TECHNIUM
SOCIAL SCIENCES JOURNAL

Vol. 12, 2020

A new decade for social changes

www.techniumscience.com

ISSN 2668-7798

Technium Social Sciences Journal
Vol. 12, 316-329, October 2020
ISSN: 2668-7798
www.techniumscience.com

Collaborative Barriers among University – Industry – Policy (U-I-P) Entities on Environmental Matters: A Case Study in Sarawak, Malaysia

Janice Manyie

Department of Forestry Science, Universiti Putra Malaysia
janice151194@gmail.com

Geoferry James Gerusu

Department of Forestry Science, Universiti Putra Malaysia
geoffery@upm.edu.my

Roland Kueh Jui Heng

Department of Forestry Science, Universiti Putra Malaysia
roland@upm.edu.my

Abstract. Realizing the importance of practicing environmental concern, it is needed to understand the tools used to tackle the issues. In this study, university – industry – policy (U-I-P) entities collaboration is a significant approach that was viewed to be the success factor towards the efforts of tackling environmental issues. Collaboration work, which involves different entities benefit in a way that pushes the entities to move towards shared objectives and goals which is to improve the environmental condition. However, although the significance of U-I-P entities collaboration was known and the linkages among U-I-P entities has started, there are still limited information on the practice of collaboration specifically on the U-I-P entities linkage structures on environmental matters in Sarawak. Thus, there is a need to identify the barriers and success factor in order to develop successful collaboration. This study addressed the gap through a mixed method of qualitative and quantitative approaches which the data were collected from 199 respondents based on a face to face interview using structured questionnaires in the major divisions of Sarawak. Drawing from a large scale of study, the study explores the status of collaboration and the barriers of collaboration in Sarawak. Findings indicated that cost, private knowledge and knowledge barrier to be a major hurdle that inhibit the development of collaboration. The assessment suggested that more efforts to increase awareness on collaboration be disseminated.

Keywords. Collaborative linkages, Barriers, Environmental concern, University - Industry - Policy Entities, Sarawak.

1. Introduction

Throughout the past decades, environmental matters have sparked interest and concern among different groups of policy makers, universities, entrepreneurs or industries [1]. This is due to the rise in environmental issues that we faced. The major cause of environmental issues that are faced in the world is the result of increased human population, and also the impacts from human

Technium Social Sciences Journal
Vol. 12, 316-329, October 2020
ISSN: 2668-7798
www.techniumscience.com

activities [2]. Growth in human population, leads to the rise of demand of goods and services that cost energy and raw materials that may impact the environment [3]. From late 1960s, Malaysia is very active in the pursuit of rapid industrialization. This rapid industrial activities and urbanization has causes pollution problems by industrial waste water, and also contribute to other types of pollution such as air pollution coming from smoke by vehicles, industrial burning process or domestic burning and noise pollution from machines or quarries [4]. During the 1970s, most of the environmental pollution was pollution from point source such as emissions from industrial plants or spillage of chemicals. However, during 1980s, environmental pollution becoming to move towards a non- point source, where emissions from numerous small activities came into focus and causes damage [2].

In Sarawak, its environmental situation surfaces due to the rapid development of the state's activities. Many has argued on the effects of the Pan Borneo Highway and also the construction of hydroelectric dams in Sarawak [5]. Although the development may benefit to Sarawak, the activities also has caused several damages such as the disruption of biodiversity and the displacement of thousands of indigenous people. Besides that, air pollution and wastewater pollution is also one of the frequent environmental issues that have hit Sarawak. An example of the environmental threat was the occurrence of haze In 1997, the Malaysian government had declared a state of emergency in Sarawak when the Air Pollution Index (API) reading in Kuching, Sarawak hit 658 [6] and later in 2019, the API in Sri Aman, Sarawak recorded a reading of 367 which is hazardous to human health. As a consequence, the government of Malaysia started to increase awareness on the environment and implement several guidelines to monitor and improve the air quality [7].

