

## UNIVERSITIES' ROLE IN FOOD GERmplasm SUSTAINABILITY

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**Abstract:** The sustainability of food germplasm is a serious issue amid climate change, the increasing world population, and the threat to local food sustainability. This study explores the dual role of universities as research institutions in the region in overcoming the threat to the sustainability of food germplasm. In particular, the qualitative research method involved in-depth interviews and included 31 informants, including researchers, lecturers, farmers, extension workers, and policymakers. Accordingly, the study results reveal that integrating higher education *dharma* can encourage role optimisation in universities and strengthening the research function can strengthen universities role in the sustainability of food germplasm. In addition, this study identifies a strategy to strengthen the research function that ensures innovation closely related to the needs, root causes, and design of farmers' behaviour change by utilising the dual role of universities. Overall, this study concludes that strengthening the research function through innovation regulations can optimise the role of universities in answering the challenges of food germplasm sustainability. Moreover, this research opens up a space for further study by utilising Information and Communication Technology (ICT) in an innovative approach.

Keywords: Sustainability, germplasm, innovation regulation, research.

### Introduction

Food sustainability and adaptation are key indicators used to measure the Global Food Security Index (GFSI) (Georgeou *et al.*, 2022). Notably, improving food germplasm is a pillar for building strong, resilient, and sustainable food production capacity (Kahane *et al.*, 2013; Fanzo *et al.*, 2022). Concurrently, the discovery and use of new genes in germplasm can provide new solutions to increase productivity, sustainability, and food diversity (Georgeou *et al.*, 2022).

Germplasm is a typical genetic resource of the local area, which includes genetic diversity and strong local adaptation (Shelef *et al.*, 2017). It also has a vital position for the sustainability of food crop heritage, a provider of regional identity, a supporter of farmers' economies, a provider of diversity for the development of varieties resistant to climate change, pests and diseases, and innovative materials in the

agricultural sector (Priyanka *et al.*, 2021; Ochar & Kim, 2023). Furthermore, germplasm is a crucial resource that ensures global biodiversity and agricultural sustainability and supports food security (Kahane *et al.*, 2013). The sustainability of germplasm food strengthens Sustainable Development Goal 2 (SDG 2), namely a world without hunger (Mkhize *et al.*, 2023; Varzakas & Smaoui, 2024), which meets the three dimensions of development sustainability, namely economic, social, and environmental (Cappelli *et al.*, 2022).

Indonesia is the world's second-largest contributor to germplasm after Brazil (Kementerian Pertanian, 2020). Specifically, the total percentage reaches 17% of the total genetic wealth of plants in the world, out of 3,256 plant species, including 30,000 types of food crops. Despite this, agricultural genetic resources are lost to 75% (Administrator-Humas

UGM, 2018). Consequently, the loss of food germplasm threatens agricultural production and food security (Priyanka *et al.*, 2021; Fanzo *et al.*, 2022; ECPGR, 2024).

Furthermore, farmers' lack of insight into the superiority of the commodities they cultivate, low competence in knowledge, attitude, and farming skills, policy regulations, and misalignment with local commodities are factors in the decline in the cultivation of food germplasm (Shelef *et al.*, 2017; Joshi *et al.*, 2018; Cvijanović *et al.*, 2020; Priyanka *et al.*, 2021; Dahalan *et al.*, 2024; Sun *et al.*, 2024). As a result, neglect of factors that weaken germplasm sustainability will threaten local food products' sustainability (Priyanka *et al.*, 2021; Fanzo *et al.*, 2022; ECPGR, 2024). This threat is becoming increasingly severe amid the growing global demand for food, with the United Nations estimating a population of approximately 9.8 billion by 2050 (Affairs, 2024), in addition to climate change (Priyanka *et al.*, 2021; Mkhize *et al.*, 2023). Therefore, innovation and research to address these challenges are urgently needed (Abera *et al.*, 2024).

Research that has been conducted highlights the important role of universities for food sustainability (Akinngbe, 2018; Mansingh *et al.*, 2019) and the strategic position of research institutions to strengthen research in developing local food products (food germplasm) (Abera *et al.*, 2024). Notably, the role of research institutions is to provide a source of information and give birth to appropriate innovations for developing local products (Pingali & Traxler, 1982).

Higher education serves as an institution that carries out both educational functions and research functions (Permendikbudristek, 2022; Thant *et al.*, 2022) and is responsible for the development of science and technology. In addition, it produces innovations needed by the community and prepares expert human resources for local governments (Department Pertanian, 2006; Alimirzaei *et al.*, 2019; Kementerian Pertanian, 2020; Paschen *et al.*, 2021; Thant *et al.*, 2022). The governance operations are delegated

to the regions (Kemdikbudristek, 2022), particularly those close to germplasma areas, where the academic community consisting of lecturers and students is gathered. The academic community uphold the *dharma* of education and teaching, research, community service, and moral values of *akhlakul karimah* (Pemerintah Pusat Indonesia, 2012; Kemdikbudristek, 2022; Universitas Muhammadiyah, 2023; Kusumawardani *et al.*, 2024). The *dharma* positions lecturers in multiple roles as educators, scientists, researchers, and problem solvers for their environment (Beddington *et al.*, 2012).

