, all the text data for 185 videos was analysed by calculating the frequency of occurrence of all words related to keywords and the period of appearance of these words. The number of words was compared to English, Bahasa Indonesia, and Basa Toraya. This language comparison is essential to draw the site's Toraja language text as one of the basics for Toraja rice landrace Toraja conservation, in national and global context. Moreover, NodeXL Pro also displayed related keywords outside the time limit of searching. Figueroa (2012) argues that language loss is another challenge to cultural sustainability and identity, as it deals with assimilation, losing a history, or sustaining the cultural imaginary by

readjusting its place in cultural memory and environmental imagination. Chart 3 shows the frequency of words in Basa Toraya related to the search string "Toraja rice ritual', whereas "*Aluk To Dolo*", "*aluk pare*", and "*pesung*" (offering) were not displayed in Bahasa and English.

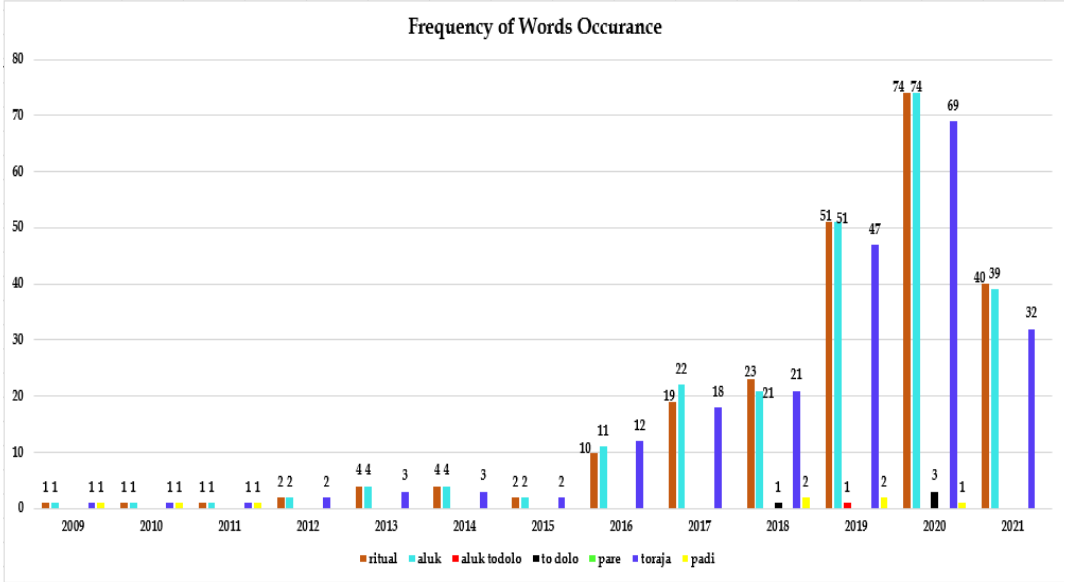



Chart 4. Frequency of words occurrences based on search string

Cell Press, Springer Nature, Elsevier, Wiley, IOP Science, IEEE Xplore, and the American Chemical Society are among the publishers that accept video abstracts as a complement to published paper (Plank, Molnár, and Marín-Arraiza 2017). Biodiversity informatics applies information technology techniques to tackle challenges and develops systems to allow data to be stored, accessed, and combined in ways that optimally serve its target communities (Bingham et al. 2017). Earlier studies showed the internet and data mining on everyday language or vernacular language and conservation of biodiversity (Funk and Rusowsky 2014 ; Roberge 2014 ; Jarić et al. 2016). Specifically, Malcevschi et al. (2012) conducted Web Information Carriers (WICs) with everyday language and scientific ones to elaborate on key issues in ecology and sustainability science through the scientific web, global web, social web, web news, and individual searches by web users. Of 185 total title videos filtered by keywords in the NodeXL workbook, the authors of the video attached several related tags to the search string. Furthermore, the rise of the internet and the science of information technology and the way science is communicated have witnessed profound change. Meanwhile, Adom (2016) have proposed the Inclusion of Children in Biodiversity Conservation Initiative. This initiative engaged children as a part of society in the biodiversity conservation strategy. Toraja rice ritual videos on YouTube are possible to educate children on how culture and technology-supported agriculture policy generally. The viewers could see children engaging in the ritual being performed.

## 4. Conclusion

Recent conservation of Toraja rice landrace practices were the product of collective memory networking, where individual memories and behaviors were connected. Meanings and symbols on stages of cultivating and consuming for daily life and rituals represent memories and behaviors on the Toraja rice landrace. Toraja land tenure on rice fields was one of the supporting systems for undertaking conversion of rice landraces. As we compared eight fields of study, we found various current forms of conservation that are developed and accepted as Toraja socio-cultural activities. Firstly, communities in Dassiriri and Buntu Tallunglipu prefer HYVs to tackle lacking labor and time-consuming before harvesting. Despite the fact that *aluk pare* is no longer performed in these villages, nevertheless, funeral ceremonies, harvest rituals, or any ritual which engages more people to feed remained to consume some glutinous rice and rice landrace varieties. Secondly, communities in Ollon and Siammang were cultivating another crop, i.e., red beans and onions since the soil and rocky terrain are tough for rice fertility. RLVs and *aluk pare* recalled in Ollon since the villagers have been cultivating rice and used to be the immigrants who hold collective memories, as attached in the interview. Thirdly, Pongbembe has the highest diversity of rice landraces, followed by Tumbang Datu. Both villages are conducting rituals of *Aluk To Dolo* and maintaining the legacy of rice seeds left by the ancestors. Almost all HYVs have not been consumed as offerings in ritual. Fourthly, Tondon Matallo and Sa'dan Pebulian had higher diversity of rice landrace, for daily consumption.

Rice landrace conservation has transformed into digital conservation through YouTube videos on the Toraja rice ritual. The social implications of conservation education through social media are shown by employing vernacular language and showing rice ritual videos. As we combined digital conservation and conservation culturomics by NodeXL, the vernacular language was revealed and analysed as a means of preserving cultural saliences in rice landrace biodiversity. Toraja rice ritual videos on YouTube are possible to educate children on how culture and technology-supported agriculture policy generally. current local Toraja rice conservation practices, which can be done by everyone.

**Conflicts of Interest:**

The authors declare no conflict of interest.

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