engineering proceedings

MDPI

Proceeding Paper

Non-Timber Forest Products By-Laws and Their Impacts on Households' Food Security in Kondoa District, United Republic of Tanzania †

Heri Sagali [1,*], Erasto Mang'enya [2] and Yingli Huang [1]

[1] School of Economics Management, Northeast Forestry University, Harbin 150040, China; hlhuangnefu@163.com
[2] Institute of Resource Assessment, University of Dar Es Salaam, P.O. Box 35097 Dar Es Salaam, Tanzania; erastom2001@yahoo.co.uk
* Correspondence: sagherry@gmail.com
† Presented at the 4th International Electronic Conference on Applied Sciences, 27 October–10 November 2023; Available online: https://asec2023.sciforum.net/.

Abstract: Humans have relied on forest resources for their basic needs, including fuel, food, and shelter. The high demand for these resources has led to the implementation of forest protection and management measures, including the establishment of by-laws. These regulations aim to control community access and use of forest products, which significantly affect the availability of non-timber forest products (NTFPs) and, in turn, food security in the study area. Our study employs a combination of probability and non-probability household sampling methods and a cross-sectional survey to collect data from respondents in Mnenia and Kolo villages. Our findings reveal that 74% of respondents in the study area experience food shortages. To address food security, 81% resort to selling household assets, 63% rely on food aid from institutions and the government, and 36.31% supplement their food supply by consuming edible NTFPs. The NTFPs available for gathering in the area encompass dead wood, wild vegetables, fruits, mushrooms, and medicinal plants, which are essential to the local communities. However, the perception of the people regarding forest management and food security indicates that 85.2% of respondents favor reducing the strictness of forest access, while 74.07% advocate for an increase in NTFP collection, recognizing potential side effects on forest management. In light of these findings, it is imperative to strike a balance between by-laws and the sustainable management of forest resources to strengthen the region's forest management and food security.

Keywords: non-timber forest products; by-laws; food security; forest management

check for updates

Citation: Sagali, H.; Mang'enya, E.; Huang, Y. Non-Timber Forest Products By-Laws and Their Impacts on Households' Food Security in Kondoa District, United Republic of Tanzania. *Eng. Proc.* **2023**, *56*, 280. https://doi.org/10.3390/ASEC2023-15323

Academic Editor: Simeone Chianese

Published: 26 October 2023

Copyright: © 2023 by the authors. Licensee MDPI, Basel, Switzerland. This article is an open access article distributed under the terms and conditions of the Creative Commons Attribution (CC BY) license (https://creativecommons.org/licenses/by/4.0/).

1. Introduction

Forests are home to all living things, including people who are entirely or partly dependent on forests for their livelihood [1]. Forests and forest products like non-timber forest products (NTFPs) have played a vital role in sustaining the livelihoods of poor, forest-dependent communities for centuries. The terms non-timber forest products (NTFPs) and non-wood forest products (NWFPs) are used interchangeably. They are products of biological materials other than wood, extracted from forest ecosystems, utilized within the household, marketed, or have social, cultural, or religious significance [2–4]. NTFPs may be collected in the wild, in trees outside forests, or produced in forest plantations and agroforestry schemes. These NTFPs include food additives (edible nuts, mushrooms, honey, birds, fruits, herbs, fish, spices, eggs, aromatic plants, condiments, and game); fibers (used in construction, clothing, furniture, or utensils); resins and gums; and animal and plant products (used for medicinal, cosmetic, or cultural purposes [2,4–6].

Kondoa district is a semi-arid area prone to drought, where most Tanzanian rural residents depend on natural resources for livelihoods [7,8]. The intensity of droughts

significantly affects agricultural productivity, water supply, food security, and human welfare [7]. Agriculture in the central zone of Tanzania has experienced a major setback due to climate change. NTFPs and crops have been affected by climate change in the study area. Non-timber forest products' access by-laws have affected food security availability within households. This research study aimed to explore the roles of NTFPs in rural livelihood and food security at Mnenia and Kolo villages in Kondoa district, Tanzania.

