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Strengthening Anoa (*Bubalus* spp.) Conservation Based on Social and Cultural Community Values in Wallacea Bioregion, Indonesia

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ABSTRACT

This study explored the local wisdom of the Pinogu community in the Wallacea bioregion concerning the conservation of the endangered anoa species, with a focus on social and cultural values. In-depth interviews were conducted with 150 households, and the data were categorized into social and cultural themes. Regarding social values, the findings revealed that the community predominantly had a moderate level of knowledge about the anoa (52.0%), while 35% had high knowledge, and 13% had low knowledge. Results from the binary logistic analysis showed that participation in anoa conservation was influenced by three key factors. Those were knowledge of the species, involvement in forestry extension programs, and past participation in conservation initiatives. In the terms of cultural values, although no traditional rules were directly associated with anoa conservation, there were existing regulations that focused on forest protection around Pinogu area and core zone of the Bogani Nani Wartabone National Park. Based on these findings, it is recommended that extension and conservation education programs be intensified for the younger generation in Pinogu community, with active involvement of the community. This approach could ensure long-term sustainability by aligning with forest conservation efforts, benefiting both the local community and broader conservation goals.

Keywords: Anoa, Conservation, local-wisdom, Pinogu, Wallace Bioregion.

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SIGNIFICANCE STATEMENT

Anoa, an endangered Sulawesi buffalo species, faces significant threats from habitat loss due to deforestation, human encroachment, hunting, and poaching. Conservation efforts are vital to protect Anoa and its habitat, including establishing protected areas and community collaboration to raise awareness about its importance. Conservation in the Wallacea Bioregion of Indonesia is crucial because it ecologically and culturally significant. The research integrates traditional knowledge and community values to enhance conservation efforts. Participatory research methods assess local communities' traditional ecological and biological knowledge, bridging the gap between scientific information and indigenous wisdom. The aim is to establish a comprehensive conservation framework that protects the species and its habitat while respecting local values and traditions. This research seeks to create a foundation for sustainable conservation practices through a holistic approach that combines scientific data with traditional knowledge.

INTRODUCTION

Integrating cultural heritage with biodiversity conservation is recognized as an essential method for the effective management of protected areas. Significant contributions to ecosystem renewal and biodiversity conservation are contributed by practices of Indigenous and traditional peoples (Berkes and Davidson-Hunt 2006; Tran et al. 2020). Since many national parks worldwide are situated on Indigenous territories, a shift from exclusionary approaches to co-management models that acknowledge Indigenous land rights and cultural values has been made (Stevens, 2014).

In Indonesia, the shift is particularly evident. The management of national parks is significantly supported by the traditional knowledge and practices of local communities. Sustainable land use practices, such as rotational farming, sacred groves, and customary laws governing resource extraction, have been maintained by indigenous people for generations. These practices are not only beneficial for sustaining community livelihoods but also for the preservation of biodiversity and the maintenance of ecological balance within the parks (He and Guo 2021; Siahaya et al. 2016). The role of cultural heritage in conservation efforts is exemplified by national parks in Indonesia such as Tanjung Puting National Park in Kalimantan. Renowned for its orangutan population, Tanjung Puting is also closely associated with Dayak people, whose practices of sustainable harvesting and forest stewardship are considered critical to park's ongoing conservation initiatives (Siahaya et al. 2016). Bogani Nani Wartabone National Park, located in the Sulawesi Islands, is recognized as a critical conservation area and biodiversity hotspot within Wallacea bioregion. The park is home to numerous endemic species. It also diverse local communities, including the Pinogu people, who reside in its western area of the national park. Located in the heart of the Bogani Nani Wartabone National Park, the Pinogu community is highly familiar with the diverse wildlife species that inhabit the forest, including the anoa (*Bubalus* spp.) (Arini and Yuliantoro 2019)

Anoa, one of the smallest wild buffalo species in the world, is distinguished by its curved horns and long tail. It is primarily found in the park's primary forests and has been classified as endangered by the International Union for Conservation of Nature (IUCN) (Arini and Wahyuni, 2016). This species is protected under Indonesian Government Regulation No. 106 of 2018. Taxonomically, the anoa is divided into two species: the lowland anoa (*B. depressicornis*) and the mountain anoa (*B. quarlesi*) (Burton et al., 2005). Wild anoa's population and its habitats continue to be threatened because of deforestation, poaching, and climate change (Burton et al. 2007; Irfan et al. 2018). It is becoming increasingly challenging to find anoa (Burton et al. 2007; Irfan et al. 2018; O'Brien and Kinnaird 1996; Rejeki 2018), even in places like Tangkoko Batuangus Nature Reserve, Gunung Ambang nature Reserve, and Manembo-nembo Wildlife Reserve, which used to be known for having anoa populations (Burton et al. 2007). Hunting of anoa has become widespread in recent years. It occurs all over mainland Sulawesi and Buton Island, primarily for consumption purposes.

Traditional rules within societies can be a powerful force in shaping the behaviour of local communities towards the utilization of wildlife resources, as breaking the rules can bring about misfortune or other negative consequences. Therefore, the existence of traditional rules can act as a deterrent to overexploitation of wildlife resources and promote sustainable practices (Kideghesho 2008). Some local communities in Sulawesi possess cultural custom values in conserving forest and wildlife resources includes anoa. These values can be found in Ngata Toro community (Mahfud and Toheke 2005), the Kaili community in Central Sulawesi (Nitayadnya 2014), and the Moronene Hukaea Lea community in the Rawa Aopa Watumohai National Park. These indigenous people have rules for hunting anoa and other wild animals. For instance, it is only being allowed to hunt adult animals. Those that are carrying young ones or pregnant are not allowed and the hunting is performed at night every three months (Jabalnur and Intan 2017).

Based on the historical, social, and cultural aspects of the Pinogu community, there are various values of local wisdom that are still preserved and utilized in the management of forest resources, including anoa conservation. From issues described above, the authors were interested to investigate in detail about the values of local wisdom of anoa and its habitat from the perspective of local people in Pinogu. The study was designed to examine the local wisdom concerning the conservation of forest resources, including anoa species, and to assess the level of community participation in conservation programs. The interviews were conducted to gather information on the respondent's economic status, education, profession, and family background. The results were analysed to understand what factors influencing the participating decision in anoa conservation and to gain comprehensive insight how conservation strategies can be carried out based on the social and cultural values of the Pinogu community.