The *dharma* of research functions as a producer of innovation, physical innovation in the form of appropriate technology as a response to changes and competitive adaptation (Ananth *et al.*, 2019; Kamara *et al.*, 2019). Meanwhile, non-physical innovations include governance management, agricultural information systems, and encouraging active participation of farmers to increase knowledge, with the function of helping farmers in solving problems (Mansingh *et al.*, 2019). Accordingly, the contribution to be achieved is to encourage innovation, scientific development, and research results that are internationally recognised or applied by the community (Kemdikbudristek, 2022), helping communities face new challenges in agriculture (Mansour *et al.*, 2022).

Additionally, indicators of success are innovations adopted by the community, implemented in regional policies, and used by related parties (Kemdikbudristek, 2022). These indicators are a manifestation of the institution's policies and vision, which have a significant impact on the role of universities in encouraging innovation (Kamara *et al.*, 2019). However, universities are challenged by the innovation gap generated by the closeness of problems in the field.

Research conducted by Lamin (Kamara *et al.*, 2019) highlighted the need to better understand the attitudes and beliefs of extension workers and research professionals regarding agricultural innovation systems. Remarkably, the agricultural extension system is a leading

institution in the agricultural sector that is engaged at the grassroots level. It has a good understanding of the region's characteristics and potential, is functionally and structurally responsible for enhancing the competence of farmers' resources, and spearheads the dissemination of innovation.

Additionally, it plays a key role in connecting farmers with resources, technology, and information, as well as being directly involved in regional food policies (Akinngbe, 2018; Shitu *et al.*, 2018; Babu & Sah, 2019; Mansingh *et al.*, 2019; Mapiye *et al.*, 2021; Moahid *et al.*, 2021; Paschen *et al.*, 2021; Priyanka *et al.*, 2021). Its position also helps bridge the gap between research and farmers, sources of information and data on the characteristics of human resources and natural resources in rural areas and accelerating the rate of adoption of technological innovations (Danso-Abbeam *et al.*, 2018; Wijerathna & Wanigasundera, 2020).

In particular, the understanding of extension is intended to bridge the gap in research practices, which currently focuses solely on the needs of researchers and not the needs of the community. However, there is no relationship of coordination between universities and the extension system. For instance, Lamin's research (Kamara *et al.*, 2019) has not yet explored solutions to this gap.

Similarly, the Planned Behaviour Theory used to assess researchers' knowledge and attitudes has not provided the solution to the gap. This poses a challenge for universities in producing innovations that can solve the threat of germplasm sustainability. Hence, strengthening the research function in higher education is an urgent need that must be addressed, requiring more in-depth exploration to significantly impact food germplasm's sustainability. Correspondingly, this study proposes strengthening the research function to optimise the role of universities in saving food germplasm.

Stavros's study (Showkat & Sindakis, 2024) demonstrated that innovation strategies can strengthen institutions. However, the authors did

not specifically explain how these innovations can ensure the sustainability of institutional functions to the maximum. This research fills this gap through efforts to strengthen the research function by internalising the philosophy of extension education in research regulations. Essentially, this effort addresses the lack of coordination and mutual responsibility between universities and agricultural extension. At the same time, collaboration is also challenging amid the issue of differences in interests, vision, mission, institutional goals, government directions, and policies (Babu & Sah, 2019; Kamara *et al.*, 2019). The internalisation of the philosophy of extension education serves as a bridge between the complexity of formal pathways and the efficiency of the process in generating innovation.

The concept of the philosophy of extension education is a strategy to ensure that innovation is created with a real impact in answering existing challenges, where substantial change becomes the core (spirit) (Kelsey & Hearne, 1955; Bloom, 1983; Akinngbe, 2018; Sulandjari *et al.*, 2020). Furthermore, this internalisation aims to ensure that the output of practical, efficient, valuable innovations can be directly felt and implemented in the rescue of local food products (Kelsey & Hearne, 1955; Isnian, 2015; Sulandjari *et al.*, 2020). This philosophy requires three elements to give birth to such innovations: Suitability of farmers' needs, addressing the root of the problem, and being designed to change farmers' behaviour (Isnian, 2015).

Moreover, to ensure that universities remain aligned with their intended direction, this research collaborates with Parsons's Social Systems Theory. It emphasises regularity in three things, namely functions, roles, and norms that form the basic units of the system (Parsons, 1951). Accordingly, this research explores institutions' strategic role in strengthening the research function of higher education. It is hoped that strengthening the research function will encourage the optimisation of the role of universities in the sustainability of food germplasm.

