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Indigenous knowledge in traditional production of rice: Impact on food security in the upland households in Ifugao, Philippines

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Abstract

Indigenous knowledge is essential to the survival of highland farming across the world. In the Philippines, the Ifugao indigenous people have a long history of rice farming which is intertwined with their indigenous knowledge and cultural identity, particularly the *Ifugao Rice Terraces* (IRT). Their traditional practices of rice production entails the use of indigenous knowledge. The investigation included a number of conventional processes, ranging from land preparation through harvesting and even the planting season. It is clear that *Ifugaos* continue to grow native rice in the region in the customary manner. It is noteworthy because Ifugao is having food security challenges, thus 82 percent of people believe that there is a high risk of food insecurity, and 70.20 percent believe that rice output is insufficient based on yearly rice production.51.2 percent felt that even though there is food insecurity, they would not go hungry.

Keywords

Indigenous Knowledge, Native rice, High land farming, Food security

Introduction

The relevance of indigenous knowledge (IK) is highlighted by previous research findings that IK is an integral component of any country's knowledge system. IK is described as an indigenous community's knowledge collected over generations of living in a particular area. It's a term that encompasses all types of knowledge — technologies, know-how, skills, practices, and beliefs – that enable local populations to build and maintain secure livelihoods in their surroundings (1). IK refers to people's abilities, skills, experiences, habits, and insights that are utilised and exploited to sustain or improve their living conditions.

IK is characterized as specific expertise that is unique to indigenous governments and serves as the foundation for agricultural decision-making and unites people to their environment. This study is based on IK, which encompasses local populations' cultural traditions, values, and beliefs. The Ifugao communities, who are regarded one of the ethnic communities in the Cordillera region of Northern Luzon, Philippines, are one of the local populations in the Philippines who can brag of a rich depository of IK. Ifugao is a landlocked mountainous province comprising eleven municipalities, one hundred and seventy-five barangays, and ten special economic zones.

Five indigenous tribes live in the province: the *ayangan, tuwali, kalanguya, keley-i,* and *hanglulu.* Ifugao's indigenous populations, which are

divided by linguistic and cultural differences, have valuable IK practices that allow them to maintain secure livelihoods in their environment. The legendary *Ifugao Rice Terraces* (IRT) (2), which is acknowledged as one of history's most ancient and deep-rooted agricultural undertakings, is proof of this. In 1995, UNESCO designated the IRT as a World Heritage Site, and the Food and Agricultural Organization later designated it as a Globally Important Agricultural Heritage System (GIAHS) (3).

The Ifugao people have a long history of rice farming, particularly in their highlands, which is relevant to the IRT. The Ifugao's heritage and culture were entwined with the traditional production of native rice in highland farms. Rice used to play an important role in the social lives of the Ifugao households because it symbolized their God's blessing and abundance (*maknongan*). There are around nine indigenous rice types produced in Ifugao, according to a study by Dominic Glover (4). Farmers cultivate native rice because it is low-cost since they use only organic fertilizers and pesticides, and IK practices create togetherness and camaraderie, according to the study. Meanwhile, according to another study by Marasigan and Serrano , farmers in Ifugao plant 20 local rice types(5)-(data can not be found in the reference paper cited). Once a year, these commonly farmed Ifugao native rice types are produced. These types are reported to be able to resist adverse weather conditions and require less fertilizer input because natural fertilizers in the soil are sufficient to meet the nutritional requirements of the plant.

In general, Ifugao's native rice types mature slowly. These types require six to seven months to mature. According to Manuel Dulawan (6), the Ifugao agrarian calendar, is defined by 12 rice ceremonies performed by a native priest known as a *Mumbaki*. Rice rites containing Ifugao IK are performed throughout the rice growing cycle(7).These IK in the form of practices, beliefs, and rituals have helped the Ifugaos to maintain a healthy relationship with their environment and assure a plentiful harvest. As traditional rice farming is inextricably linked to Ifugao culture, and also because it represents IK passed down through generations, it remains as a reflection of Ifugao indigenous agriculture that encapsulates the concept of long-term food security while living in harmony with nature.