MATERIAL AND METHODS

Study Area

The study was conducted in Pinogu Subdistrict (Figure 1). This site was administratively located in Bone Bolango Regency, Gorontalo Province, Sulawesi Island. It was geographically located at coordinates 123°26'14.00" E and 0°29'35.51" N. The study lasted for one year from January to December 2019. Pinogu Subdistrict was estimated to cover approximately 496.00 Km^2, with a recorded population of 2,047 people. The population density per square kilometre was calculated to be 4.13 (Indonesia Statistic of Bone Bolango 2023).

Pinogu is designated as an enclave of the Bogani Nani Wartabone National Park (BNWP). During the Netherlands' colonization, Gorontalo became a part of the Netherland East Indies. The Netherland established a residency in Gorontalo and developed its economy and surrounding area by implementing cultivation practices on several important crops such as coffee, cocoa, rice field, and cloves. This development attracted migrants, resulting in a growing population over time. After Indonesia gained independence in 1945, Gorontalo became a part of the Republic of Indonesia. In 2002, Pinogu was designated as one of the sub-districts in Gorontalo Province (Katili et al. 2015). Historically, the Pinogu people were the origin of the current Gorontalo society (Ndjamuddin 1987). Pinogu village existed before the Bogani Nani Wartabone forest area became national park. It was designated as a national park based on the Decree of the Minister of Agriculture No. 736 of 1982 and located at the altitude of 370-410 m above sea level and surrounded by three different mountains, namely Mount Tilongkabila, Mount Ali and Mount Gambuta (Sancayaningsih et al. 2016). The economy of the Pinogu community is primarily strenghtened based on agricultural practice. Residents engage in subsistence farming, growing crops such as rice, maize, and vegetables. Additionally, the mountainous terrain is conducive to grow various fruits and cash crops, including coffee. Livestock farming by raising chickens, cows, and goats is also common (Indonesia Statistic of Bone Bolango 2023). The local economy is heavily reliant on natural resources and traditional agricultural practices (Chbika et al. 2023).

The Gorontalo people are rich of cultural heritage that is reflected in their traditional practices, arts, and rituals. The community's social structure is often organized around extended family units, and traditional leadership is important in maintaining social order and cultural practices. Its community was rich of tradition by using resources from BNWNP area, including wood, rattan, mushrooms, honey, bamboo, agarwood for traditional medicines and food (Arini and Yuliantoro 2019). The distance between Pinogu and the nearest village, Tulabolo, was estimated to be around 40 km away and it could only be reached on foot through the BNWNP area or using a modified motorcycle. The traveling time was approximately twelve hours by motorcycle (Sancayaningsih et al. 2016; Arini and Yuliantoro 2019).

Data collection

Population and Samples

Prior to conducting interviews with the community, permits were proposed to the heads of both the village and sub-village. Additionally, a permit proposal was submitted to visit Bogani Nani Wartabone National Park. During data collection, the authors were accompanied by national park officers or local prominent figures, based on whose recommendations the interview subjects were selected. These individuals also assisted in translating the research into local language. Respondents were selected from all villages, totalling 150 household (Table 1). Further discussions were conducted with selected respondents, including ranger, head of the Tulabolo resort, and head of BNWP management in the Gorontalo Section, to complement the data and information gathered and to discuss conservation programs implemented in BNWNP.

Procedure and Research Design

In each village, the village head was first introduced to the researchers and a national park officer, and the study's background was explained. The survey was conducted by moving from one household to another. Each participant received a single interview lasting 30 to 45 minutes. Households were sampled in each village. A household head was defined as any adult, man or woman, who responsible for the household. The interviews were conducted individually to avoid audience effect bias.

At the start of the survey, participants were informed that their participation was voluntary, and that all information provided would be treated anonymously (names of participants were not asked) and confidentially. The interviews were initiated as informal conversations to establish trust with the participants by inquiring about their general knowledge of the national park and the wildlife of Bogani Nani Wartabone. The benefits of the study for wildlife conservation were explained, and the interview proceeded only if the participant agreed and felt comfortable with the study. At the end of the interviews, participants were informed that the research was being conducted to specifically contribute to the conservation of the

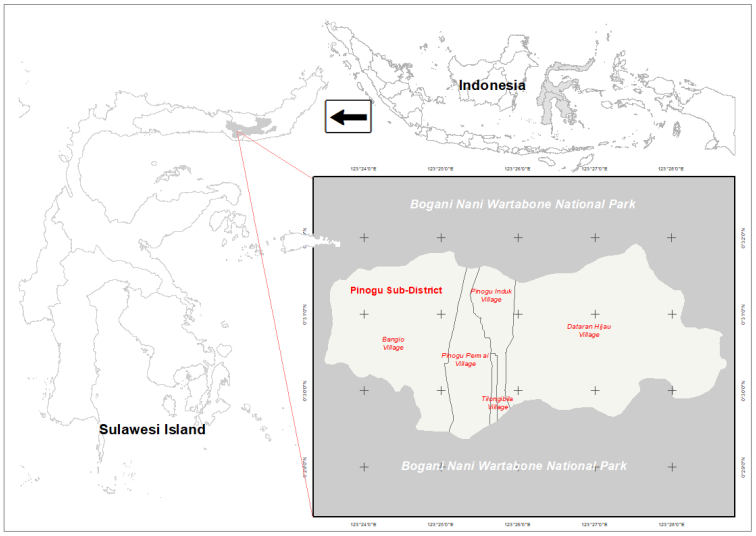

Figure 1. Study location in Pinogu Subdistrict, Bone Bolango, Gorontalo Province.

Table 1. Distribution of the Number of Respondents from Village and Sub-village Levels in Relation to Forest Resources Use in and Around Bogani Nani Wartabone National Park.

Village	Sub-village	Number of Respondents
Bangiyo	Buniyaa	11
	Aduolo	14
	Wapalo	5
Pinogu Permai	Oginawa	11
	Ayudugiya	13
	Longo	6
Green Plains	Binontodaa	10
	Olama	10
	Malago	10
Tilongibila	Inomata	13
	Paalangi	7
	Pongaa	10
Pinogu Induk	Sub-village 1	8
	Sub-village 2	14
	Sub-village 3	8
Total Respondents		**150**

anoa. This information was withheld prior to the beginning of the survey to avoid influencing the participants' responses. The questionnaire was framed and piloted to ensure that the questions aligned with the needs of the study.