**Materials and Methods**

***Main Components of the Research***

This research involves elements of higher education and elements of germplasm. Universities serve as research institutions that produce regional innovations, which are expected to solve food problems optimally and germplasm for its function in local food sustainability. Key elements of higher education include lecturers, institutional leaders, and students, whereas the germplasm element includes farmers, agricultural extension workers, policymakers, and traders.

road infrastructure and Internet networks on the islands, and has food germplasm that is experiencing serious extinction threats (BPS Provinsi Sultra, 2024). The research location consists of two points: (1) Kendari City: The location of university informants, consisting of Halu Oleo University (UHO), representing the most significant public university and Kendari Muhammadiyah University (UMK), representing the largest private university. It focuses on the field of internal research under the name of the Lembaga Penelitian dan Pengabdian Masyarakat (LPPM-UHO) and Direktorat Riset Teknologi dan Pengabdian Masyarakat (DRTPM-UMK) and (2) North Buton Regency: The location of food germplasm element informants. The research was conducted from December 2023 to March 2024, with the selection performed purposively. The location of the study is illustrated in Figure 1.

***Location and Time of Study***

The research was conducted in Southeast Sulawesi Province, Indonesia. The province, supported by public and private universities as regional educational and research institutions is an archipelagic area with limited access to central research institutions, constraints on

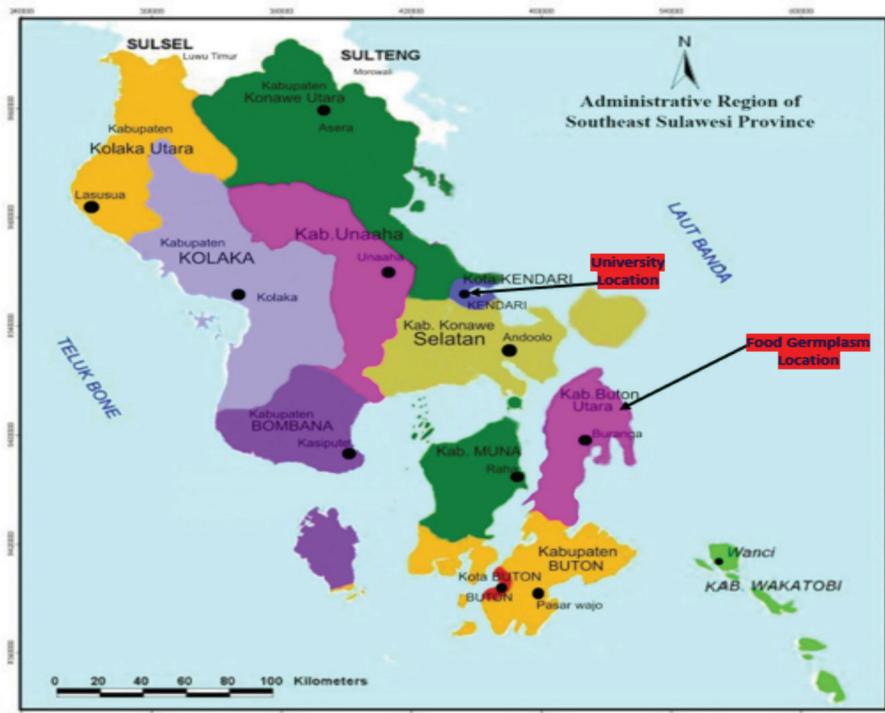


Figure 1: Research location  
Source: National Land Agency

### **Research Methods**

The research method is qualitative participatory. Data collection techniques include in-depth structured interviews, observations, Focus Group Discussions (FGDs), and document studies. Simultaneously, to increase the validity of the data, triangulation of sources and techniques is performed.

### **Data Collection Procedure**

Data collection is based on information saturation to ensure that it can be conducted in several meetings with one informant. The steps are: (1) Initial interview: Information from the first interview is summarised, keywords and common threads are established, then, a provisional conclusion is made, (2) verification and deepening: The conclusion of the first interview results is verified with a follow-up interview that is increasingly in-depth until the information obtained is saturated. Following this, the results of information saturation are summarised and focus points are made to ask for an agreement with the informant. The results agreed upon by the informant are the end of the interview, (3) Continued in-depth discussion: If there is unsuitable information then the in-depth discussion will be continued until all points are agreed upon.

### **Method of Selection and Acquisition of Informants**

The selection of informants was performed using purposive sampling to ensure the inclusion of various perspectives crucial to understand the sustainability of food germplasm. In particular, informants were selected based on their relevance, experience, and involvement in the issue of food germplasm. The selected informants comprise university researchers in food innovation, policymakers involved in agricultural development, agricultural extension workers who know local agricultural practices, and farmers who directly cultivate local varieties such as *pae memea*.