Therefore, it can be concluded that clean environmental conditions are the crucial necessity that are needed for the betterment of life. In case of environmental crisis, prompt action must be taken to mitigate its negative consequences. However, the environment is not the responsibility of only one side of entity but it is a shared responsibility in an integrated manner of university –industry – policy (U-I-P) entities collaboration. The approach of U-I-P has emerged as a trend and started to be recognized by most countries, governments and organizations and was suggested as the ways to tackle environmental issues. The approach itself has been implemented in many countries including Malaysia. As the approach of collaboration are growing in recognition various factors of why is collaboration important has been studied.

One of the reasons are there are many potentials of collaboration which includes higher productivity. According to [8], organizations that collaborate with each other tend to have higher productivity than those who does not collaborate with each other. This is supported by [9] who mentioned that the organization that collaborate with each other has higher quality of result than the organization that does not care to collaborate with each other.

However, there are barriers that hinders the development of collaboration relationship. In order to develop a successful collaboration, it is essential to identify the risk components, and challenges in order to develop a policy for industry and university collaboration. The lack of resources, lack of technical knowledge, and absence of qualified professional is a challenge in developing collaboration. Furthermore, lack of commitment, skills and organizational factors also aid in the barriers of a collaborative environment between industry, universities and policy makers [10]. All these factors or barriers affect the success of collaboration.

2. Problem Statement

The linkages among university – industry – policy (U-I-P) entities has begun in the recent years as to answer the government's vision which is to encourage working in an integrated manner of collaboration. The effort of collaboration is viewed to be the tools for success especially

Technium Social Sciences Journal
Vol. 12, 316-329, October 2020
ISSN: 2668-7798
www.techniumscience.com

when used in dealing environmental matters [11]. Institutional linkages is important in managing environmental matters. There are growing amount of evidences that depicts the engagement of one entity with another entity in addressing environmental problems in Malaysia or internationally [12]. The government itself has implemented several policies that are in favor to collaboration in addressing environmental matters. However, while there are government focus in collaborative work on environmental matters, it is still reported that there are little collaboration relationship established with no clear overview on the exact level of collaboration [13]. There are lack assessment and very limited information known on the status of the linkage structures between U-I-P entities in Malaysia, particularly in Sarawak. Thus this study is to explore on the status level of linkages on environmental collaboration, the barriers that limited collaborative linkages especially on environmental matters among U-I-P in Sarawak, Malaysia along with the ways to mitigate the barriers.

3. Research Methods

The study employs a mixed method to access the U-I-P entities linkages in Sarawak particularly on matters that are related to the environment. The data collection for the study was collected by a face to face interview from 199 respondents and entities in four main divisions of Sarawak that are in Kuching, Sibu, Bintulu and Miri.

3.1 Target respondents

The target respondents for this study are selectively selected from three different entities of university, industry and policy makers in Sarawak. Respondents from these entities are selected based on their knowledge or experience on the subject study.

3.2 Study areas

The study areas for the study of U-I-P entities linkage structures on environmental matters is located in Sarawak, the largest state in East Malaysia which is located near the Northwest Borneo Island. There are 12 divisions in Sarawak which are Kuching, Samarahan, Sibu, Mukah, Bintulu, Miri, Betong, Kapit, Limbang, Sarikei, Serian and Sri Aman. However, in the study, data collection are only collected from only four main divisions of Sarawak that are Kuching, Sibu, Bintulu and Miri as shown in Figure 1 below.

