

Burning Grey: The Worldwide Influence of a Locally Published Grey Literature

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Abstract:

Rice is a major staple crop in the Philippines, which produces a large amount of rice each year. On the other hand, rice production generates biomass waste in the form of rice husks. In consideration of the rice husks' potential as a biomass energy source and support the development of the rice husk gas stove technology in the Philippines, Engineer Alexis T. Belonio had published a grey literature (GL) entitled "Rice Husk Gas Stove Handbook." Hence, to fully understand the impact of the technology, a citation analysis was conducted. The works that cited the GL were retrieved from Google Scholar using Harzing's Publish or Perish software. The complete title of the GL was used as keywords for the search string. Results revealed that the GL was cited by 155 literatures written by 398 authors from 31 countries. Seventy-five (48.4%) of the 155 literatures were cited 797 times. The results showed the wide utilization and the impact of locally-published GL, thereby confirming GL's value in research and development.

Introduction

Rice production is one of the most essential economic activities in the world (GRiSP, 2013). It is the staple food of more than 50% of the world's population, with more than 700 million tons produced annually (CGIAR, 2019). Rice is primarily a foodstuff and continues to be a major food staple in Asia, Latin America, the Caribbean, and increasingly in Africa, and the global rice production is expected to grow by 58 mt to reach 567 mt by 2030 (OECD/FAO, 2021). In the Philippines, rice is the staple food and is one of the most important staple crops in the country. As a matter of fact, Philippines ranks as the world's eighth-largest producer of rice (GRiSP, 2013). In 2020 alone, a total of 19.44 million metric tons (MT) of rice was produced (Agoot, 2020), which also made a significant amount of agricultural waste, such as rice husks. Rice husks or rice hulls are the hard protective covering of rice grains and are the by-product of rice production during the milling process. An estimated 2 million tons of rice husk are produced annually in the Philippines (Fung and Jenkins, 2003; Belonio, 2005). Rice husk is considered as the most abundant agricultural by-product in the country (Vinluan, 2002), and it holds a great potential to be a biomass energy source that could help address the population's increasing fuel needs according to Philippine Rice Research Institute as stated in the paper of Simeon (2016).

According to Lim et al. (2012), huge dependence on conventional and fossil fuels pose a significant problem in fossil fuel depletion, climate change, and environmental protection. Additionally, though fossil fuel is predicted to remain the dominant energy source by 2030 (Lim et al., 2012), Mofijur et al. (2019) argued that it would be incapable of supporting the global energy demand in the future due to its limited reserves. Many developing countries generally use Liquefied Petroleum Gas (LPG) as conventional fuel source for cooking (Punin, 2020). In the Philippines, conventional source of fuel such as the LPG is commonly used by many households (Belonio, 2005). However, the volatile oil price and growing emphasis on environmental conservation has led to the development, seeking, and utilization of alternative energy sources (Lim et al., 2005). Thus, the Department of Agriculture in the Philippines and the International Rice Research Institute developed the rice husk gas stove technology in 1986. Aside from its financial viability, utilization of rice husks as a biomass energy source through this technology also offers environmental sustainability by reducing the rice husk disposal problem (Belonio, 2005; Kumar, 2013).

Also, it has less carbon dioxide emission than traditional fuel sources in cooking, therefore “contributing to carbon sequestration for greenhouse gas mitigation” (Simeon, 2016).

Hence, to contribute to the development of the technology, Central Philippine University in Iloilo City, Philippines, through the leadership of its faculty member Engineer Alexis T. Belonio, developed a rice husk gas stove in 2003 (Strauss, 2016). Furthermore, to fully disseminate the technology, the University published in 2005 the "Rice Husk Gas Stove Handbook," a grey literature (GL) that is being used as one of the prime references in sustainable energy sources research.

Grey literatures are information produced in print and electronic formats not controlled by commercial publishing, where publishing is not the primary activity of the producing body (Tillett & Newhold, 2006). Grey literature is usually produced by associations, academic institutions, research institutions, libraries, societies, etc. common types are theses, unpublished documents, conference proceedings, datasets, reports, working papers, etc. (Mason, 2012; Schopfel & Farace, 2009).

GL’s value in bringing unnoticed, unexplored, and difficult to acquire information from different facets of society contributes to the development of a nation through its literary output (Gul, Shah, Ahmad, Gulzar, & Shabir, 2021). However, GL’s usability and utilization are faced with issues of discoverability due to the locality and indigenouslyness of the information; accessibility due to GL’s uniqueness and challenge in its inclusion in indexing and citation database; and content reliability and validity due to the often lack of peer-review process (Shrivastava, & Mahajan, 2021; Gul et al., 2021, Bickley, Kousa, & Thelwall, 2020). Hence, it is useful to discover and understand the influence of a locally published GL, thereby confirming GL's value in research and development.