However, due to rapidly changing natural environments and fast-paced cultural changes, the stock of IK of the Ifugaos is at threat of extinction. Despite the various programs and projects being undertaken by national and local government agencies, non-government organizations, academic institutions, and other development agencies to preserve and perpetuate the rich IK systems of the Ifugao people, many Ifugao IKs are in various stages of extinction as a result of the disruption of traditional oral communication channels. Because most IK is stored in people's memories and is primarily passed down orally, it is vulnerable to extinction because its owners or caretakers are usually elderly, and the young generation's values and lifestyles are impacted by globalization, modernization, development and progress.

The topic of IK argues that crop production and food security cannot be sustained if people's indigenous knowledge is ignored. If efforts are to be taken to alleviate problems of food security or insecurity in upland households, the function of IK in the traditional production of native rice in Ifugao is worth of considering. However, there has yet to be a conscious translation of the IKs' impact on rice production to long-term food security in upland households. Food security is defined as having physical and economic access to sufficient, safe, and nutritious food that fits one's dietary needs and preferences for a healthy existence at all times.

Mostly, Ifugao families procure and consume hybrid types of rice beside the locally produced native rice varieties. Since the traditional production of native rice is not only important for upland households' livelihood strategies, but also one of the primary expressions of the Ifugao communities' unique culture and sacred traditions, investigating IK practices and their magnitude of use is considered significant and relevant in order to gauge their impact on food security in upland households. Harvested palay provides an adequate supply of food for upland households in Aguinaldo, Banaue, and Mayoyao, but not in Hingyon and Hungduan, according to the research. According to Awuor Ponge , (8), food security means that food is always on hand and/or available; that every member of the family has access to it; that it is nutritionally sufficient in quality, quantity, and variety; and that it is appropriate and acceptable within the given culture. As a result, food security is less dependent on agricultural output and more on people's capacity to demand and control their resources in order to acquire the food they require (9).

As a result, the scope of this study focused on the impact of IK practices in traditional native rice production and their extent of use by upland households of the different ethnic communities of Ifugao in order to determine whether they would contribute to resolving problems of food (in)security and addressing the mounting concerns of poverty. It has also recorded IK methods in traditional rice farming r. As IK is important to development, it is proposed by Brokensha (10) (this reference is not that is cited) and Warren(11), (this reference is not that is cited) as noted by Ponge (8), that it is to be gathered and documented in a logical and methodical manner.

Materials and Methods

A quantitative approach was used in the study to determine the significance of the food security to the IK process in planting native rice varieties. The questionnaire responds to three parts, first is the Socio-Economic Profile of the respondents, second is the IK practices in the traditional production of rice varieties and last is the household rice self-sufficiency and food security.

Food security was assessed and analysed using a modified version of the US Household Food Security Survey Module (US HFSSM), which was derived from the ‘US Department of Agriculture's Guide for Measuring House-

hold Food Security – 2000' and based on the paper by Melgar-Quinonez *et.al.* (12). The US HFSSM comprises nine questions that ask respondents whether they have to cut back on to the quantity and quality of food they eat. This Survey Module was updated to focus just on households with children and adult food poverty. The process of data collection (13) is based on the characteristics of each IK and process for data preparation (14). The Survey Module evaluates only the sufficiency of household food as directly perceived by family members in the context of this study, not the nutritional adequacy of meals.

As per this Survey Module, replies such as "often true" and "sometimes true" are considered affirmative responses. Responses such as "rarely" and "never true" are deemed unfavourable. To establish the scale value and categorization for a family, the Food Security Scale Score was determined by counting the number of positive replies and reading the relevant scale values from a standard table. Table 1., shows how a family with three “yes” responses to the core questions was given a scale rating of 2.4. Only two food security status levels (categories) were examined in this study.

Table 1. Food security scale values and status levels corresponding to number of affirmative responses

No. of “affirmative” Responses	1998 Food Security Scale values	Food Security Status Level (Category)
0	0.0	Food secure
1	1.0	
	1.2	
2	1.8	
	2.2	
3	2.4	Food insecure without Hunger
4	3.0	
5	3.4	
6	3.9	
7	4.3	

Food security is defined as the determination of the amount of food to be supplied at each meal, as well as the assessment of long-term stability in producing/cultivating the amount required for a certain period of time. The standard of being secure in terms of self-perception, analogies of food storage, and food sufficiency are taken into consideration by analyzing Tables 1 and 2 from the Guide to measure Household Food Security of 2000.