Technium Social Sciences Journal
Vol. 12, 316-329, October 2020
ISSN: 2668-7798
www.techniumscience.com

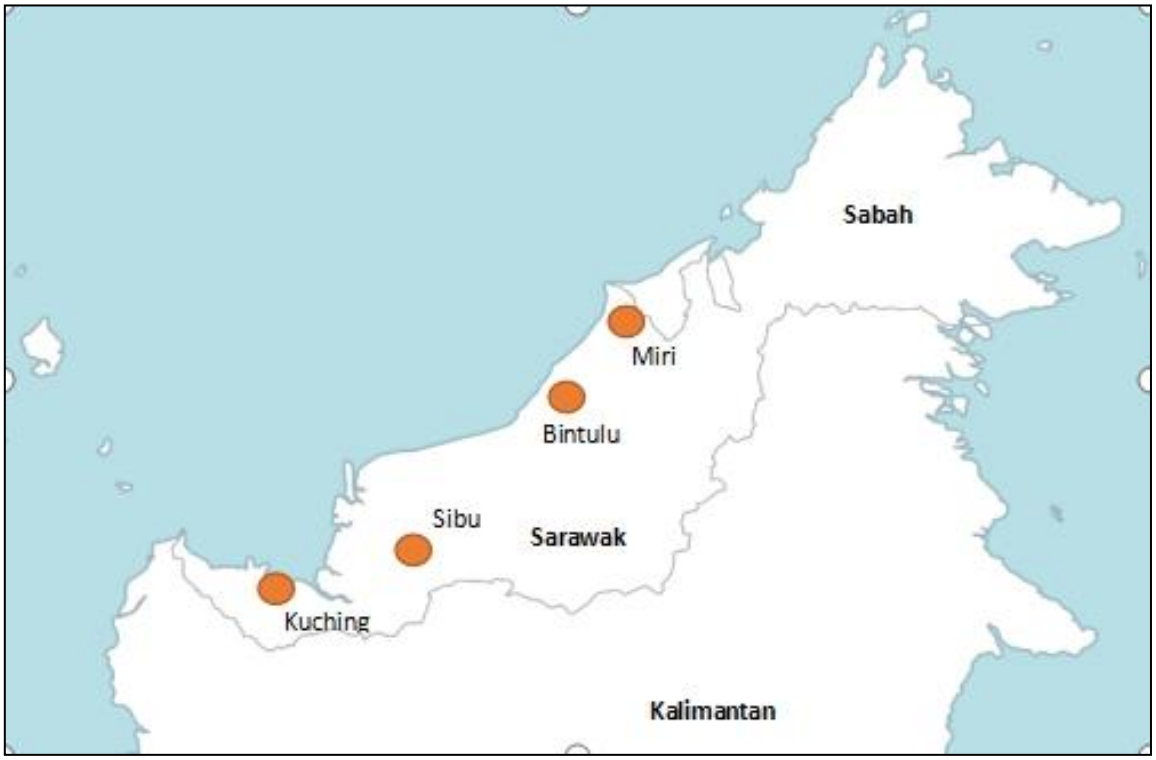

Figure 1. Study location in Sarawak

Kuching is known as the capital city of Sarawak which are also known as the administrative division that serve as the economic center for Sarawak. The local governing bodies in Kuching comprises of the Kuching North City Hall (DBKU), Kuching South City Council (MBKS) and Padawan Municipal Council (MPP). As for Sibu, Sibu is an inland town that is located at the central region of Sarawak. The town of which are governed by the Sibu Municipal Council (SMC) are highly recognized for its timber industry. On the other hand, Bintulu is a coastal town located in the central region of Sarawak. The local governing body for Bintulu is known as the Bintulu Development Authority (BDA) and the town is famously known for its industrial activities that houses many industrial areas such as the Samalaju Industrial Park. Lastly, Miri is the coastal city in the North Eastern of Sarawak. Known as the second largest city in Sarawak, Miri is famous for its oil and gas industry.