The paper aimed to determine the impact of the technology developed by Engr. Alexis Belonio through the GL “Rice husk gas stove handbook”. Specifically, it aimed to determine the impact of GL by: 1) identifying the nationality of the authors who cited it; 2) determining the most common publishers of the citing work; 3) identifying the publication type of the citing works; 4) determining the number of citations of every citing works, and; 5) identifying the disciplines where the GL was being used and defused.

Methodology

The study included 155 literatures that cited the GL Rice Husk Gas Stove Handbook by Engr. Alexis Belonio. The data were identified and extracted from Google Scholar using Harzing’s Publish or Perish software. The search string used to retrieve the data was the complete title of the GL “Rice husk gas stove handbook”. To verify that the GL was cited in the retrieved literatures, the in-text citations and reference list of each title were checked manually.

Citation analysis was used to determine the influence of the GL. The analysis covers the nationalities and the collaborative activities of the authors who cited the GL; publisher; and publication type. To further see the influence, the analysis will also include the number of citations generated by the citing article and the discipline where the GL is prominently being used and being diffused. Frequency counts, percentages, and mean were used to describe the results.

Results

The GL written by Belonio was cited by 155 literatures which was written by 398 authors from 31 countries. Seventy-five (48.4%) of the 155 literatures were cited 797 times. This reflects the wide extent that the GL was used directly and indirectly.

Table 1 shows the number of authors per continent, where Asia leads with 274 authors (68.84 %), followed by Africa with 69 authors (17.34 %) and Europe with 8.79 % (35 authors).

Continent	No. of authors (f)	Percentage (%)
Asia	274	68.84
Africa	69	17.34
Europe	35	8.79
North America	15	3.77
South America	3	0.75
Australia	2	0.5
TOTAL	398	100

Table 1. Number of authors per continent

Moreover, the table below (Table 2) reflects the number of countries per continent where the nationality of the citing authors belongs. Asia included 10 countries (32.3%), followed by Africa and Europe, with eight (25.8%) countries each. North and South America consist of two (6.5%) countries each, and Australia only has one (3.2%).

Continent	No. of countries (f)	Percentage (%)
Asia	10	32.3
Africa	8	25.8
Europe	8	25.8
North America	2	6.5
South America	2	6.5
Australia	1	3.2
TOTAL	31	100

Table 2. Number of countries per continent

It can be assumed that since Asia dominates the rice production and consumption around the globe (Rice Alamac, 2013) and where more than 90% of rice is produced and consumed in the continent (CGIAR, 2019), many researchers notice the potential of the by-products of rice production.