The data were classified into two categories: social

and cultural data (Figure 2). Social data were categorized to include socio-demographic factors (such as gender, age, length of stay, occupation, income level, number of family members, educational level, and extension intensity), level community knowledge about the anoa, and willingness to participate in anoa conservation program. Cultural data were collected to assess the existence of local wisdom values supporting anoa conservation.

Both social and cultural data was collected using semi-structured questionnaires to guide the interviews, incorporating both open and closed-ended questions (Rakshya 2016; Noga et al. 2018; Sibarani 2018). Examples of closed-ended questions included: *"How old are you?"*, "*How long have you been a resident of this village/sub-village?"*, *"What do you do for a living?"*. *"Are you familiar with anoa?"*, *"Have you ever seen anoa before?*", *"Do anoa exhibit aggressive behaviour and can they attack humans?", Is anoa an endemic animal that is only found in Sulawesi?",* respondents were provided with set of predefined answers choices. Examples of open questions included: "*What is your opinion about the anoa?*", "*does the anoa provide any benefits to you?"*. These questions were designed to be answered freely by respondent based on their individual opinions and experiences. During the questionnaire application process, additional information provided during free conversations was recorded in note blocks.

Data Analysis

The social data which relate to the socio-demographic characteristic of the respondents, were quantified and tabulated using Microsoft Excel 365. Eight questions were used to assess respondents' knowledge about the anoa. These questions were derived from a literature review and researchers' field experiences. The level of community knowledge about the anoa was assessed with two possible answers "Yes" and "No". Score of 1 was assigned for the answer "Yes" and 0 for "No". The scores were then calculated to determine the highest and lowest scores. The results were categorized into three classes: high, moderate, and low scores. A high score indicated individuals with substantial knowledge about the anoa, while moderate and low scores represented individuals with sufficient and insufficient knowledge about anoa, respectively.

The willingness to participate in anoa conservation program was assessed through interviews conducted with the community using closed-ended questions with two response options: "willing" and "unwilling". Significant factors affecting individuals' willingness to participate in conservation programs were identified using binary logistic regression. Ten independent variables consisting of nine variables of the socio-demographic characteristics and one variable of the level of public knowledge about anoa were used. Nine socio-demographic characteristics included gender, level of education, age, duration of living, main source of livelihood, origin, monthly income, participation in forestry extension programs, involvement in previous conservation programs, and level of knowledge. A binary logistic regression analysis was employed to identify the key factors influencing the conservation participation by the community. If the analysis results show that the Omnibus Tests of Model Coefficients yielded a value of 0.00 ($p < 0.05$), it indicates that the model is a good fit and has a significant simultaneous effect. Conversely, if $p > 0.05$, it indicates that the model is not a good fit and does not possess a significant simultaneous effect

The cultural data related to the existence of local wisdom values supporting anoa conservation were analysed qualitatively and descriptively. Eight questions were employed to assess respondents' knowledge about the existence of local wisdom concerning anoa. The data were examined and interpreted to identify and describe key themes and patterns in the local wisdom values. Descriptive analysis was utilized to summarize and present the findings, with the presence and nature of local wisdom that supports anoa conservation being highlighted. The results were presented in a narrative form, with a detailed account being provided of how local wisdom values contribute to anoa conservation efforts.

Based on the findings, recommendations for anoa conservation strategies were proposed, in light of social and cultural values present in the Pinogu Community. The data were analysed using a SWOT matrix, which involved identifying four key elements: first, the internal attributes and resources that support a successful outcome (Strengths), second, the internal factors that might hinder the achievement of objectives (Weaknesses), third, the external conditions that could be exploited for benefit (Opportunities) and the fourth, the external factors that could trouble or harm (Threats) (Dalton 2018).

RESULTS

Social Value

Socio-demographic Characteristic

A total of 150 household heads participated in the study across five villages around Bogani Nani Wartabone National Park. The social condition based on the demographic and socio economic of the respondents in the Pinogu community indicated that the majority of respondents were male (98.0%) (Table 2). In terms of educational level, most respondents (74.0%)

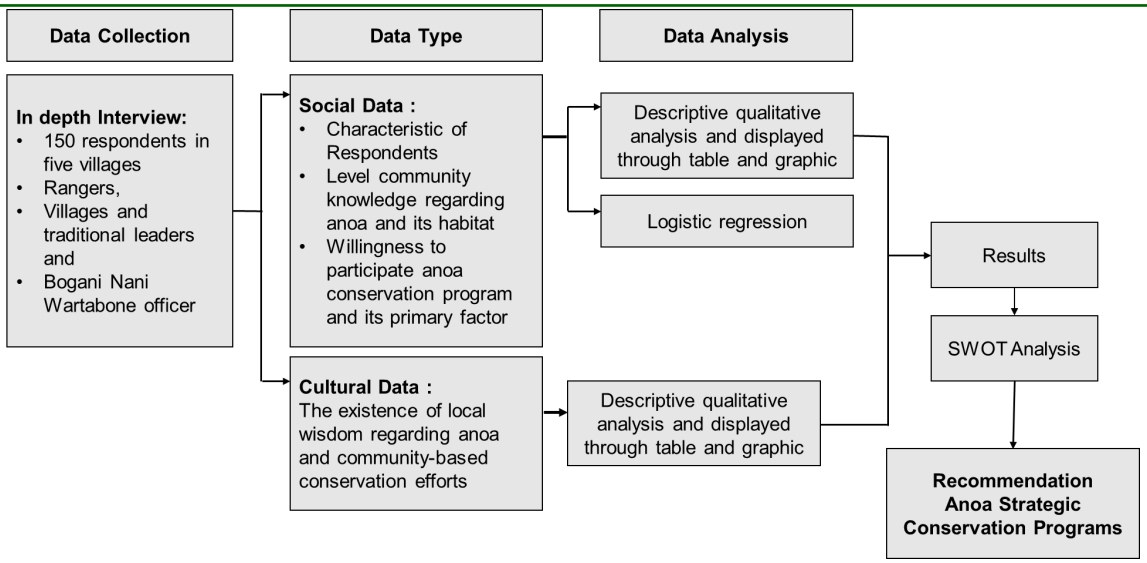

Figure 2. Data Collection and Research Methodology.

had only completed elementary school. The respondents were predominantly at the ages of 41-64 years old (52.0%). However, those who were in younger generation, particularly men, tended to leave Pinogu to seek higher education and better job opportunities. Based on data from the Indonesia Statistic of Bone Bolango (2023), there was only one elementary school and one junior high school in Pinogu District.