3.3 Sample size

Sample size is a statistical method that was used to study the whole population of the subject study without actually involving the whole population. The formula to calculate sample size was taken from [14]. Below is the formula to determine sample size:

$$S = \frac{(x^2)(N)(1-P)}{((d^2)(N-1)+(x^2P(1-P))}$$

where,
s = sample size needed;
N = Population size;
P = population proportion (assumed to be 0.50);
d = degree of accuracy (0.05); and

Technium Social Sciences Journal
Vol. 12, 316-329, October 2020
ISSN: 2668-7798
www.techniumscience.com

x^2=table value of chi square for 1 degree of freedom at desired confidence level is 3.841

In Sarawak, up to year 2019, identified are 400 industries that are selected according to the significance of the research. Therefore, the calculation for the sample size can be obtained by using the formula as follow:

$$S = \frac{(x^2)(N)(1-P)}{((d^2)(N-1)+(x^2P(1-P))}$$

$$s = \frac{(3.841)(400)(0.25)}{(0.0025)(399)+(0.96)}$$

$$s = 196.1; \quad s \approx 196$$

In the research, the sample size used were taken from three different entities which are the universities, industries, and policy entities from Kuching, Sibu, Bintulu and Miri. The sample size used were summed up as in Table 1.

Table 1. Sample size for the study of U-I-P entities linkages structure on environmental matters in Sarawak

	University	Industry	Policy
Kuching	3	50	3
Sibu	1	45	1
Bintulu	1	45	2
Miri	1	46	1
Total	6	186	7

3.4 Data collection procedures

Main instruments used in the data collection throughout the study is the questionnaires. The questionnaires was developed based on [15], and was modified accordingly based on the research objectives. Throughout the data collection session, questions based on questionnaires was asked face to face to the respondents.

3.5 Data analysis

Data analysis in the study was analyzed using SPSS. Type of analysis used is descriptive analysis, where the raw data was transformed into a new summary of format that is easier to interpret.

4. Results and Discussion

4.1 Collaboration Status in Sarawak

The result from the study of University – Industry – Policy (U-I-P) entities linkage structure on environmental matters are based on the questionnaires answers by the respondents in Sarawak. Figure 2 is the pie chart for the percentage of collaboration.

Technium Social Sciences Journal
Vol. 12, 316-329, October 2020
ISSN: 2668-7798
www.techniumscience.com

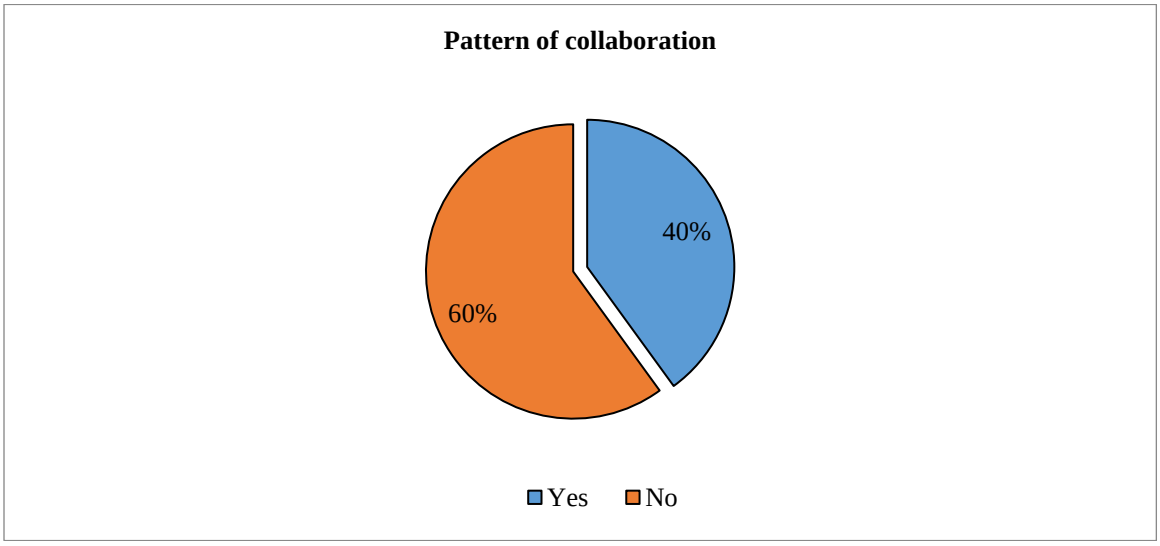

Figure 2. Pattern of collaboration in Sarawak (Yes/No)