2. Methods

2.1. Study Area

This study was conducted in 2017 in two villages within the Kondoa district found in the Dodoma Region in central Tanzania (Figure 1). The district is between latitudes 4°12′ and 5°38′ south and longitudes 35°6′ and 36°2′ east of Greenwich [7,9]. Kondoa District shares borders with Babati in the north, Kiteto District in the east, Manyoni District in the southwest, Singida District in the west, and Hanang District in the northwest [10]. The district was considered because it is endowed with a natural forest and is among the districts where REDD (Reducing Emissions from Deforestation and Forest Degradation) pilot projects were implemented in the country. Thus, the contribution of NTFP to food security could be easily assessed. The district has a total area of 13,210 square kilometers, of which 50.5% is suitable for agriculture, 25.5% is under natural pasture, 16% is forest reserve, and the remaining 8% comprises urban areas and water swamps [11].

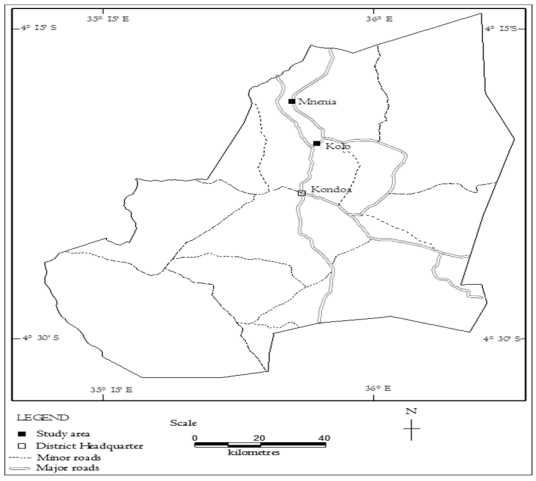


Figure 1. Map of Kondoa District showing the Study area.

2.2. Data Collection and Analysis

A cross-sectional survey was undertaken on 135 respondents from two villages, Kolo and Mnenia. It involves collecting data simultaneously without repetition from the target population. This study used probability and non-probability sampling to sample households who were the unit of analysis and groups of respondents, such as government officials, respectively

The two villages,(Table 1) namely Kolo and Mnenia of Kolo ward, were selected purposively because they were among the 18 villages of the REDD+ project in the Kondoa district. The study applied a cross-sectional survey to collect data using a questionnaire survey. The fieldwork was conducted to collect qualitative and quantitative data from both primary and secondary sources. Probability sampling was used to obtain samples from the head of household (HH), and purpose sampling was to obtain information from leaders related to forest management in the Kolo and Mnenia villages, like the District Forest Officer (**DFO**), Village Executive Officer (**VEO**), and Village Natural Resources Committee Member (**VNRCM**). Probability and non-probability sampling were used, where simple random sampling was applied to the heads of households and purposive sampling was applied to VEO, DFO, and VNRCM due to their roles as leaders to ensure by-laws are

followed. Other methods, such as observation and focused group discussion (**FGD**), were also used. The collected data were coded into Statistical Packages for Social Science (SPSS; IBM version 18.0) for analysis. Among the variables that will be discussed are illegal entry and awareness of punishment, types of NTFPs permitted to be extracted and restricted human activities, local perceptions of improving management by-laws and satisfaction with by-laws, and strategies employed to enhance household food security. Its results will be presented in the different statistical models.

Table 1. Respondents and informants of the study.

Category of Respondent Name of Village	Head of Household	FGD	DFO	VEO	VNRCM	Total
Kolo	65	10		1	5	81
Mnenia	75	10		1	5	86
Total	135	20	1	2	10	167

Note: **FGD**—focused group discussion; **DFO**—District Forest Officer; **VEO**—Village Executive Officer; and **VNRCM**—Village Natural Resource Committee Management. Source: Field Survey 2017.

3. Results and Discussion

3.1. Household Food Security Status

Household food insecurity in the study area is an issue. The findings from Table 2 show that 74% of respondents in the study area have a food shortage. This is headed by Kolo village with 44% and followed by Mnenia, which has 30%. This was known as the lean season and crop failure.

Table 2. Household food shortages (n= 135).

Village	Yes Frequency	%	No Frequency	%	Total Frequency	Total %
Kolo	60	44	16	12	75	56.3
Mnenia	41	30	18	13	59	43.7
Total	101	74	34	25	135	100

Source: Field survey 2017.

To improve the household food security status, the communities of Kolo and Mnenia villages employed different strategies. The findings from (Table 3) revealed that 81.5% of the respondents managed to enhance food security by selling household assets. Also, 63%, 36.31%, and 25.97% were enhanced through food aid from an institution, eating edible NTFPs, and selling NTFPs, respectively. Other strategies were 15.57% food aid from the government, 11.85% to skip meals, 8.89% migration to other areas with food, and 5.92% assistance from relatives.