### **Categorisation of Informants and Interview Topics**

**Number of Informants:** 31 people, consisting of the head of LPPM and DRTPM, various categories of lecturers (researchers, experts, staff, etc.), students (researchers and farmers), agricultural extension workers (Unit Pelaksana Teknis Daerah (UPTD), sub-district coordinators, etc.), farmers (food germplasm, chairman of Gapoktan), policymakers (Badan Perencanaan Pembangunan Daerah (BAPPEDA), Food Security Office), and local traders. The information collected is structured based on the informant type and the topic discussed, as summarised in Table 1.

This research integrates data from various categories of informants to explore potential opportunities that universities have in a balanced and close manner to the needs, root causes, and design of changes in farmers' behaviour. This aims to identify the maximum role of effective and efficient universities, supporting the development of solutions based on local conditions and the collaboration of various parties.

### **Conceptual Framework of Data Analysis**

The data analysis in this study uses the Talcott Parsons Social Systems Theory approach, which internalises the philosophy of extension education (Parsons, 1951). It plays a crucial role in guiding the *dharma* of higher education, serving multiple roles as educators, scientists, researchers, and problem solvers within a single system. This system contributes according to its respective roles to strengthen the research function of higher education. Finally, as a system, these multiple roles can only be differentiated, yet cannot be separated.

Furthermore, the internalisation of the philosophy of extension education plays a role in ensuring that the research regulations can accommodate the needs, root causes, and design of changes in farmers' behaviour. With substantial changes in the spirit of the philosophy of extension education (Akinngbe, 2018),

Table 1: Resource persons and topics

Sources	Number of Resource Persons	Interview Duration (Minutes)	Interview Topics	Number of Meetings (Times)	Meeting Time
Head of LPPM/DRTPM	2	150	Functions of the institution Scope of activities Regulation Policy	3	Tuesday, 12-12-2023 Thursday, 14-12-2023 Monday, 18-12-2023
Lecturers of various categories: Lecturers, General Researchers, Food Researchers, Private Researchers, Expert Researcher	5	610	Assignment <i>Dharma</i> of higher education Responsibilities and roles Structure Value Research mechanism Necessity Problems and solutions	6	Thursday, 14-12-2023 Saturday, 16-12-2023 Monday, 18-12-2023
Food germplasm research students	2	220	Student research regulations Roles and responsibilities for food germplasm Perception, knowledge, and attitude toward the germplasm of food in their region The position of the university for oneself and germplasm food Expectations for higher education	4	Wednesday, 03-01-2024 Friday, 05-01-2024 Sunday, 07-01-2024 Friday, 01-03-2024
Agricultural Extension Officers: Head of the UPTD, Head of Human Resources and Extension (SDMP), District Extension Coordinator, District Extension Officer (PPL)	8	420	Farmer needs, root causes, design change What has been done for food germplasm Innovation: Needs, availability, sources, impacts, and mechanisms of utilisation Policies applicable to food germplasm, challenges, obstacles, problems, and expected solutions Relationship with research institutions	7	Sunday, 31-12-2023 Sunday, 07-01-2024 Wednesday, 10-01-2024 Thursday, 18-01-2024 Tuesday, 30-01-2024 Thursday, 15-02-2024 Sunday, 03-03-2024

<p>Food germplasm farmers, old farmers, child farmers, heads of Gapoktan/farmer groups</p>	<p>10</p>	<p>400</p>	<p>Food germplasm: Perception, position, attitude, hope, function Needs, root causes, and design of change Innovation: What is already there, what is adopted, what is expected Challenges, obstacles, problems, and desired solutions</p>	<p>6</p>	<p>Friday, 29-12-2023 Sunday, 31-12-2023 Sunday, 07-01-2024 Monday, 08-01-2024 Wednesday, 10-01-2024 Friday, 19-01-2024</p>
<p>Policy stakeholders: BAPPEDA, Head of Research and Development, Head of the Agriculture Office, Secretary of the Food Security Service</p>	<p>4</p>	<p>480</p>	<p>Food policy Regulation: Policy and innovation Perception and position of food germplasm</p>	<p>4</p>	<p>Thursday, 11-01-2024 Friday, 12-01-2024 Monday, 15-01-2024 Tuesday, 16-01-2024</p>

Source: Authors' work

Parsons's Social Systems Theory becomes relevant. It emphasises adherence to the values of the role and norms of higher education, guiding research and giving rise to research regulations in higher education. Such regulations aim to ensure changes in farmers' behaviour for the sustainability of food germplasm.