Based on the duration of their stay, most of them had lived in the area for more than 30 years (82.7%). The respondents were mainly native Pinogu residents (87.3%). In terms of main source of livelihood, 72.7% of the respondents worked as farmers, indicating that the Pinogu people had strong connection to agriculture (Katili et al., 2015). Approximately of 40.0% of the respondents had income between 500,000 to 1,000,000 rupiah or $33.33 to $66.67 USD. Furthermore, it was found that 45.3% of the respondents had participated in extension program. According to the respondents, extension were one way to increase public knowledge. However, those usually carried out in Pinogu were mostly related to agriculture and health. They were rarely associated with forestry and environmental issues.

Community knowledge levels regarding anoa

In the Suwawa language, the anoa was referred to as "*bantango tutu*", and in the Gorontalo language, it was known as "*buulu tutu*", which means wild cow or midget buffalo. Anoa was recognized to exhibit solitary behaviour, although it was occasionally found in small group. The results showed that the level of knowledge of the Pinogu community about anoa predominantly moderate (52.0%), suggesting that sufficient knowledge about the anoa was held by the community. A high level was demonstrated by 35.0% of respondents, while 13.0% were categorized as having low knowledge.

It was found that the community's knowledge about anoa was generally high, as 94.0% of respondents were reported to be familiar with the anoa, and 68.7% were reported to have had direct contact with the anoa in the forest (Table 3). According to local information, it was reported that the anoa exhibited aggressive behaviour and could potentially attack humans (67.3%). However, it was argued by some that tended to avoid human disturbance due to its natural behaviour as wildlife (Mustari 2019).

This study showed that 76.0% of respondents disagreed with the statement that the anoa population in the wild is decreasing. According to them, the population of anoa in the forest was considered to be stable, particularly within the Bogani Nani Wartabone National Park. This opinion is supported by the fact that more than 50% of respondents reported having seen the anoa directly. It was found that 85.3% of respondents did not familiar with the ecological function and benefits of the anoa for forest ecosystem. Approximately 14.7% of respondents were reported to have a good understanding of the ecological function of the anoa.

Local Community Awareness

The binary logistic regression analysis was used to determine the factors that significantly influenced the participation of the Pinogu community. The dependent variable was community participation. The regression analysis results showed that the Omnibus Tests of Model Coefficients value was 0.00 (< 0.05), meaning that the model was fit, and it had a simulta-

Table 2. Detailed Overview of Respondent Characteristics, Including Demographic and Socio-economic Variables.

Variables	Categories	Percentage (%)
Gender	Man	98.0
	Woman	2.0
Level of education	Elementary school	74.0
	Junior high school	14.7
	Senior high School and up	11.3
Age (years)	<15 years old	0.0
	15 – 40 years old	39.3
	41 – 64 years old	52.0
	>65 years old	8.7
Duration stay in the study area (years)	<10 years	1.3
	10-30 years	17.3
	>30 years	82.7
The main source of livelihood	Farmer	72.7
	Labourer	18.7
	Civil servants	2.0
	Merchant	6.7
Origin	Pinogu	87.3
	Outside of Pinogu	12.7
Monthly income (IDR)	<500,000	24.7
	500.000-1.000.000	40.0
	1.000.000-1.500.000	14.0
	>1,5000,000	21.3
Extension participation	Yes	45.3
	No	54.7
Past conservation participation	Yes	90.7
	No	9.3

neous influence. The result of Nagelkerke R Squared value from Binary Logistic Regression test was 0.371 meaning that the independent variable could explain the dependent variable by 37.1%. The other 62.9% was determined by another factor. The Hosmer and Lemeshow Test result showed value of 0.587 (> 0.05). It was concluded that the model was acceptable, but it showed no significant difference between its observation values. Three of ten variables had significant partial effects and positive corelation (Sig value < 0.05) on community participation. Those factors were knowledge (sig. value 0.015), forestry extension (sig. value 0.027), and participation in previous conservation programs (0.039) (Table 4). Individuals with the past experience in conservation program might have better understanding of the goals and methods of conservation, as well as a greater appreciation for the importance of conservation efforts.

Table 3. Detailed Overview of Respondent Characteristics, Including Demographic and Socio-economic Variables.

No	Questions	Yes (%)	No (%)
1.	Were you aware that the areas around Pinogu are part of the BNWNP?	86.0	14.0
2.	Are you familiar with anoa?	94.0	6.0
3.	Have you ever seen anoa before?	68.7	31.3
4.	Does anoa exhibit aggressive behavior and can they attack humans?	67.3	32.7
5.	Is anoa an endemic animal that is only found in Sulawesi?	42.0	58.0
6.	Is anoa a protected animal in Indonesia?	64.0	36.0
7.	Do you agree that the current population of anoa has decreased	24.0	76.0
8.	Are you aware of the benefits of anoa in forest ecosystems?	14.7	85.3

Table 4. Logistic Binary Regression Results for Factors Influencing Willingness to Participate in Anoa Conservation Programs.

Variables	B	S.E	Sig.
Gender	-18.361	22927.140	0.999
Level of education	-0.404	0.447	0.367
Age	-0.19	0.457	0.968
Duration of stay	-0.503	0.740	0.497
The main source of livelihood	-0.347	0.344	0.313
Origin	0.316	0.814	0.698
Monthly income	-0.026	0.209	0.900
Forestry extension program	1.305	0.537	0.015
Participation in the past conservation program	1.016	0.459	0.027
Level of knowledge	1.450	0.701	0.039

The results indicated that at least nine activities were identified by the community as necessary for the conservation of anoa in Pinogu. The key activities highlighted by the community for anoa conservation in BNWNP (Figure 3) included stopping hunting (33.0%), protecting the forest (27.2%), increasing socialization and extension programs (18.4%), and implementing village regulations for anoa and wildlife protection in Pinogu (13.59%). In addition to these activities, the community also mentioned other measures such as prohibiting outsiders from hunting anoa or other wild animals, imposing strict penalties for rule violations, and developing tourism.