From the pie chart in Figure 2, it can be observed that only 40% mentioned that there is collaboration on environmental matters among U-I-P in Sarawak while the remaining 60% strongly agree that there are no familiar collaboration work. Thus, it can be assumed that there are collaboration in Sarawak but the level of collaboration is not maximum as there might be barriers that impede it. The barriers of collaboration that found in this study consists of 40 types of barriers (Table 2)

4.2 Barriers of Collaboration

In this section, all the barriers perceived in the study of collaboration linkages among U-I-P entities on environmental matters in Sarawak are listed as in Table 2 and Figure 3.

Table 2. Listed barriers in Sarawak

No.	Barriers of collaboration	Total
1A	Acceptance from university/industry	1
2A	Bureaucracy	7
3A	Private knowledge	14
4A	Top management view/support	6
5A	Compliance	1
6A	Cost	19
7A	Differences in culture	3
8A	Experience	2
9A	Expertise	4
10A	Focus on money performance only	8
11A	Funding	10
12A	Hard to collaborate	6
13A	Implementation	5
14A	It is a new approach	1
15A	Knowledge barrier	11
16A	Lack of communication	1

Technium Social Sciences Journal
Vol. 12, 316-329, October 2020
ISSN: 2668-7798
www.techniumscience.com

17A	Time	1
18A	University should explore more	1
19A	Unrealistic expectation that it is easy	1
20A	Visible benefit of collaboration	2
21A	Lack of resources	3
22A	Lack of rewards to collaborators	1
23A	Long time frame to start	1
24A	Mindset from industry	3
25A	Neglect environment	4
26A	No barrier	4
27A	Not interested	2
28A	Poor awareness on collaboration	1
29A	Quality of result	1
30A	Recognition	6
31A	Same repetition of subject	2
32A	Size of company	1
33A	Commitment	5
34A	Cooperation	6
35A	Equal partnership	8
36A	Policies	6
37A	Trusted partners	4
38A	No initiatives	9
39A	Willingness to change	1
40A	Lack of help from authority	6