**Results and Discussion**

***Profile of Food Germplasm in Pae Memea, North Buton Regency, Southeast Sulawesi***

The germplasm of food in North Buton Regency, Southeast Sulawesi is organic brown rice field rice (*Oryza nivara*), which the local community calls *pae memea*. Currently, the *pae memea* is under threat of extinction, as evidenced by the declining percentage of cultivations. In addition to *pae memea*, the results of field interviews identified at least five other local food varieties that are still cultivated on a limited scale, namely cassava, gembili, corn, taro, and various types of local bananas.

Furthermore, these varieties are in the process of being documented and preserved by several local institutions. All of these plants grow in traditional farming systems and face the threat of genetic erosion. Considering their contribution to food security and their role in representing local communities' cultural identity, all germplasm types have great potential to be conserved through the active role of universities, research institutions, and other related institutions.

However, this study prioritised *pae memea* due to their unique symbolic, economic, and nutritional value. This study positions *pae memea* as a pilot model in local germplasm conservation strategies, which can be adapted and replicated to preserve other local varieties. Additionally, this approach explores the strategic potential of the food industry and encourages synergistic initiatives across agencies to support the preservation of local food germplasm more broadly and sustainably. The results of the field research and the profile of *pae memea* are presented in Table 2.

Table 2: Profile of *pae memea*/coloured rice (*O. nivara*)

<b><i>Pae memea</i>/Coloured Rice (<i>O. nivara</i>)</b>	
<b>Categorisation</b>	<b>Description</b>
Local name/designation	<i>Pae memea</i>
Food category	Certified organic brown rice <i>Wakawonda, Wangkariri, Wakombe, Warumbia, Watanta, Warangka, Mahaludu, Wabalongka, Patirangga, Waapolo, Kasakabari, Wangkaluku, Wangkariri, Wabila</i>
Varieties and uniqueness	Each variety has its own colour, texture, aroma, taste, and benefits; many varieties have been lost.
Endangered food germplasm	Although the origin of this commodity is unknown, it is estimated to have existed since the first people lived in North Buton, where it was bred and inherited from generation to generation until now. Although development efforts outside North Buton have been conducted many times, they have not grown. Currently, there is a decrease in the number of farming families.
Benefit	<i>Pae memea</i> is a staple food for some farmers. Due to the high price, there has been a decline in cultivation, and only certain groups can access it. <i>Pae memea</i> is highly sought after for sugar sufferers and stomach diseases, used as a basic ingredient for making a local powder that is functional for farmers who will work in the fields, in anticipation of the sun directly touching the skin of the face and can anticipate itching due to exposure to wild grasses from farming.
Meaning	<i>Pae memea</i> for the local community is like their soul. Despite the decline, not all informants were willing to accept the possibility that <i>pae memea</i> had disappeared from the land of North Buton; to them, <i>pae memea</i> 's position was like a sea with salt.

Source: Primary data

Potential and weaknesses of *pae memea* can serve as an innovation space for universities to develop science, innovation, and technology in the food sector. True *pae meme* can be developed and play a vital role in the agricultural sector and food security. It also contributes in improving the farmers' welfare as part of the function and role of germplasm (Priyanka et al., 2021; Mkhize et al., 2023; Ochar & Kim, 2023). Nevertheless, ensuring sustainability remains challenging for universities (Thant et al., 2022).

**Optimising the Role of Universities for the Sustainability of Food Germplasm**

*Strategic opportunities for higher education for food sustainability*

Reporting on the role and responsibility of universities for food is necessary to reveal the strategic opportunities of universities for food sustainability. The study's results are summarised in Table 3.

Table 3 explains that research on food is needed for the sustainability of food germplasm. These findings align with Beulah's (Pretorius & Schönfeldt, 2023) expectations, which emphasised the significance of supporting the sustainability of local food systems through transdisciplinary approaches, partnerships, and collaborations. However, unlike Beulah's study, which emphasises formal cooperation, this study highlights the strategy of strengthening the internal function of research by optimising the *dharma* of higher education, enabling researchers' roles to be maximised without relying on formal external cooperation.

The *dharma* of higher education consists of four pillars that support the establishment of higher education: Education and teaching, research, community service, and problem-solving to address community challenges (*akhlakul karimah*/spirit of morality). Accordingly, identifying opportunities to optimise the role of universities for the sustainability of food germplasm is conducted by examining the position of universities in each of their *dharma*s. The results of the study are outlined in Table 4.

Table 4 illustrates that each *dharma* of higher education contributes to the development of food germplasm. This includes its research and community service functions, collaborations with research institutions in the region, local government agriculture offices, and local agricultural extension workers and non-governmental organisations. In particular, UHO and the UMK actively participate in community-based research, seed bank initiatives, and local food crop varieties. As such, these institutions play a central role in innovation and the dissemination, preservation, and education of food germplasm.