It was found that at least ten activities were expected by the Pinogu community from BNWNP to support and enhance their participation in anoa conservation and community well-being, as shown in Figure 4. The programs included were socialization and extension programs related to forest and conservation (27.27%), joint forest patrols with the community (23.64%), assistance with the provision of livestock, land, seeds, and clean water facilities, forest rehabilitation, clarification of national park boundaries, support for improving the livelihoods of the Pinogu community, and conservation education.

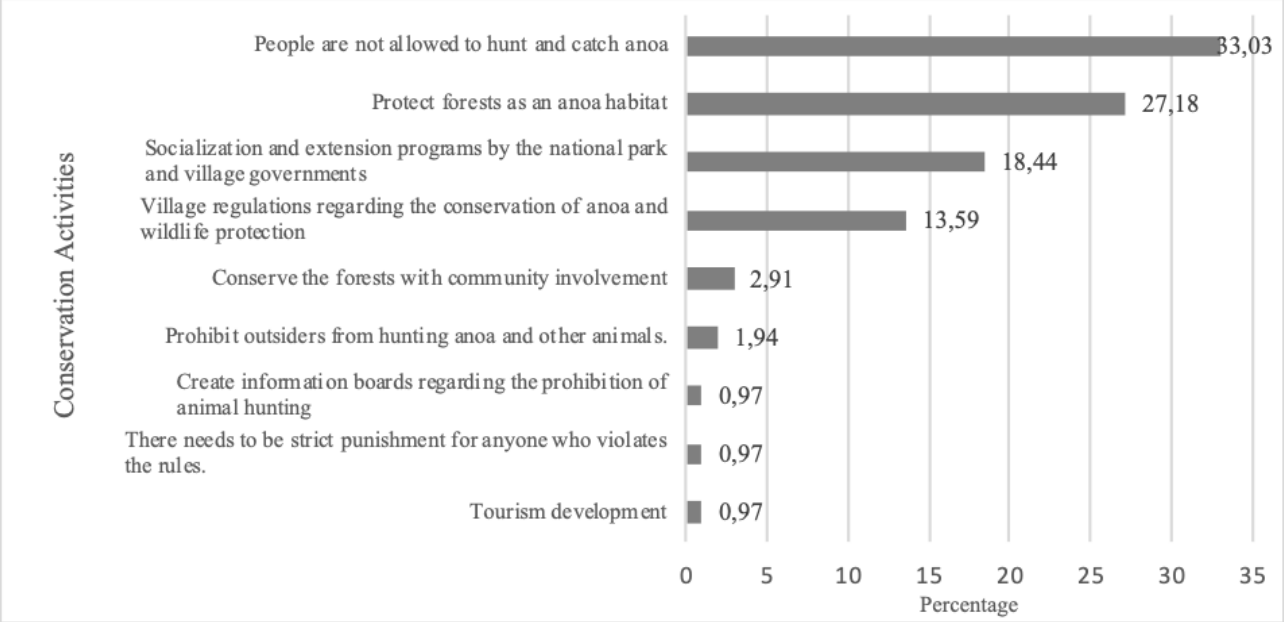

Figure 3. Activities Required to Conserve Anoa from the community.

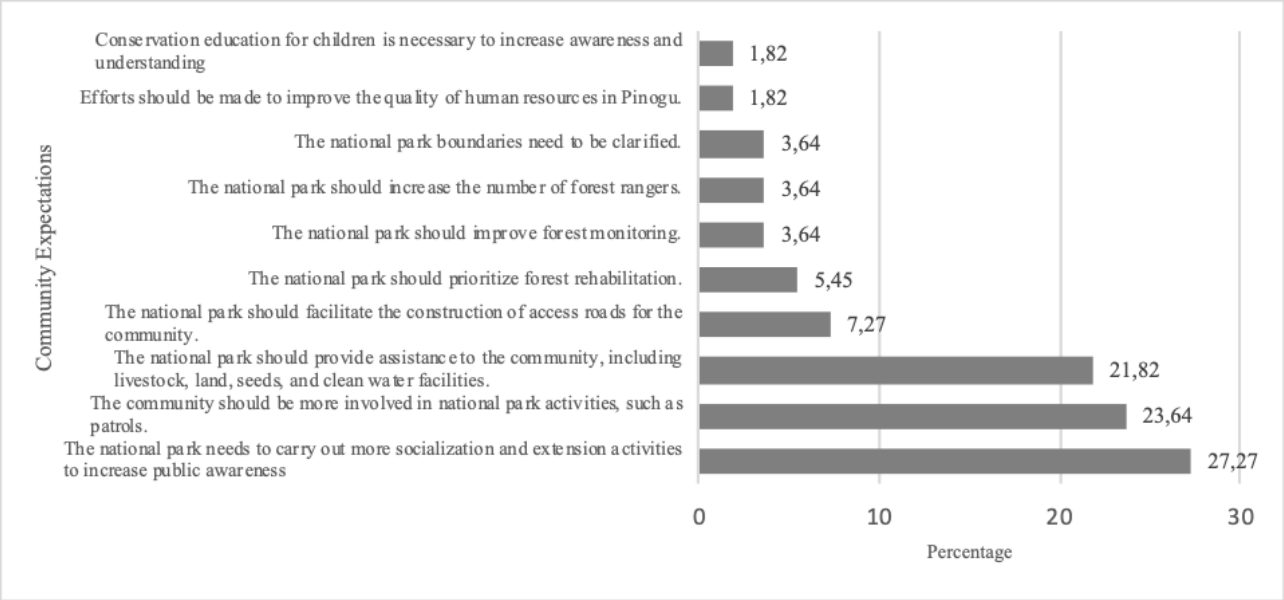

Figure 4. Expected activites by Bogani Nani Wartabone National Park for anoa conservation and community well-being.

Cultural Value

Local Wisdom in Pinogu Community

The identification of the local wisdom values in Pinogu community (Table 5) indicated that 21.6% and 5.4% of respondents provided information regarding the presence of local wisdom in Pinogu related forest preservation and informal regulation prohibition the hunting of anoa. These values have regulated how to conserve their nature, for instance, the prohibition of cutting trees along rivers and mountains, and the use of forest resources adjusted to their needs. These rules had been unwritten yet, but it had existed since the time of their ancestors.