3.2. Present NTFPs Access by-Laws

The findings from Table 4 revealed the respondent's demonstration of the present NTFP access by-law, in which the local community around the Mnenia and Kolo Hill Forest Reserve was allowed to gather. Most respondents reported that 75.57% were deadwood, 64.5% were wild vegetables, 54.82 were wild fruits, 40.74% were mushrooms, and 17.41% were medicinal plants.

Table 3. Strategies employed in enhancing household food security (n = 135).

Village/ Frequency	Sell HH Assets	Food Aid from Institution	Eat Edible NTFPs	Sell NTFPs	Food Aid from Gov't	Skip Meals	Migration	Assistance from Relatives
Kolo Frequency	54	36	20	19	9	10	4	3
%	40	26.7	14.81	14.07	6.67	7.41	2.96	2.22
Mnenia Frequency	56	49	29	16	12	6	8	5
%	41	30	18	13	59	43.7		
Total Frequency	110	85	49	35	21	16	12	8
%	81.5	63	36.31	25.97	15.5	11.85	8.89	5.92

Based on multiple-response analysis: Source: Field survey 2017.

Table 4. Types of NTFPs permitted to be extracted from Mnenia and Kolo forest reserves (n = 135).

Village/Frequency	Dead Wood	Wild Vegetables	Wild Fruits	Mushrooms
Kolo Frequency	50	54	34	22
%	37.04	32.6	25.19	16.3
Mnenia Frequency	52	43	40	33
%	38.53	31.9	29.63	24.44
Total Frequency	102	97	74	55
%	75.57	64.5	54.82	40.74

Based on multiple-response analysis: Source: Field survey 2017.

Apart from the availability of the by-laws, which allowed the community to harvest some of the NTFPs, different human activities were restricted in the area. Figure 2 shows that 64% and 42% of farming activities in Kolo and Mnenia villages, respectively, were followed by 32% and 28% of charcoal-making in the same villages. Also, Mnenia village had 14% and 4% of grazing and mining, respectively, followed by Kolo village, which had 11% and 2% of grazing and mining, respectively.

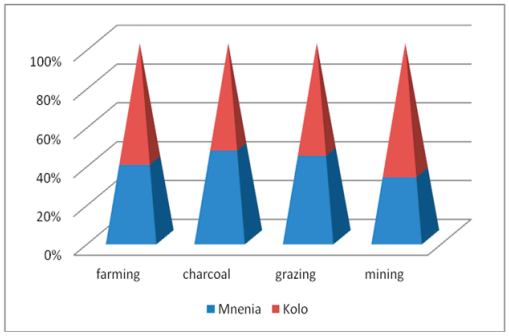


Figure 2. Restricted human activities in the Kolo Hill Forest Reserve. Source: Field Survey 2007.

3.3. Awareness of Punishment for Illegal Entry into Kolo Hill Forest Reserve

This study scrutinized the awareness of punishment for illegal entry into the Kolo Hill Forest Reserve. Based on multiple-response analysis, the results in (Table 5) show that 85.19% of the respondents are aware of fines, 77.06% of imprisonment, 69.63% of punishments, and 28.2% of fines, imprisonments, and punishments.

Table 5. Awareness of punishments for illegal entry into the Kolo Hill Forest Reserve (n = 135).

Village/Frequency	Fines	Imprisonment	Punishment	Both
Kolo Frequency	60	56	52	14
%	44.44	41.5	38.52	10.4
Mnenia Frequency	55	48	42	24
%	40.57	35.56	31.11	17.8
Total Frequency	102	97	74	55
%	85.19	77.06	69.06	28.20

Based on multiple-response analysis: Source: Field Survey 2017.

The survey conducted in Kolo and Mnenia villages showed the respondents' satisfaction with the Kolo Hills forest reserve management by-laws. The results of (Figure 3) showed that 72% and 78% of the respondents in Kolo and Mnenia villages were dissatisfied, respectively. Also, 22% of Kolo and 14% of Mnenia were satisfied with the Kolo Hill Forest Reserve management by-laws. Most of the people in Kolo and Mnenia were dissatisfied with the management by-laws.