Overall, the role and function of *dharma* higher education demonstrate the synergy and continuity between *dharma*s in supporting the sustainability of food germplasm, starting from the educational process to the evaluation stage of innovation results applied in the field. This suggests that the dual roles of lecturers have a strategic value that supports each other comprehensively. Furthermore, this aligns with Parsons's Social Systems Theory, which

Table 3: The role and responsibility of university researchers for food

Role	Responsibility
The object of the research is to reveal local potential, ensure the superiority of the content, develop products including benefits, use value, added value, competitive, give birth to new varieties that are resistant to climate and pests and diseases, introduce, socialise, and introduce to the international world scientifically, develop various diversified products, apply substance content to expand its use further, enrich, introduce, and support food security.	The development of knowledge, intellectual values, and moral responsibility for the regional potential

Source: Primary data (2023-2024)

Table 4: Higher education institutional *dharma*

Name	Role	Function	Assignment	Shape	Ranking for Food
Education and teaching	Educator, scientist	Forming student competencies and producing human resources.	Conducting educational and teaching activities.	Teaching and learning process: Discussions, assignments, practicums, Real Work Lectures (KKN)/ Amaliyah Work Lectures (KKA), internships.	The first regulation: Connecting universities with the regions, including farmers, local products and food germplasm, regional food policies, and agricultural extension systems.
Research	Researchers	Creating innovation, both non-physical innovations (ideas/ solutions) and physical innovations (appropriate technology).	Conduct research according to the field.	Conduct experiments and test samples, explore the community's needs and problems, design solutions, and publish research results.	Core regulations must be on target, effective, and efficient in creating the right innovation for the needs, root causes, and design of farmers' changes.
Community service	Problem solver	Applying science and the sustainability of research results.	Solving the problems of the surrounding community through science and institutional efforts.	Counselling, technical guidance, mentoring, assisting villages, expert staff, and occupying certain positions in local government according to scientific fields.	Further regulation for the application of research results.
<i>Akhlakul karimah/ moral values</i>	Role models	Ensuring that the three <i>dharmas</i> are carried out by practising divine values.	Synergising science with real applications in society.	Instilling spiritual values and morality in society.	Follow-up regulation: Ensuring innovation runs and evaluating follow-up actions (to get to the initial process).

Source: Primary data processing results and secondary data

states that each subsystem has its contribution according to its role in realising the system's goals. In this case, the dual role in higher education through its *dharma* has become a unit for developing food germplasm.

Efforts to maximise the role are conducted by integrating the pillars of higher education. The

results of the integration are provided in Table 5. Table 5 provides operational regulations for actions from the initial stage of innovation to the end of the implementation and follow-up stages. This highlights the crucial role universities can play in mitigating the threat to food germplasm. Although the researchers conduct

Table 5: Integration of higher education pillars for local food sustainability

Pillar	Role	Action	Shape	Process	Output
Education and teaching	- Innovation input start research basic materials/ materials research	Information collection, mapping, selection	- Local products - Farmer problems farmers' needs	- Lecture assignments - Practicum	Research topics featured hotels
Research	Process creation innovation	- Research team - Proposal research - Research	- Proposal/thesis - Internal research - External research (cooperation)	Together with students, lecturer teams, and research stakeholders	Innovation
Devotion community	Output: Research follow-up innovation application	Service team	- KKN/KKA - Field practice - Fostered villages - Mentoring	With students, lecturer teams, involvement stakeholders, farmer involvement	Product implemented
Coaching morals and karimah	Ensure internalisation of morality and religious values in the three pillars		Integrity responsibility, commitment	Productivity	Highly committed academic community, integrity, and responsibility

Source: Primary data processing results (2023-2024)

their activities on campus, they still maintain their proximity to the region. Additionally, this research is in line with the findings (Salminen *et al.*, 2024), which affirm the strategic role of universities in building a sustainable food system through multidisciplinary approaches, collaboration, and curriculum strengthening. However, the excellence of this research lies in its ability to solve the problem of the lack of road infrastructure and Internet access in the archipelago. This can be achieved through the integration of the *dharma* of higher education and the active involvement of students as information agents in the preservation of food germplasm.

### ***Challenges of Higher Education for Food Sustainability***

Although universities have a strategic role for lecturers, they face challenges in maximising

their role for food, as the informant revealed. The expressions of the informants are presented in Table 6.

The challenges outlined in Table 6 can stem from conflicts within the researcher and internal conflicts within the institution. This requires careful handling to ensure that the consistency of higher education can be maintained. A study by Marota (2024) highlighted the need for a high commitment to institutional management. This study builds on this by emphasising the significance of values in maintaining a consistent commitment to the institution.