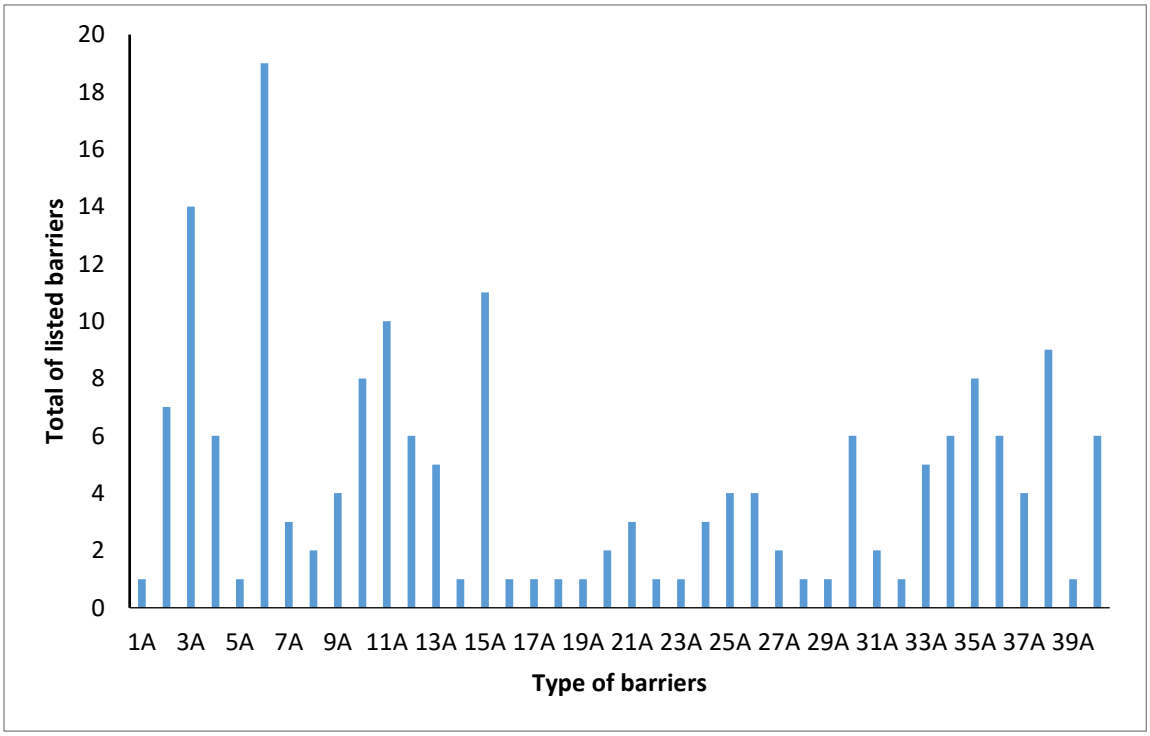

Figure 3. Barriers of U-I-P entities collaboration in Sarawak.

Technium Social Sciences Journal
Vol. 12, 316-329, October 2020
ISSN: 2668-7798
www.techniumscience.com

The study found that there are a total of 40 barriers identified in Sarawak (Table 2). If these barriers are not identified and addressed intensively by collaborating partners, then the level of collaboration may be weakened and does not gives fruitful results. For these reasons these barriers of mutual challenges of collaboration in Sarawak should be attentively identified and addressed prior to successful collaboration. The main perceived barrier of collaboration among U-I-P entities is cost, private knowledge and knowledge barrier (Figure 3). Cost is an amount of values or money that are required in order to ensure the effectiveness of collaboration. A university research or a collaborative partnership with industries require a certain amount of cost for it to be functioning. It can be in monetary form, effort or materials. As said by [16], to achieve the goals of collaboration, it is important to consider whether the cost is achievable or not.

Second highest barriers is private knowledge. Some entities, mostly industries are so secretive and private with their knowledge that they tend to not open up or excited to collaborate with their collaborating partners in fear that the knowledge will be leaked out [17]. An example, the university plays the roles of economic actor by which some universities are encouraging their researchers to commercialize their knowledge with industry to get research incentives [18]. On the other hand, the industry solve certain issues and develop new creation for competitive advantages [19]. The university are more inclined to share their knowledge but the industries are stern with their knowledge to avoid knowledge leakage [20]. The process of knowledge creation in the private sector is mainly to create an economic value of the new knowledge as part of a strategic mechanism to gain competitive advantage [21].

Besides that, knowledge barrier is also considered as collaborating constraint among U-I-P entities in Sarawak whereby there is no knowledge on how to start collaboration work or simply does not realized of the importance of partnership for goals especially in tackling environmental issues. Other barriers that are commonly challenging collaboration include bureaucracy, funding and government support. These barriers need to be addressed efficiently in order to ensure the success of collaboration goals.

4.3 Improvement of collaboration flaws

There are numerous suggested ideas that were generated from the respondents to nurture and improve the U-I-P collaboration. The responses of suggestions and recommendations are discussed for mitigation work to improve the flaws of collaboration. A total of 100 perception ideas were retrieved from the investigation as in Table 3.