Table 2. Food security status level/ category description

Food Security Status Category without hunger	Description
Food secure	Households show no or minimal evidence of food insecurity
Food insecure	Food insecurity is evident in household members’ concerns about adequacy of the household food supply and in adjustments to household food management, including reduced quality of food and increased unusual coping patterns. Little or no reduction in members’ food intake is reported.

Based on their impression and idea of food (in) security, the respondents themselves defined who were at "high risk" and "no risk" of food insecurity in this study. The ethological variables, the respondents' conceptions of food (in)security, were elicited by asking why they regarded farmers to be "high risk" or "no risk" of food insecurity. In order to measure the extent to which the identified IKs are employed in the traditional cultivation of native rice varieties, a Likert scale was used to various assertions about IK activities. In this study, the degree of usage of IKs was measured using a four-point rating scale ranging from 'frequently,' 'occasionally,' 'rarely,' to 'not at all.' Rahman (2012) conducted research that assessed the "extent of usage of IKS in agricultural operations," which inspired this four-point scale and the indigenous knowledge usage index (IKUI), (citation not gien for Rahman (2012). Table 3 depicts the scoring methodologies.

Table 3. Scoring techniques for measuring IKS

Extent of Use of IKs by rating scale items	Weights assigned	Definition of Qualitative Description
Frequently 3	3	IK is being practiced/ used regularly (constantly) during the agricultural calendar
Occasionally 2	2	IK is being practiced/ used once in a while (sometimes)
Rarely 1	1	IK is almost never practiced/ Used
Not at all 0	0	IK is not or never practiced/ Used

The rating system shown above was used to assess the 36 documented IK practices, beliefs, and rituals based on a survey of existing literature on the issue. During the preliminary fieldwork, no new IK was discovered by key informants. The score for an individual responder on the "extent of usage of IK practices" was computed by adding the scores for all of the enlisted IKs. The IKUI was also computed to assess the location of the individual indigenous knowledge in the rice production cycle in comparison to the other enlisted IKs.

IKUI = N1 X 3 + N2 X 2 + N3 X 1 + N4 X 0.

where,

IKUI = Indigenous knowledge use index;

N1 = Number of farmers who used the IKs frequently;

N2 = Number of farmers who used the IKs occasionally;

N3 = Number of farmers who used the IKs rarely;

N4 = Number of farmers who did not use the IKs at all.

The IKUI for each of the IKs could range from 0 to 500.

To analyze, summarize, and categorize the quantitative data, descriptive statistical techniques such as frequencies, percentages, means, and standard deviation were utilized. Correlational analysis was also utilized as a statistical approach to examine the relationship between variables using the SPSS program and Pearson's Product Moment Correlation Analysis.

Table 4. Number of respondents in the study sites

Name of Municipality	No. of Barangays	No. of respondents (Households engaged in native rice production)
1. Asipulo	9	11
2. Hngyon	12	37
3. Hungduan	9	139
4. Kiangan	14	34
5. Aguinaldo	16	132
6. Banaue	13	60
7. Mayoyao	9	87
Total	100	500

The snowball sampling approach was employed in the study to produce responders per municipality. This approach was used since there was insufficient information to create a sample frame. Using this method, a few possible respondents (known sources of information) from each barangay (village) were questioned initially, and they (1st interviewees) then named other sources of information in the community. As the procedure progressed, the number of respondents seen in table 4, grew like a snowball until the total number of required respondents, ie., 500 was attained.

Fig. 1. Location Map of the Study

As of now, no extensive research has been conducted on the impact and/or effect of IK practices on food security amongst upland households, as well as the degree of usage, notably in the traditional cultivation of native rice in Ifugaos found in figure 1. Why concentrate on native rice production? Previous discussions highlighted the importance of rice in the life of the Ifugao indigenous peoples, such that Ifugao culture is deeply entrenched in rice culture. It represents prosperity and blessing, which helps to maintain indigenous homes. As a result, for upland communities, rice cultivation includes more than just planting rice seedlings in terraces (*payoh*); it also entails IK activities throughout the production cycle from preparation of the terraces to harvesting the grains as described in Table 5.