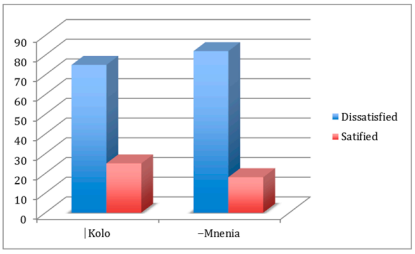


Figure 3. Satisfaction with the Kolo Hills Forest Reserve management by-laws. Source: Field Survey 2007.

3.4. Perception of Improving the Mnenia and Kolo Hill Forest Reserve Management by Law and Food Security

According to the results from Table 6, the perception of respondents to improve the Mnenia and Kolo Hills forest and food security was 85.2% said to reduce strictness, followed by a 74.07% increase in the quantity of NTFPs, a 63.7% increase in the days of entering the forest reserve, a 44.44% reduction in NTFPs collection fees, and a 28.15% reduction in fines.

Table 6. Local perceptions of improving Mnenia and Kolo Hills Forest Reserve management by-laws (n = 135).

Response	Kolo Frequency	Village %	Mnenia Frequency	Village %	Total Frequency	%
Reduce strictness	60	44.44	55	40.74	139	85.2
Increase the quantity of NTFPs	53	39.26	47	34.81	100	74.07
Increase the days of entering The Forest Reserve	44	32.60	42	31.11	86	63.7
Fees	24	17.8	36	26.7	60	44.44
Reduce fines	16	11.9	22	16.3	38	28.15

Based on multiple-responses analysis: Source: Field Survey 2017.

4. Discussion

Kondoa district relies on semi-arid areas with scattered, short rainfall and a prolonged dry season [11]. The extreme weather conditions and low rainfall in the study area have severely affected crop farmers [8] and caused them to experience food insecurity. The study in Table 3 has confirmed that 74% of respondents have a food shortage. This has been confirmed by the study conducted [12] in Mnenia village; 70.7% of the respondents worried about sufficient food, and 55.2% ate fewer meals. Also, [12], insisted that crop failure is due to weather conditions, which are common and widespread throughout the

study area. Generally, the results recommended that the study area has food insecurity, a life-threatening problem. In a similar study conducted in Ethiopia by [13] on NTFPs and food security, out of 160 sample households, 84 households were identified as food insecure. According to [14] on NTFPs and food security, out of 160 sample households, 84 households were identified as food insecure.

Besides having food insecurity in the area, different strategies were adopted to increase household food security in the study area. Among the leading strategies were selling assets (81.5%), food aid from an institution (63%), government (25.97%), eating edible NTFPs (36.31%), and selling NTFPs (15.57%). The mentioned strategies differed from the FGD in Kolo and Mnenia, which confesses that most of their food and income during lean seasons and crop failure is from the NTFPs. Apart from other strategies, the NTFPs substantially contributed to food security in the study area. The same study by [13] in Kilolo district, Tanzania, found that 80% of local communities living adjacent to Mgori Forest Reserve obtained honey, vegetables, and wild fruits from the forest. This helped to improve their food security and nutritional needs. Also, the previous study [15] indicated that households receive food aid through wild collection and consumption, which provides some form of food supplement during a severe food shortage. Similarly, the household survey in Kenya showed a strong relationship between self-reported food insecurity and increased wild edible products (WEP) consumption from personal farms, neighbors' farms, and overall [16]. Moreover, a study by [2] revealed that 44% of respondents were food secure within their household due to gathering NTFPs. Similarly, as indicated in [14,17], NTFPs are the second contributor to household food security as they supply various products from the forest as an alternative source.

The introduction of by-laws in forest management in Tanzania first focused the local communities on understanding and fully exercising their rights and duties [18]. It aimed to improve the conservation and management of forests to ensure forest benefits were shared among all participants [19]. To achieve this, people are made aware of a management plan, and by law, the forest will be protected [20]. During the survey, it was observed that 75.57% and 64.5% of respondents, respectively, reported accessing and harvesting dead wood and wild vegetables, which the by-laws allowed them at Kolo Hill Forest Reserves. The local communities' awareness of the forest management by-laws and rights shapes their attitude towards them, making enforcement of the by-laws relatively smooth. Furthermore, it was found during the household survey that all the respondents were aware that by-laws regulated access to forest reserves and the appropriation of NTFPs. The reason for this could be the enforcement of the by-laws, which prohibited communities' access to natural forests and wildlife resources around the catchment areas. Instead, they were encouraged to plant trees and establish woodlots to obtain forest products [21]. This was conducted to ensure the safety of the forest resources, and penalties have been set aside for those who violate the by-laws [22]. Although stakeholders at all levels typically identify environmental goals—such as conservation, reduction in degradation, and sustainable use of forest resources—as critical objectives of the new forest laws, far fewer individuals, and villagers in particular, mentioned socio-economic goals in general and poverty reduction in particular [23].