Table 3. Perception ideas to improve collaboration among U-I-P entities on environmental matters in Sarawak

No	Ways to improve flaws of collaboration	Frequency of perception ideas suggested
1	Enforcement of policy	23
2	Proper platform for collaboration	19
3	Increase funding	14
4	Government support	10
5	Develop strong relationship with others	6
6	Educate society towards the existence	5
7	Environment as priority	4

TECHNIUM SOCIAL SCIENCES JOURNAL

Technium Social Sciences Journal
Vol. 12, 316-329, October 2020
ISSN: 2668-7798
www.techniumscience.com

8	Frequent meeting to discuss start-up of collaboration	4
9	Commit to partners 100%	3
10	Increase resources	3
11	Adapt methods from other country (Implement methods of collaboration from other countries)	2
12	Communicate on the expectation (Communicate on what to expect from collaboration)	2
13	Create an existing topic (Create a new topic to collaborate)	2
14	Disseminate findings on benefit (Disseminate the advantages of collaboration)	2
15	Disseminate the potential of collaboration (Disseminate what collaboration could offer)	2
16	Enhance collaboration knowledge (Strengthen knowledge on collaboration)	2
17	Enhanced communication	2
18	Foster greater understanding between different mindset	2
19	Good coordination on one person to assemble everyone	2
20	Incentives	2
21	Industry should approach university	2
22	Open to collaboration	2
23	Provide incentives	2
24	Start with more research work	2
25	Top management need to discuss	2
26	Train new and fresh skills	2
27	Instill collaboration values through conferences	1
28	Instill importance of environmental concern	1
29	Two way engagement, approach from university, more marketing	1
30	Accuracy in planning	1
31	Adapt from successful collaboration	1
32	Adapt to differences in culture	1
33	Always be motivated and spirited	1
34	Approach from university	1
35	Approach from other agency or government	1
36	Approach other than being approached	1
37	Change old approach to new approach	1
38	Change old mindset of company	1
39	Change our mindset	1
40	Create a more informed input	1
41	Depend on the administrative	1
42	Develop guidelines of collaboration	1
43	Educate people	1
44	Educate top management	1

TECHNIUM SOCIAL SCIENCES JOURNAL

Technium Social Sciences Journal
Vol. 12, 316-329, October 2020
ISSN: 2668-7798
www.techniumscience.com

45	Effective organizational system	1
46	Enhance communication or network by attending seminars	1
47	Enhance reach of entities	1
48	Enhance skills	1
49	Enhance communication	1
50	Focus on values of cooperation	1
51	Funding and set up department specific for collaboration	1
52	Gain experience by working with small project first	1
53	Gather expertise from different industries	1
54	Give incentives or create innovation	1
55	Good coordination on one person to assemble everyone, policy, budget	1
56	Government aid in consistent communication	1
57	Government requirements	1
58	Hard to get collaborators	1
59	Help from third party	1
60	Incentives or recognition	1
61	Incentives, start from young, mandatory enforcement	1
62	Increase CSR activity	1
63	Increase funding and awareness	1
64	Increase funding and frequent meet up	1
65	Increase funding and support	1
66	Increase funding, incentives	1
67	Increase funding, simplify bureaucracy	1
68	Increase funding, train expert	1
69	Increase incentives, recognition	1
70	Increase knowledge	1
71	Initiative from university	1
72	Instill awareness on importance of environmental collaboration	2
73	Instill collaboration values	1
74	Instill importance of environmental collaboration	1
75	Knowledge sharing	1
76	Leaders create more awareness	1
77	Learn from other country	1
78	Learn from those who are experienced	1
79	Legal requirement and support from government	1
80	More initiatives and motivation	1
81	Need third party who are experienced	1
82	No direct communication, never collaborate on environmental matter	1
83	Open mind for collaboration	1

Technium Social Sciences Journal
Vol. 12, 316-329, October 2020
ISSN: 2668-7798
www.techniumscience.com