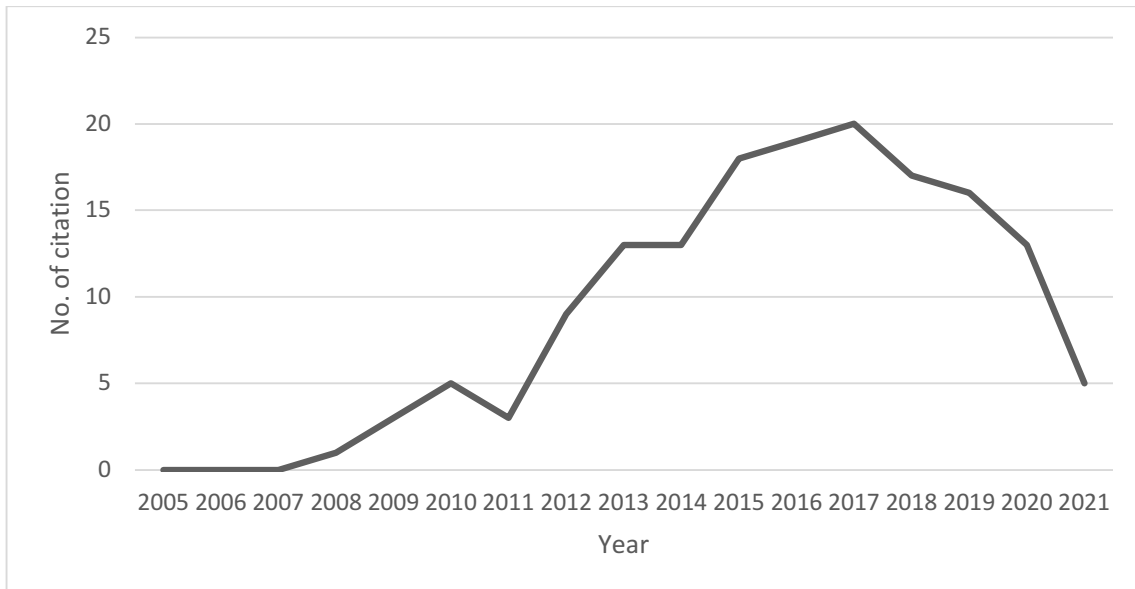


Figure 1. Number of citations per year

Since its publication in 2005, the GL has been cited 155 times. The work was cited at its highest in 2017, with 20 citations, as shown in Figure 1. On average, the work was cited 11 times a year in the course of 17 years. The peak was within 2015-2017, and in those years, Indonesia was the country with the highest number of citations. According to Faizah and Husaeni's (2018) work about the development of consumption and supplying energy in Indonesia's economy, the energy consumption from 2007 to 2017 fluctuated. Specifically, the energy consumption in households increased during the said years. The energy used by households includes biomass, gas, kerosene, LPG, and electricity. The types of biomass energy consumed by households are firewood, charcoal, and others used for cooking. Increased consumption in this sector is due to an increase in the number of family members and households in Indonesia. It can be assumed that this might be why researchers have ventured into researching the potential of rice husk as an alternative biomass energy source.

The result of the citation analysis also revealed that almost half of the first authors (49.03%) were Indonesian. It is also the same for the number of co-authors, where 98 (40.33%) of them are Indonesian out of 243 co-authors. The majority (90 %) of the first authors were affiliated with Academic Institutions, and the remaining proportions were connected with Government institutions (Figure 2).

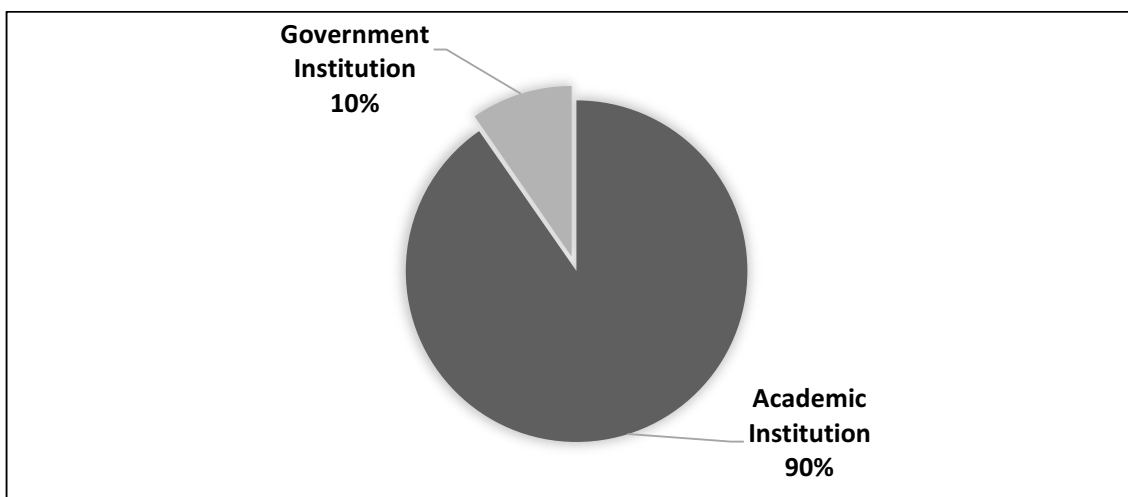


Figure 2. First author affiliation

Institution	f	%
Universitas Muhammadiyah Surakarta, Indonesia	19	11.45
Universitas Sriwijaya, Indonesia	5	3.01
Maharana Pratap University of Agriculture and Technology, India	4	2.41
Nong Lam University, Vietnam	4	2.41
Universitas Gadjah Mada, Indonesia	4	2.41
Universitas Jember, Indonesia	4	2.41
Universitas Sultan Ageng Tirtayasa (UNTIRTA), Indonesia	4	2.41
Bahir Dar Institue of Technology, Ethiopia	3	1.81
Indian Institute of Technology, India	3	1.81
McGill University, Canada	3	1.81

Table 3. Authors' affiliated institutions

Out of 101 institutions identified, the top 10 institutions with the greatest number of frequencies are all academic institutions (Table 3). Five of them come from Indonesia, two from India, and one from Vietnam, Ethiopia, and Canada, respectively. Universitas Muhammadiyah Surakarta, Indonesia ranks first with 11.4% followed by Universitas Sriwijaya, Indonesia with 3%.