Rules and regulations were set to prevent the area from being destroyed. In the study area, people knew of all types of punishment for illegal entry to the forest reserve. This was the same as the study by [24], which showed that 72.4% of respondents were satisfied with the rules and regulations. However, these observations contradict the results obtained during PRA exercises. The discussions showed that people would like to be more satisfied with the rules and regulations governing the reserved area. The above contradiction happened because the process of imparting environmental education varies from one place to another.

5. Conclusions

Our study area of Kondoa district is characterized by decreased and unpredictable rainfall, temperature increases, prolonged dry seasons, droughts, and reductions in agricultural products, which have been the main effects of climatic changes. This has resulted in the area being greatly affected by food insecurity. The management of forests involved by-laws that allowed the community to harvest some NTFPs and restricted some activities within the forest, like charcoal burning and farming activities. The local community has enhanced food security by selling their assets, receiving food aid from a government institution, and eating and selling edible NTFPs. In household food security enhancement, it is vigorous to embrace agroforestry to aim at sustainable agriculture. Understandably, local communities are the managers and decision-makers on how to use natural resources. Similarly, people's perceptions should be assimilated with the by-laws to sustain natural resources and food security in the area. Additionally, we should emphasize income-generating, non-farm, and off-farm activities to reduce the forest dependency in the study area.

Author Contributions: Conceptualization, E.M. and H.S.; methodology, H.S. and E.M.; formal analysis, E.M.; investigation, E.M.; writing—original draft preparation, H.S., E.M. and Y.H.; H.S., E.M. and Y.H.; supervision, Y.H. All authors have read and agreed to the published version of the manuscript.

Funding: This research received no external funding.

Institutional Review Board Statement: Not applicable.

Informed Consent Statement: Informed consent was obtained from all subjects involved in the study.

Data Availability Statement: The data presented in this study are available upon request from the corresponding author.

Conflicts of Interest: The authors declare no conflict of interest.

References

1. Dolui, G.; Chatterjee, S.; Chatterjee, N.D. The importance of non-timber forest products in tribal livelihood: A case study of santal community in Purulia District, West Bengal. *Indian J. Geogr. Environ.* **2014**, *13*, 110–120.
2. Olaniyi, O.; Akintonde, J.; Adetumbi, S. Contribution of Non-Timber Forest Products to household food security among rural women in Iseyin local government area of Oyo state, Nigeria. *Res. Humanit. Soc. Sci.* **2013**, *3*, 41–49.
3. Pandey, A.; Tripathi, Y.; Kumar, A. Non timber forest products (NTFPs) for sustained livelihood: Challenges and strategies. *Res. J. For.* **2016**, *10*, 1–7. [CrossRef]
4. Hendriks, M.; Wolvekamp, P. Non-Timber Forest Products Improving Forest Conservation and Livelihoods. Available online: https://www.bothends.org/uploaded_files/document/Both_ENDS_card_NTFPs.pdf (accessed on 25 October 2023).
5. Adam, Y.O.; Pretzsch, J.; Pettenella, D. Contribution of Non-Timber Forest Products livelihood strategies to rural development in drylands of Sudan: Potentials and failures. *Agric. Syst.* **2013**, *117*, 90–97. [CrossRef]
6. Delacote, P. Agricultural expansion, forest products as safety nets, and deforestation. *Environ. Dev. Econ.* **2007**, *12*, 235–249. [CrossRef]
7. Swai, O.; Mbwambo, J.; Magayane, F. Gender and perception on climate change in Bahi and Kondoa Districts, Dodoma Region, Tanzania. *J. Afr. Stud. Dev.* **2012**, *4*, 218.
8. Mayaya, H.; Opata, G.; Kipkorir, E. Understanding climate change and manifestation of its driven impacts in the semi arid areas of Dodoma Region, Tanzania. *Ethiop. J. Environ. Stud. Manag.* **2015**, *8*, 364–376. [CrossRef]
9. Hamisi, S.H. A Geography of Kondoa District. *Int. J. Innov. Res. Technol.* **2019**, *4*, 504–510.
10. Tanzania, U.R. *2012 Population and Housing Census: Population Distribution by Administrative Areas*; National Bureau of Statistics and Office of Chief Government Statistician: Dodoma, Tanzania, 2013.
11. Loubser, D.; Knowles, T.; Boardman, P. *Kondoa Irangi Hills REDD+ Project*; African Wildlife Foundation: Nairobi, Kenya, 2014.
12. Simons, C.; Svec, J.; Hartwig, K. *The Whole Village Project—Village Reports for Mnenia, Filimo, and Kelema Kuu in Kondoa Distric*; University of Minnesota: Minneapolis, MN, USA, 2010.
13. Abdulla, A.M. Contribution of non-timber forest products to household food security: The case of Yabelo Woreda, Borana Zone, Ethiopia. *Food Sci. Qual. Manag.* **2013**, *20*, 1–12.
14. Msalilwa, U. *Role of Non-Timber Forest Products in Climate Change Adaptation by Forest Dependent Communities in Kilolo District*; Sokoine University of Agriculture: Iringa, Tanzania, 2013.
15. Msola, D.K.; Ligate, E.J.; Chen, C.; Wu, C. *Contribution of Tanzania Southern Highlands Forest Diversity to Household Income and Food Supplements: The Case of Mufindi District in Tanzania*; Sokoine University of Agriculture: Morogoro, Tanzania, 2017.