Table 5. Identification of the Local Wisdom Values of the Pinogu Community.

No	Questions	Answers (%)	
		Yes	No
1.	Are there any local visdom about preserving the forest?	21.6	78.4
2.	Are there any local wisdom about anoa passed down from the ancestors? (For example, anoa is a respected animal)	0.0	100.0
3.	Are there any relics related to forest preservation and anoa?	0.0	100.0
4.	Is there a part of the anoa that is utilized in traditional ceremonies?	0.0	100.0
5.	Have any of the forests used to conserve anoa populations been encroached upon?	0.0	100.0
6.	Are there any indigenous institutions that support wildlife (anoa) conservation?	0.0	100.0
7.	Are there any written rules regarding the prohibition/regulation of hunting/utilization of anoa?	0.0	100.0
8.	Is there an informal regulation about the prohibition of anoa hunting ?	5.4	94.6

DISCUSSION

Social Value

The people of Pinogu have lived in close proximity to forest areas for decades, fostering a deep understanding of biodiversity and its benefits. (Jalilova and Vacik 2012; Gandiwa et al. 2014; Truong 2022). Based on this study, the level of knowledge about the national park and anoa among the Pinogu community was found to be moderate to high. This indicates that the community have a good understanding. The level of knowledge within the Pinogu community is also influenced by the origin of the residents and duration of their stay in the area. Based on socio-demographic characteristic, the majority of respondents were found to be native Pinogu people who lived more than 30 years. This study has shown that the length of time individuals have lived in particular area is closely linked to their environmental knowledge and engagement in conservation activities (Toruńczyk-Ruiz and Martinović 2020).

Pinogu community is known to utilize various types of wildlife for meat consumption (Arini and Yuliantoro 2019), provided that such practices are not restricted by their religion and beliefs. Among these wildlife species, the meat of the anoa is included. The consumption of anoa meat is not intended to serve as a primary food or to be included in every meal but is consumed when it is available. Hunting anoa could only be done by skilled hunters who usually used dogs to track and chase their target animals, or set snares called "*dodeso*" in Gorontalo language. The anoa meat was usually only sold to fellow Pinogu people. Anoa fresh meat was red in colour and it contained high protein and low fat (Basri et al. 2008). It was usually sold in one-kilogram plastic bag with the price ranging from 20,000 to 30,000 rupiahs or 1.33*to*2.00 USD each.

Logistic regression analysis identified three key factors affecting participation: knowledge of the anoa, involvement in forestry extension programs, and past participation in conservation initiatives. An extension was a systematic process of exchanging ideas, knowledge, and techniques that changes attitudes, practices, knowledge, values, and behaviour to better forest management (Kandzior and Rivas 2014). Extension forestry programs play a crucial role in raising awareness about the Anoas and the threats they face. By educating local communities about the ecological importance of Anoas and their role in the ecosystem, these programs can foster a sense of responsibility and urgency. Participants gain insights into how their actions, such as deforestation and poaching, directly impact anoa populations (Agbogidi and Ofuoku 2009).

Past participation in conservation programs can also enhance an individual's willingness to engage in future initiatives by shaping their attitudes and values. As individuals become more aware of the benefits of conservation and observe the positive outcomes of their previous efforts, they are more likely to develop a conservation-oriented mindset. This shift in attitudes has been documented by Kollmuss and Agyeman (2002), who found that previous involvement in environmental programs is significantly associated with stronger pro-environmental attitudes and behaviours.

Among those interested in participating, motivation was influenced by opportunities such as assisting national park officers in patrolling and monitoring anoa populations, contributing to anoa conservation, and increasing daily income. Participants were par-

ticularly willing to engage when assigned by village leaders, taking on tasks such as protecting forests and wildlife or supporting government conservation programs. Respondents also faced the challenge of balancing conservation activities with the need to prioritize work to support their families. Nevertheless, some individuals remained motivated by the opportunity to contribute to national park initiatives, protect the anoa, and improve their livelihoods.

Over the past three decades, community-based conservation strategies have been promoted as a means of supporting sustainable development (Noe and Kangalawe 2015). Active involvement in community initiatives was recognized as critical for wildlife conservation. Volunteers who patrolled and monitored illegal activity such as poaching, were integrated to these efforts (Mogomotsi et al. 2020). This approach has also been applied to address challenges in Indonesia's conservation areas. The country faces high exclusion costs, as forest areas and the surrounding communities are often interdependent. Due to limited human resources, the government struggles to monitor all forested areas across Indonesia (Massiri et al. 2019).

Cultural Value

As many as 100% of the respondents stated that no local wisdom directly related to anoa in Pinogu Community. However, 21.6% of the respondents stated that there was a traditional rule about preserving the forest. For example, that was a rule the people were not allowed to cut Fig trees (*Ficus* spp.) in the forest. The community believed the tree "spirit" would be angry. The concept of a "tree spirit" was often associated with traditional beliefs and practices. These beliefs varied among different regions and ethnic groups in the country. However, it generally involved the idea that trees had spiritual or supernatural qualities and were inhabited by spirits or entities that could influence the natural world. This local wisdom could also be found in other regions of Indonesia such as in Yogyakarta City (Suad et al. 2017), and in other country such as China (Shi et al. 2014). Scientifically, ficus trees were essential trees and had various benefit to the environment, animals and humans (Peniwidiyanti et al. 2022). They were sources of feed for almost all wildlife in the forest, from birds to mammals, including anoa. Anoa had high preference for ficus fruits that fallen on the forest floor. According to (Basri et al. 2008) *Ficus vasculosa* Rump seeds dominate the anoa's diet in the wild. In the other hand, 5.4% of the respondents stated that there was an informal rule in controlling poaching in the Pinogu forest previously. Based on this information, deeper investigation of wildlife hunting prohibition was conducted along with community leaders and members who knew about this rule. These rules and appeals mentioned in the ancient times indicated that there was a prohibition of anoa hunting. Anoa was an animal that should not be hunted due to its aggressive behaviour and potential danger to humans. It was also not allowed for people outside Pinogu to hunt any animals around the Pinogu and BNWNP's forest area.