Taking these factors into account, the findings of this study will serve as baseline data and will contribute to the body of knowledge regarding the impact of IK practices in the production of native rice on food security in upland households in Ifugao, as well as the scope and extent of use of these IK practices. Furthermore, it will highlight the limitations of utilizing IK. It will also reveal whether socioeconomic characteristics and ethnic affiliation influenced the amount to which indigenous knowledge practices were used, as well as whether usage of these IK practices had an effect or impact on food security among the upland families of Ifugao.

As a result, if baseline research on the impact and/or effect of IK practices on food (in)security is to be considered in policy formation, and if the engagement of local people as active collaborators and decision-making units is to be incorporated in the development process, this study is relevant. This research is important if suitable interventions are to be conducted to ensure the maintenance and continuation of these indigenous traditions that are inextricably linked to the way of life of the Ifugao ancestors.

Results & Discussion

The conservation and adaptive management of Globally Significant Agricultural Heritage Systems (1) indicated that the availability of water prompted Ifugao highland families to build terraces. The *Tuwali* ethnic group does have a plentiful supply of water from the densely wooded Mt. Napulawan in Hungduan, Mt. Atugu between Hingyon and Lagawe, Mt. Kappugan in Kiangan, Mt. Kesimelan in Asipulo, and Mt. Polis between Ifugao and Mountain Province.

Figure 2 reveals that the Tuwali ethnic group accounted for the bulk of respondents (65%), while the Ayangan ethnic group accounted for 31.6 percent. Only 3% of those polled identified as *Kalanguya*.

Farmers in the municipalities of Asipulo, Hingyon, Hungduan, and Kiangan, as well as portions of Banaue, are mostly *Tuwali,* whereas certain groups in Banaue and the whole municipalities of Mayoyao and Aguinaldo are *Ayangan*. The majority of the *Tuwali* ethnic group is home to Globally Important Agricultural Historic Systems (GIAHS) and UNESCO heritage sites such as the Hungduan, Kiangan, and Banaue Rice Terraces.

Table 6 reveals that a large proportion (82.0 percent) of upland families involved in traditional rice cultivation were deemed "high risk" to food (in)security by local

Table 5. Indigenous knowledge practices throughout the rice production cycle

IKs	Description
Kiwang (Off Season)	Rice fields are left to fallow to regain their fertility. This is the time that the fields are left alone with all the drying and rotting rice stalks including the grasses. Prestige feasts are usually held during this period as there is abundance of food.
Ahilamun (weeding or clearing of rice terraces)	Small groups of women cut the dead and ratooning rice plants, which are treaded into the mud to decay, thereby enhancing soil fertility. This is done after the first bundles are removed from the granary.
Ahiloba (cleaning the walls/ slope/ stone wall of the rice fields) -	Terrace walls including the paddies, dikes, and surroundings are cleared. Water outlets are blocked to raise water levels in the terrace. At the same time, they make mounds (*inado/ pingkol)* at the center of the field or at the sides of the terraces for planting vegetables. While cleaning the wall, the women also clean the rice plants from plant borers and remove grasses within the rice plants. Farmers also look for rat tunnels and place sticks or bundled grass in the holes to prevent the rats from coming out.
Lawang (Planting Season)	This is the season of field work and rice planting. During this period, terraces are prepared for planting.
Ahigaud/ ahi law-ang	As soon as the women finish clearing the field, the men level the pond field, reshape the paddies, and repair the destroyed part of the rice field, especially the stonewalls and the dikes.
Ahipaphod (Seed bed preparation)	In preparing the seedbed (panopnakan), the pond field is drained. Any living organism that might eat the seeds or deter their germination is removed. Next, the seedbed is leveled.
Ahihopnak/ ahipatang	The rice panicles are placed on the seedbed. Seeding is done only in the afternoon so that fowls will not devour it.
Ahiboge/ ahitunod	When the seedlings grow about a foot, transplanting (*kahiboge*) sets in. The owner of the biggest rice field (*tumonak*) initiates the first transplanting activity in his rice field.
Tiyalgo/ ti-algo (Dry Season)	This is a period of insufficient rice supply. The rice seedlings are growing by this time. Farmers devote their time maintaining rice crops and irrigation channels as well as destruction of pests.
Ahikagoko, ahihagaphap, ahilupung -	When the crops grow about 2 feet tall, groups of women pull the weeds, bury them in the mud to let them decay, thus enhancing the fertility of the soil. This enables the palay roots to acquire all the necessary nutrients from the soil. After which, the paddies (*hagaphap*), walls and surroundings (*lupung*) are cleaned for the second time.
Ahiabul/ahiadug	As soon the crops boot (*munbuhbuh/ munhulit*), the farmers put up scarecrows and tie strings to ward off birds from eating the spikelet.
Hanglag	Early bundles of rice are reaped from the rice fields and toasted to make *tinukpi.* This is to test the grains if they are ready to be harvested. Meanwhile, the *mumbaki (native priest)* invokes the deities to hasten the ripening of the grains.
Ahitulu/ ahibotok/ ahi ani	After confirming that the grains are ripe, harvest begins. Very early in the morning, before harvesters reach the rice field, a small group of women set out to cut choice seeds (*binong-o*) to be used on the next agricultural cycle. Women harvest the grains while the men carry the harvest to the rice granary.