Through Parsons's Social Systems Theory (Parsons, 1951), values are emphasised as essential for maintaining the institution as a system running consistently within its functional corridor. Moreover, this study reveals that the values supporting institutional commitment are Godlike values internalised by the academic

Table 6: Lecturer problems based on informant expressions

Kind Problems	Informant Expressions
Unclear responsibility for food	“DRTPM and LPPM have no special responsibility for food” (DRTPM, LPPM)
Structural constraints	“We want to go further, but many things limit us: Tupoksi, funds, time, and now the lecturers are already busy with various administrative obligations...” (Lecturer Element)
Time limitations and lecturers/researchers	“Lecturers’ time is filled with fulfilling reports, especially the data collection system and policies on lecturers that change so that lecturers are only preoccupied with improvement affairs and the accompanying administration...” (Lecturer Element)
Systems and regulations	<p>“... regulations regulated by the government, we are only preoccupied with administrative matters, many research are not funded, community service is of very little value...” (Research Lecturer)</p> <p>“... The central system is changing; our data collection archives are very severe every time we ask for lecturer data, not to mention policy changes. The fickle Ministry of Education...” (Educator Lecturer)</p>
Budget and bureaucratic issues	<p>“Many studies are not funded; community service is of minimal value...” (Expert Lecturers)</p> <p>“Our funds have not been maximised, there are not many funds for internal research, research funds for service funds are still very limited” (DRTPM, LPPM)</p> <p>“Research and community service, we need a letter of assignment because it is related to financial consequences, because we do research and service, we spend funds...” (Educator Lecturer)</p>
The issue of recognition and awards	“... Community service is of minimal value; this makes many lecturers lazy...” (Lecturer, Researchers, Scientist)
Ineffective coordination	“... There are many things we can make, but we are limited in our duties; improvisation in science is said to take people’s tupoksi...” (Research Lecturer, Expert Staff Lecturer)

Source: Primary data processing results (2023-2024)

community. These values function to maintain the commitment, integrity, and responsibility of researchers to food sustainability. This is as revealed by the informant:

“... everything we do is education, research, service. In the midst of society, there must be divine approaches; I want to help provide welfare to others, benefit the wider community, because religion says that the best human beings are those who can provide

benefits. Our lives are also blessings. That allows us to continue carrying out the dharma of higher education with full responsibility, high commitment, and integrity...” (Lecturer, Scientist, Food Researcher, Private Researcher, DRTPM)

The value approach can overcome obstacles such as reluctance, laziness, and indifference. Nonetheless, it does not make material the main requirement for performing its duties and

responsibilities for food. Thus, these Godlike values stimulate consistent improvement of the competence and professionalism of academic personnel, leading to enhanced self-quality and institutional productivity.

### ***Strengthening Innovations that Ensure Adoption***

Efforts to produce effective and efficient innovations contribute to the problem of the sustainability of food germplasm in North Buton Regency. These efforts are conducted by ensuring that innovations are tailored to the needs of farmers, addressing the root of the problem of declining food germplasm cultivation, and the resulting innovations can condition changes in farmers' behaviour. In line with this, the internalisation approach of the philosophy of extension education in higher education research regulations is the key to ensuring that the resulting innovations are effective, efficient, and relevant to local needs for the sustainability of food germplasm in the North Buton Regency. Correspondingly, this approach is conducted through a series of systematic stages, including preparation, implementation, evaluation, and research follow-up. The results of the study are presented in Table 7.

Table 7 details this internalisation process, starting from preparation, namely the formation of a research team and the determination of innovation target objects based on information on needs, root causes, and change designs. Specifically, this stage utilises data from local students, agricultural extension systems, secondary data, and previous research results. Furthermore, the implementation of the research is directed at making innovations using the principles of extension education, ensuring the accommodation of needs and the sustainability of changes in farmers' behaviour.

In addition, the evaluation was conducted to assess the compliance of innovation with the philosophy of extension education, which includes consistency with needs, root causes, and change design. Meanwhile, the follow-up stage involves publishing and disseminating

research results with open access to facilitate the adoption of innovations by farmers, extension systems, policymakers, and other multi-stakeholders. Collectively, this process creates innovations that address local problems and ensure their sustainability and implementation in the long term.

Overall, the regulation clearly reports the strategic outputs produced to enhance universities' functions, strengthen their position as problem solvers for community problems, and ensure innovation adoption for interested parties.

### ***Analysis of Strengthening Research Functions to Optimise the Role of Universities for Local Food Sustainability***

Food problems are the responsibility of all parties. However, as educational and research institutions in the region, universities hold a position to be responsible for the sustainability of food germplasm. This study has confirmed that strengthening institutions that impact the role of universities can maximise their role in saving local food. With the approach of strengthening innovation through the collaboration of Parsons's Social Systems Theory and the internalisation of the philosophy of extension education, this research has been able to maximise internal resources.