Government regulations in Pinogu came from the BNWNP, which included prohibitions on wildlife hunting for protected animals and illegal logging in the national park area. Respect among the community was one of the characteristics of Indonesian culture, including respect and conformity to leaders such as village officials, community leaders, and religious figures, particularly in traditional societies. According to Djafri (2015), the people living near BNWNP and Bone Bolango are intimately connected to nature and the forest. A person with environmental insight and cultural ethics was needed as a leader in this community. The communities, village officers, traditional and religious leaders, and the BNWNP built a commitment to maintain the national park forest together. This commitment proved that the forest ecosystem around the Pinogu District was well-maintained.

Pinogu people continued practicing cultures and customs that are believed to embody specific cultural ideologies. The local wisdom existing in Pinogu included traditional ceremonies (Umar 2017), local knowledge of medicinal plants (Katili et al. 2015), and the traditional language (Azhar 2012). Traditional ceremonies were practiced during weddings, funerals, and religious events. However, some cultural traditions have begun to be marginalized and lost. This may not solely be due to diminished emphasis on these practices but could also be a result of profound societal transformations that have rendered these traditions less relevant or less applicable as guidelines for contemporary life. One example of a disappearing culture was the "Modayango" ceremony. It was related to human efforts to ensure safety and prosperity, prevent diseases and disasters, and achieve a successful harvest of agricultural products. The traditional ritual usually involved washing the eggs of Maleo (*Macrocephalon maleo*) and Junglefowl (Phasianidae) in the river, which were considered symbols of the salvation of humans and nature. The Modayango ceremony was led by a leader who burned frankincense. It was also accompanied by certain verses, movements, and artifacts that were believed to produce magical powers capable of granting requests. This belief had led to the Modayango ritual being used as the last resort in solving society's problems. However, from the Islamic viewpoint, the activities in the Modayango ceremonies were considered animistic beliefs, and therefore, this culture was abandoned during the Gorontalo Sultanate (Umar 2017).

In 1875, Pinogu was regulated by the government of The Netherlands. Much later, in 2012, Pinogu was established as one of the districts in the Gorontalo Province. Changes in the government system, such as the transformation from non-formal rules in society to government rules, had become one of the factors contributing to the diminish of local wisdom and its influence by modern cultures. According to Kuswanda (2021) and Yamani (2011), clearing of sacred forests by immigrants without any significant impact often diminished the indigenous community's belief in the mystical things they held before. Technological developments have shifted the mindset of traditional communities, leading them to increasingly accept this transformation. This change has occurred among several local communities on Sumatera Island.

Recommendations and strategies based on social and cultural value to anoa conservation

A conservation strategy is an approach that focuses on conserving living resources and provides policy guidance on to implement conservation efforts. In particular, a conservation strategy is an activity that identifies necessary actions to improve efficiency and integrate conservation and development. In Indonesia, the strategy for anoa conservation was recorded on the Regulation of the Minister of Forestry No. 54 of 2013 regarding the Anoa Conservation Strategy and Plan 2013-2022. One of the strategies mentioned in regulation was the community joint-action plan program in the management of conservation and buffer areas (Wiratno 2019).

According to Kideghesho et al. (2008), community joint-action or co management was natural resources management paradigm that involved sharing power, responsibilities, rights, and duties between the government and local resource users. This approach recognized the important role of local communities in natural resources management and sought to promote their active participation and engagement in decision-making processes. By sharing power and responsibility, co-management can help ensure the local communities had voice in the management of natural resources and they could work together with government agencies to promote sustainable practices. Co-management had gained popularity in recent years as a means of promoting effective natural resources management and had been applied in a wide range of contexts, including fisheries, forestry, and wildlife conservation.

In Bogani Nani Wartabone National Park (BNWNP), programs have been designed to ensure that genuine collaboration with the local Pinogu community is fostered through joint socialization efforts, shared habitat management, and cooperative anti-poaching patrols. The forests surrounding Pinogu have been preserved largely due to the community's traditional practices, and proximity to the core zone of BNWNP has been maintained. A site adjacent to the settlement, known locally as "Mainunggu," where deer, pigs, and anoa frequently gather, has been identified through local knowledge and park authority surveys as a key wildlife observation area.

It is crucial that conservation strategies are developed through a co-creative process, recognizing the community's deep connection with this landscape. The potential of "Mainunggu" as a site for ecotourism should be shaped by the community's priorities and insights, ensuring that any development is aligned with both conservation goals and local values. Knowledge about the site's ecological significance can be provided by local residents, and ecotourism activities can be shaped by them to ensure sustainability and respect for the environment.

Rather than limitations being solely imposed to protect fragile ecosystems or endangered species, the community should be empowered to guide visitor management practices, such as the determination of appropriate visitor numbers and the establishment of culturally and ecologically sensitive guidelines. By integrating traditional knowledge and conservation expertise, the area can be protected, and economic benefits can be provided, ensuring that both the environment and the local people are allowed to thrive together.

One strategy to enhance understanding and action around anoa conservation is through mutual learning facilitated by forestry extension and conservation education. While individuals and communities are educated about conservation practices through forestry extension programs, the incorporation of traditional knowledge and forest management techniques from local communities should also be included, creating a two-way exchange of insights. Participation in such programs allows for the sharing of knowledge, enabling a deeper understanding of the importance of protecting natural resources and the development of conservation strategies that integrate both modern and traditional practices.

Through this shared learning process, a comprehensive understanding of conservation goals and methods can be achieved, as well as an appreciation of the community's unique knowledge of the forest ecosystem and its species. Knowledge extension, participation promotion, and awareness raising can be effectively undertaken by the national park in collaboration with the community, ensuring the integrity of the area and the conservation of its biodiversity. Research by Irfan et al. (2018) in Donggala, Central Sulawesi, underscores those collaborative efforts in anoa protection such as joint socialization, ecotourism activities,

education, and economic improvement initiatives are recommended. These actions ensure that conservation efforts are informed by both expert knowledge and the lived experiences and traditional wisdom of the community, contributing to a more sustainable and inclusive strategy.

It is expected that active engagement and independent contribution from the community in the national park plan will be achieved. Future programs should be designed to focus not only on conservation but also on the enhancement of economic opportunities for communities in buffer areas (Qin, Wang, and He 2024; Rampheri and Dube 2021) Continuous optimization of community participation as contributors to habitat inventory, monitoring, management, and patrol programs must be ensured.