Only a few (9%) of the citing literatures have a foreign collaboration in their work. 91% of the authors did their work without collaboration from other countries or nationalities. Most of the literatures that have been extracted were Journal Articles with 54.19% or 84 citing literatures. There were also Theses/Dissertations with 27.10% (42 citing literatures) followed by Conference Proceedings with 13.55% (21 citing literatures). Research Documents (including Research Articles, Projects, and Reports), Monographs, Technical Documents, and Bulletins were also identified and analyzed, as shown in Table 4. Moreover, most of the citing literatures (64%) are Open Access (Figure 3).

Type of Publication	f	%
Journal articles	84	54.19
Theses/Dissertations	42	27.1
Conference Proceedings	21	13.55
Research Documents	3	1.94
Monographs	2	1.29
Technical Documents	2	1.29
Bulletins	1	0.65
TOTAL	155	100

Table 4. Type of Publication of the citing literatures

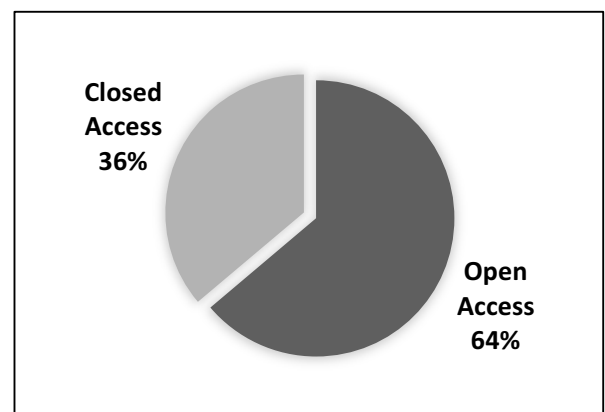


Figure 3. Type of access

The result of the analysis has identified 125 journals. Reflected in Table 5 are the journals with the most number of citing literature. Universitas Muhammadiyah Surakarta leads with 10.97%, followed by Renewable and Sustainable Energy Reviews (2.58 %) and Universitas Jember with 1.94%. Seven of the 10 (italicized) are Open Access journals.

Journal	f	%
Universitas Muhammadiyah Surakarta	17	10.97
Renewable and Sustainable Energy Reviews	4	2.58
<i>Universitas Jember</i>	3	1.94
<i>Berkala Fisika</i>	2	1.29
<i>Berkalan Ilmiah Teknologi Pertanian</i>	2	1.29
EPD Congress	2	1.29
<i>International Letters of Chemistry, Physics and Astronomy</i>	2	1.29
<i>IOSR Journal of Applied Chemistry (IOSR-JAC)</i>	2	1.29
<i>Journal of Sustainable Bioenergy Systems</i>	2	1.29
<i>Jurnal Teknik Kimia Indonesia</i>	2	1.29

Tables 5. Journals with the most number of citing literature

Publisher	f	%
Universitas Muhammadiyah Surakarta	15	9.6
<i>Springer</i>	9	5.8
<i>Elsevier</i>	6	3.8
IOP Publishing	4	2.6
<i>Taylor & Francis</i>	4	2.6
UMS Institutional Repository	3	1.9
Universitas Jember	3	1.9
Universitas Sriwijaya	3	1.9
Digital Repository Universitas Jember	2	1.3
FLUIDAS Asociatia Nationala Profesionala De Hidraulica Si Pneumatica	2	1.3

Table 6. Publishers with most number of citing literature published

Out of 106 publishers identified, Universitas Muhammadiyah Surakarta is the highest with 9.6%. Springer follows with 5.8 %, and Elsevier falls third with 3.8%. Table 6 shows the publishers with the most number of published citing literature. Only three commercial publishers (italicized) are included on the publishers with the most number of published citing literature, which includes Springer, Elsevier, and Taylor & Francis.

The GL was mainly used in the field of Mechanical Engineering (40.65%) followed by Agricultural Engineering (39.35%) and Industrial Engineering (11.61%), as shown in Table 7. It can be assumed that Mechanical Engineering ranked first because authors or researchers are using Belonio's work to create their own modified or specific version of the invention. Also, they referred to the GL for more information regarding the use of rice husk as biomass energy.