16. Shumsky, S.A.; Hickey, G.M.; Pelletier, B.; Johns, T. Understanding the contribution of wild edible plants to rural social-ecological resilience in semi-arid Kenya. *Ecol. Soc.* **2014**, *19*, 34. [CrossRef]
17. Shemnga, T.A. *Assessment of the Contribution of Non-Timber Forest Products to Household Food Security and Income around Baga Catchment Forest in Lushoto District, Tanzania*; Sokoine University of Agriculture: Morogoro, Tanzania, 2015.
18. Faure, N.; Benjamin Ichou, T.; Venisni, A. *Communities at the Heart of Forest Management: How Can the Law Make a Difference? Sharing Lessons from Nepal, the Philippines and Tanzania*; ClientEarth: London, UK, 2019.
19. Newton, P.; Schaap, B.; Fournier, M.; Cornwall, M.; Rosenbach, D.W.; DeBoer, J.; Whittemore, J.; Stock, R.; Yoders, M.; Brodnig, G. Community forest management and REDD+. *For. Policy Econ.* **2015**, *56*, 27–37. [CrossRef]
20. Enqvist, J. Involving Forest-Dependent Communities in Climate Change Mitigation: Obstacles and Opportunities for Successful Implementation of a REDD Mechanism in Babati District, Tanzania. Bachelor's Thesis, Södertörn University College, Huddinge, Sweden, 2010.
21. Mussa, K.R.; Mwakaje, A.G. The impact of equitable payment for watershed services scheme on livelihoods in Tanzania: The case of Uluguru Mountains. *Int. J. Dev. Sustain.* **2013**, *2*, 1031–1051.
22. Nzunda, E.; Luoga, E.; Mahuve, T. Community-Based Forest Management in Tanzania: Strengths, Weaknesses, Opportunities and Threats. In Proceedings of the Thirteenth Biennial Conference of the International Association for the Study of Commons (IASC), Hyderabad, India, 10–14 January 2011.
23. Robinson, E.J.; Maganga, F. The implications of improved communications for participatory forest management in Tanzania. *Afr. J. Ecol.* **2009**, *47*, 171–178. [CrossRef]
24. Kajembe, G.C.; Silayo, D.; Mwakalobo, A.B.; Mutabasi, K. *The Kilosa District REDD+ Pilot Project, Tanzania: A Socioeconomic Baseline Study*; IIED: London, UK, 2013.

Disclaimer/Publisher's Note: The statements, opinions and data contained in all publications are solely those of the individual author(s) and contributor(s) and not of MDPI and/or the editor(s). MDPI and/or the editor(s) disclaim responsibility for any injury to people or property resulting from any ideas, methods, instructions or products referred to in the content.