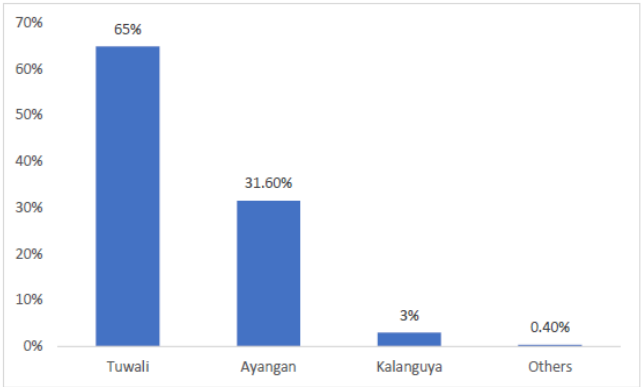

Fig. 2. Ethnic affiliation of respondents

Table 6. Food (in) security based on local standards (emic indicators)

Name of Municipality	High Risk		No Risk	
	Frequency	%	Frequency	%
1. Asipulo	1	9.09	10	90.91
2. Hingyon	34	91.89	3	8.11
3. Hungduan	110	79.14	29	20.86
4. Kiangan	27	79.41	7	20.59
5. Aguinaldo	115	87.12	17	12.88
6. Banaue	47	78.33	7	20.59
7. Mayoyao	76	87.36	11	12.64
Total	410	82.00	90	18.00

farmers based on emic indicators derived from their own concept and knowledge of food (in)security. According to the statistics, families classified as high risk of food (in)security were more likely to have low to very poor food security.

On the other side, 18.0 percent of families were categorized as "no danger" of food (in)security, indicating that they enjoyed a high level of food security. According to the responses, food security has something to do with food sufficiency and accessibility, the capacity to satisfy the requirements of the family, the availability of re-

sources, and even the family's values. This suggests that the personal and economic circumstances of households have an impact on food security.

on benchmark measures, Table 7 reveals that 48.8 percent of respondents were "food secure," while 51.2 percent were "food insecure but not hungry."

Table 7. Food security of households using benchmark indicators as defined by outsiders (US HFSSM)

Food Security Status Category	No. of HH with Affirmative Responses	Percentages
Food secure	*244	48.8
Food insecure without hunger	**256	51.2
Total	500	100

It should be mentioned that when the benchmark measures were used, upland families were roughly food secure. The prevalence of food insecurity without hunger was also noticed, which is consistent with Betty of Mayoyao's frequent claim: "*kurang chi ma-an para pamelya. wachay payo mi ngem nisalda kinali mungudwa ami ji ani*." (The family does not have enough food. We have rice paddies, but they are mortgaged, so we split the produce). On the one side, Kindipan of Hingyon had this to say, which was shared by the other respondents: "*hay importante ya mangan ta 3 times a day ya mabhug ya mapnek ta*." (What matters is that we eat three times a day and feel full and content.) During the interview, respondents stated that they consume entire meals (breakfast, lunch, and supper), although consumption was rationed among members, particularly in big families.