Consistent with this, the combination of education and research has created its own distinctiveness and excellence. Moreover, the internalisation of godlike values in this study fosters the consistency, integrity, and responsibility of researchers towards food while helping to overcome weaknesses due to the challenge of strengthening institutions. It also complements Marota's research (Marota, 2024), which did not reveal how to strengthen the consistency of institutional management.

Higher education demands increased human resources from every regulation that carries out its *dharma*. Thus, involving the needs, root causes, and design of farmers' behaviour change is crucial for establishing innovation, as it highlights the basis of farmer behaviour change.

Table 7: Internalisation approach of extension education philosophy on higher education research regulations

Stages	Types of Activities		Prerequisite	Source	Output
	Person in Charge	Description			
Preparation	Team determination researcher (individual or team)	Ideas, ideas, ideals, hopes, and ambitions	Appropriate scientific concentration	Higher education database	Team and proposal formed research
Implementation	Determination target object innovation	Requirements information, root causes, and change design	Data accuracy	Local students, agricultural extension systems, secondary data, and previous research results	Professionalism is formed and the competence of researchers is improved
	Process manufacture innovation	Accommodating needs, root causes, and design of change	Compliance with the agricultural extension philosophy	Consistency integrity responsibility researchers	
Closing	Evaluation	Innovation trial of compliance with the internalisation of extension education	Concession conformity needs, root causes, design target change		Innovations that are by need, root causes, and designed to change farmers' behaviour
Follow-up	Publications, open access to innovation	Dissemination of research results	-	Research team	Adoption of innovations of interest: Farmers, agricultural extension systems, policymakers, scientists, and multi-stakeholder

Source: Primary data processing results (2023-2024)

Notably, incorporating these three elements into innovation will foster its sustainability. In essence, innovation that meets the community's needs is what farmers need for them to be able to continue their farming activities with a sense of joy and happiness. Research in Ethiopia by Gerba *et al.* (2019) highlighted that although the government's program involves many farmers, it fails to involve their participation since the program does not accommodate the needs of farmers. This demonstrates the significance of accommodating the needs of farmers in an innovation.

The point of addressing the root of farmers' problems is to help them overcome obstacles in developing their farming. Oftentimes, the issues that appear on the surface for farmers are not the root of the problem. Hence, providing treatment does not solve the problem. Examples of cases in Indonesia (Isnian, 2015) with regional flagship programs in education through Educational Operational Assistance are not the root of the problem that leads to programs/innovations not bringing change to clients. As a result, this research has emphasised the root of the problem as a condition for innovation.

Regarding change design, it is hoped that the innovations adopted will improve farmers' competence to ensure that permanent changes can occur and a positive learning climate is formed in every innovation (Bloom, 1983). Thus, adopting innovation is a process of permanently changing oneself positively, as it can meet the needs of farmers, address the root of the problem, and increase self-competence. Such solution innovations will ensure that all parties adopt them without exception. As a result, the benefits are felt internally by the university and by interested parties who benefit from the innovations created.

The three elements (needs, root causes, change design) emphasised in this study address Kamara's research concerns (Kamara *et al.*, 2019), which require considering the perception of agricultural extension workers to bridge the gap that occurs between innovation and problems in farmers. This research also

complements Stavros' research (Showkat & Sindakis, 2024), which did not explain how innovation strategies can strengthen institutions. Thus, this research has theoretical and practical implications. Theoretically, it provides scientific implications for developing innovative and renewable approaches through needs-based innovation, root causes, and client change design. For universities, it has implications for strengthening the research function, bringing science closer to the community, and harmonising policies with local governments. However, this study has weaknesses in utilising Information and Communication Technology (ICT).

In essence, the opportunities presented by the current era of ICT convergence to generate innovations, both in terms of inputs and outputs for disseminating research findings can be leveraged in innovation regulations. Accordingly, the characteristics inherent in ICT create a broader space for synergy among relevant stakeholders. This can positively contribute to the integrated efforts of all local resources in preserving local food potentials, where universities serve as sources of inspiration and motivators, driving innovation accessibility within the framework of their regulation. Overall, this study opens up opportunities for future research to explore the utilisation of ICT in innovation regulations in areas with significant local food potential yet limited community access.

## Conclusions

*Pae memea* is a food germplasm with strategic value for food security and regional identity. Universities play an essential role in the preservation of the *pae memea*. In line with this, the *dharma* of higher education, including education, teaching, research, community service, and moral values of *akhilakul karimah* can be optimised for food. Furthermore, role optimisation can be achieved by strengthening the research function through innovative approaches tailored to farmers' needs, addressing root causes, and designing behaviour change strategies. In addition, integrating all the higher

education *dharmas*, based on the philosophy of extension education, becomes the primary strategy. Thus, higher education institutions can be fully optimised to ensure the sustainability of food germplasm.

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### Conflict of Interest Statement

The authors declare that they have no conflict of interest.

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