The social and cultural strengths of the community should be incorporated into a collaborative approach for anoa conservation in Pinogu. This approach should be reflected in a SWOT matrix (Figure **??**), which will illustrate how the knowledge and perspectives of the community can inform and enhance conservation strategies. By fostering collaboration, strategies can be co-created that integrate traditional practices with modern conservation techniques, ensuring that the efforts are both effective and culturally appropriate.

Based on the SWOT analysis presented in Table 6, several factors were identified to support the success of community-based anoa conservation programs. Strengths (S) included the knowledge possessed by the community, the interest shown participating, and the adherence to cultural values related to natural conservation. The unique knowledge and perspectives held by local communities, including traditional practices and beliefs, were recognized as crucial to the success of conservation efforts. Valuable insight into local wildlife populations, their behaviours, and ecological roles were provided by this knowledge. Community participation was noted as essential, as it fostered a sense of ownership and responsibility for natural resource management and protection. Increased support for conservation policies was facilitated by involvement in decision-making processes, resulting in more effective and sustainable outcomes. The factor of obedience to the community leaders was also highlighted as a social force that could aid the development of anoa strategies. Opportunities (O) for anoa conservation included the prioritization of anoa as one of 25 endangered species by Indonesian conservation efforts. Increased attention from global conservation organizations, such as the IUCN and the Global Species Management Plan (GSMP) for wild cattle, was noted as a significant opportunity for conservation actions aimed at increasing anoa population. Weaknesses (W) identified included the low level of education within the community and the limited employment opportunities in the service and other sectors. These factors posed challenges to effective conservation efforts, as the community's capacity to engage in and benefit form conservation programs was impacted. Threats (T) included the remote location of the Pinogu community and limited accessibility, which compounded challenges in implementing conservation activities. The dependence of the Pinogu people on forest resources, including those in BNWNP area, highlighted the need for alternative economic resources as a priority for conservation strategies.

Table 6. SWOT matrix of anoa conservation strategy in Bogani Nani Wartabone National Park.

Internal Factors	**Strength (S)**	**Weakness (W)**
External Factors	1. Knowledge and insights about local conservation practices and the natural environment are provided by the community. 2. The potential for collaboration is indicated by the community's active interest in conservation. 3. Effective conservation strategies are supported by strong cultural values and respect for traditional knowledge. 4. Integration of local and formal conservation approaches is facilitated by organizational support.	1. Limited formal education levels are experienced by the community. 2. Improvements in the willingness to engage in conservation programs are needed. 3. A relatively low income level is experienced by the community. 4. Limitations such as restricted accessibility and land are faced by Pinogu.
Opportunity (O)	**SO Strategies**	**WO Strategies**
1. Protection of anoa is prioritized by the Ministry of Environment and Forestry (MoEF) to increase its population. 2. Involvement of the community in conservation activities is included in government programs (BNWNP). 3. Development priorities of local governments include the area. 4. Coexistence with BNWNP and proximity to monitoring sites for anoa and babi rusa are established	Active partnerships with BNWNP in patrolling, monitoring, and area rehabilitation are established by community involvement, ensuring local knowledge informs conservation efforts. Ecotourism programs are developed based on community cultural values and conservation objectives. Public understanding of anoa conservation is increased through collaborative educational initiatives involving both local knowledge and formal practices. Regulations for hunting and protection of anoa and other species are documented and implemented through community-driven rules (e.g., Village Regulations/PERDES). Preparation of anoa conservation strategies is facilitated by local institutions, integrating community expertise.	Training programs for tour guiding and other conservation roles are implemented to empower community members, enhancing income opportunities. Development of non-timber forest products (honey, mushrooms, coffee) into valuable products is supported by local knowledge. Promotion, distribution, and marketing of local products are increased to boost the community's economy. Information boards and outreach activities are created, involving the community in conservation education and policy-making. Support for the community through provision of livestock, seeds, and clean water facilities is provided.
Threats (T)	**TO Strategies**	**TW Strategies**
1. A lack of socialization about forests and conservation is present in some areas. 2. Environmental quality changes due to anthropogenic development are observed. 3. Challenges in conservation management are posed by remote and difficult-to-access locations. 4. Limited employment opportunities in Pinogu are noted.	Community activities are developed and managed in line with cultural values, integrating local insights into conservation practices. Socialization, extension, and environmental education efforts are expanded to address the lack of awareness and promote community engagement. Landscape changes due to development are minimized by incorporating community feedback and traditional knowledge into planning. Infrastructure improvements, such as community access roads, are facilitated to support conservation efforts and improve connectivity.	Special interest tourism is created and promoted to highlight conservation efforts and incorporate local knowledge. Collaboration with schools to include environmental education in curriculum is achieved, ensuring younger generations are informed and engaged in conservation. Ecotourism infrastructure is developed to support conservation goals while providing economic benefits to the community. Innovative solutions are applied to address remote location challenges and improve accessibility and conservation management.

CONCLUSION

The integration of social and cultural values into anoa conservation efforts in Pinogu has been deemed essential for program success. The SWOT analysis had identified key strengths, including the community's traditional knowledge and international conservation attention, which supports effective programs. Weaknesses, such as fading traditional knowledge and moderate understanding of anoa's ecological roles, must be addressed. Social value, through community engagement, enhances conservation effectiveness by fostering ownership and responsibility. Cultural value, reflected in traditional practices, is vital for sustaining forest ecosystems and should be leveraged for anoa conservation. Strategic actions required development of education programs to improve knowledge, enhancing economic conditions, involve the community in conservation, and establish culturally aligned regulations. Future research should focus on assessing the impact of culturally tailored education programs, evaluating the socio-economic benefits of integrating traditional knowledge with modern practices, and exploring the scalability of community-based models to similar regions. These studies will provide valuable insights into achieving sustainable and culturally relevant conservation outcomes.

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DATA AVAILABILITY

The data used to support the findings of this study are available from the corresponding author upon reasonable request.

CONFLICT OF INTEREST

The authors have no conflicts of interest to declare.

CONTRIBUTION STATEMENT

Conceived of the presented idea: DIDA, JK. Carried out the data analysis: WK, DIDA. Wrote the first draft of the manuscript: AFI, DIDA. Review and final writing of the manuscript: JK, WK, AFI.

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