The findings reveal a discrepancy with the respondents' own judgment of having a high risk of food (in)security, which may be translated to a predisposition to have a low to extremely low degree of food security based on local norms (emic indicators).

No. of "affirmative" responses: *0-2- Food Secure; **3-7 Food Insecurity without hunger

Table 8 also includes respondents' replies to the question of whether their yearly rice output is sufficient to fulfil the family's rice demands. According to the findings, 70.2 percent of respondents believe that their yearly rice output is insufficient to satisfy their family's rice needs, while almost 30.0 percent claim that their rice production for a year is sufficient to fulfil their family's rice needs.

Table 8. Sufficiency/ insufficiency of respondents' annual rice production

12	Yes		No	
	Frequency	%	Frequency	%
1. Asipulo	5	45.46	6	54.54
2. Hingyon	11	29.73	26	70.27
3. Hungduan	58	41.72	81	58.27
4. Kiangan	6	17.65	28	82.35
5. Aguinaldo	32	24.24	100	75.76
6. Banaue	17	28.33	26	70.27
7. Mayoyao	20	22.99	67	77.07
Total	149	29.80	351	70.20

According to Table 9, there is a substantial link between the amount to which respondents employ Indigenous Knowledge practices and their food security, both in terms of ceremonies and indigenous agriculture methods.

Table 9. Impact of IK on food security among the upland households

IK	Correlation	p-value	Remarks
Ritual	0.227	<0.0001	Significant
Indigenous Agricultural Practices	0.149	0.001	Significant

This suggests that individuals who performed the ceremonies on a regular basis and used traditional farming practices had higher food security. It also suggests that the amount to which respondents used IK practice had an impact on their food security.

This might be ascribed to the fact that native rice cultivation requires less capital due to the utilization of locally accessible resources (e.g., decaying weeds and rotting rice stalks used as fertilizers) and that indigenous agricultural techniques are simple to implement. Furthermore, as documented in previous research and stated by Gomez (2005), the productivity of *payoh* (terraced ponds) was connected to the nutrient-rich water flowing from the *muyung* (communal forest). (citation not gien for Gomez (2005).

Conclusion

The relevance of rice to food security was hypothesized in this study. Rice is more than a staple meal for the indigenous peoples (IP) of Ifugao; it is also a status symbol. The cultivation of native rice is deeply ingrained in the Ifugao culture, as seen by the ceremonies and feasts held at each stage of the production cycle. These ceremonies are accompanied by indigenous knowledge farming techniques that support the traditional cultivation of native rice. Clearly, these IKs in the traditional cultivation of native rice exemplify a sustainable and one-of-a-kind agricultural approach that is in tune with nature since it does not require the use of commercial pesticides and inorganic fertilizers. Further, these IKs in the production of native rice help the Ifugao farmers meet their needs because it does not require huge capital, and that indigenous agricultural systems are easy to implement.

According to the study's findings, upland families have a significant risk of food (in)security. Based on regionally defined criteria or emic indicators, this translates to a poor degree of food security. It should be emphasized that respondents had a similar perspective and notion of food security. This is consistent with the study's findings on the yearly rice production insufficient to fulfil the household's

rice demands. On the one hand, based on benchmark measures, over half of upland families were classified as "food secure," while more than half were classified as "food insecure without starvation." The study also indicates that the use of indigenous knowledge in the traditional production of rice had an impact on the food security of the Ifugao households, such that those who practice more the indigenous agricultural systems had better food security.

It is thus suggested that appropriate intervention be done by stakeholders to conserve and perpetuate the IKs in native rice production not only to help combat food insecurity among the upland households but also to preserve the cultural heritage, relevant to the IRT which is the only recognized GIAHS in the Philippines.

It is likewise suggested that a research be conducted on the impact of climate change on traditional farming methods and food security in Ifugao families. This arises from the fact that climate change is currently altering agricultural seasons, which has an impact on farmers' usage of traditional farming techniques and systems, as well as their food security.

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Authors contributions

ED designed and carried out the study. Likewise, ED wrote and finalized the manuscript.

Compliance with ethical standards

Conflict of interest: Author does not have any conflict of interests to declare.

Ethical issues: None.

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