Discipline	f	%
Mechanical Engineering	63	40.65
Agricultural Engineering	61	39.35
Industrial Engineering	18	11.61
Agriculture	11	7.10
Chemical Engineering	1	0.65
Electrical Engineering	1	0.65
TOTAL	155	100

Table 7. Disciplines where the GL was diffused

Also, in analyzing the literatures, the words used by the authors in the title were counted. More than 600 words were identified using the titles of the literatures. MAXQDA was used in generating this word cloud data visualization (Figure 4) and word frequency table (Table 8). The most used word was “Biomass” and “Gasifikasi” (Indo: gasification) tied with the frequency of 33 (4.89%), followed by “gasifier” with 4.44 % (30 times) and “rice” with 3.70% (25 times). We did not translate the words or the title in the process of extracting the word frequency to show the diversity of the words.

Word	f	%
biomass	33	4.89
gasifikasi (Ind./gasification)	33	4.89
gasifier	30	4.44
rice	25	3.7
sekam (Ind./husk)	24	3.56
udara (Ind./air)	22	3.26
design	21	3.11
gasification	21	3.11
husk	19	2.81
padi (Ind./paddy)	19	2.81
pengaruh (Ind./influence)	16	2.37
stove	15	2.22
variasi (Ind./variation)	15	2.22
biomassa (Ind./biomass)	14	2.07
energy	14	2.07
gas	14	2.07
kompur (Ind./stove)	13	1.93
bakar (Ind./burn)	12	1.78
downdraft	12	1.78
performance	12	1.78
tungku (Ind./furnice)	12	1.78
limbah (Ind./waste)	11	1.63
updraft	11	1.63
cookstove	10	1.48
evaluation	10	1.48

Table 8. Word frequency



Figure 4. Word frequency

Discussion

Energy’s role in social and economic development is vital and acknowledged worldwide (Pode, Diouf, & Pode, 2015). However, the global demand for energy and resources is increasing continuously due to industrialization, rapid population growth, and consumption of goods and services (Lim et al., 2012; Quispe, Navia, & Khhat, 2016). The increasing demand affects both the energy resources and food supply, hence the production of agricultural products, such as rice, is moving in parallel. Rice is being grown in many countries worldwide (CGIAR, 2019) where most of it was produced and consumed in Asia (GRiSP, 2013; OECD/FAO, 2021). This production growth also constitutes equivalent agricultural residues such as rice husks. The crisis presented by the finite energy resources and huge production of agricultural residues paved the way for the

governments to utilize the potential of rice husks as an alternative and renewable biomass energy (Quispe, Navia, & Khhat, 2016; Kate & Chaurasia, 2018).

We can assume that majority of the authors that cited the GL were from Asia because of the potential and abundance of rice husks, an agricultural waste that can be utilized for alternative biomass energy since the region is also leading in rice production (GRiSP, 2013). This is supported by Pode, Diouf, & Poda's (2015) statement that biomass energy was being developed and widely used in Asian countries. Moreover, Quispe, Navia, and Kahhat (2017) discussed in their paper the energy potential from rice husk per year per region, where Asia leads, followed by America, Africa, and Europe.

The majority of the literature was open access journal articles, mostly published in academic institutions through their repositories. This result is in line with the statement of Gul et al. (2020) in their paper that the role of Open Access Repositories (OAR) in disseminating grey literatures are evident. Grey literature continues to play an essential part in the research endeavor of researchers (Palcullo, Geromiano, & Superio, 2021). Predominantly, repositories are institutional, disciplinary, aggregating, or governmental. Specifically, Institutional Repositories (IR) are managed by academic or research institutions (Gul et al., 2021). Tsunoda, Sun, Nishizawa, & Liu (2017) stated that IRs "aim to provide open access to institutional research output, to create global visibility for institutions' research, and to store and preserve other institutional digital assets, including unpublished or otherwise easily lost grey literature such as theses, working papers or technical reports."

Conclusions and Recommendations

This study exhibited that the role of Grey Literature as a source of information stays essential, especially for researchers. The top users of the GL came from the countries which are also considered leading countries in rice production and consumption. The GL was used in different disciplines, mainly in Mechanical Engineering and Agricultural Engineering, and most of the literature that used the GL was available as Open Access.

The study shows that even locally-published grey literature could be of value to the international community; thus, publishers must ensure that the distribution of these resources must not be limited to the local community only.

Furthermore, Institutional repositories play important roles in disseminating and preserving these publications; thus, whenever possible, the establishment of such is recommended.

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