84	Open to listening and understand collaboration partners	1
85	Open to new approach	1
86	Other agency should not be dependent on government only	1
87	Policies are too general - make it more detailed, informed society	1
89	Proper management planning	1
90	Propose topic	1
91	Put assurance in people	1
92	Recognize, reward collaboration	1
93	Reduce bureaucracy work	1
94	Reward collaborating partners	1
95	Staff exchange for knowledge transfer	1
96	Start with more research work	1
97	Propose new topic interest	1
98	Propose a valuable project	1
99	University propose topic	2
100	Willing to adapt for change in the company	1

The findings indicated ten (10) perception ideas that are frequently revealed by the respondents which are: 1) enforcement of policy; 2) proper platform for collaboration start-up; 3) increase funding; 4) government support; 5) develop strong relationship among U-I-P entities; 6) educate society towards the existence of collaboration; 7) make environment as priority; 8) frequent meetings for collaboration start up; 9) commit to collaboration partners 100%; and 10) increase resources (Table 3). The description for the perception ideas were then detailed out in Table 4.

Table 4. Description for perception ideas on ways to improve U-I-P flaws

No	Description of Main Perception Ideas on Ways to Improve U-I-P Collaboration
1.	**Enforcement of policy** To aid in collaboration especially collaboration related to environmental matters, there is a need for the government to formulate or enforced a policy that encourages the universities and industries to develop a professional relationship [22]. The U-I-P entities should be actively engaged in creating an institutional framework to implement policies that are in favor of collaboration.
2	**Proper platform for collaboration start up** To ensure the effectiveness and successful implementation of collaborative partnership, it is important to have a proper platform for collaboration start up. The collaboration has taken place by ways of conferences, seminars, consultancy, join research or other projects [23].

Technium Social Sciences Journal
Vol. 12, 316-329, October 2020
ISSN: 2668-7798
www.techniumscience.com

3	**Increase funding** Funding is one of the critical component which may ensure the successful establishment of collaborative partnership. The universities in developing countries like Malaysia are reliant on additional resources like government support and funding.
4	**Government support** Government support is one of the most important factor that leads to a successful collaboration especially in a developing country as the support from government is important at the start of a collaborative efforts [24]. The government seek to stimulate collaborative partnership through their roles of providing funding, incentives and policy to boost strategic collaboration initiatives.
5	**Develop strong relationship among U-I-P entities** A strong relationship is very important to sustain the U-I-P entities linkage structures. To develop strong relationship, there must be a direct communication among all entities [25]. There must also have a clear communication to discuss the roles and goals to collaborating partners to avoid any misunderstanding and risk of failed collaboration [26].
6	**Educate society towards existence of collaboration** The first step to educate the society towards the existence of collaboration is to create awareness on the subject matter. A successful collaboration need leaders who are aware of the importance and benefit of it.
7	**Environment as priority** In the study, collaboration is to strengthen collaboration efforts on environmental matters. However, some of the collaborating partners does not put the status of good environmental condition as top priority but only prioritize on profitable gains such as monetary gain, incentives or recognition. Therefore, there must be a priority setting in every collaborative efforts that are focused only on main objectives as priority.
8	**Frequent meeting for collaboration start up** Lack of communication may disrupt a collaboration relationship. It is very necessary that the collaborators can work together by interacting frequently with each other to engage in efforts that may increase cooperation.
9	**Commit to collaborating partners 100%** In order to realize the delivery of successful collaboration, there must be a two way interaction with each other. There must also be a full commitment among collaborating partners. The collaborating entities should be responsible and committed for the projects that they started and willing to work through achieving the goals and objectives of collaboration.

Technium Social Sciences Journal
Vol. 12, 316-329, October 2020
ISSN: 2668-7798
www.techniumscience.com

10	**Increase resources** To improve the flaws of collaboration, it is vital to have sufficient resources to cater to the work. Shortage of resources, or outdated facilities are the cause that mitigate the strengthening of collaboration. Hence, there must always be sufficient resources such as manpower, or relevant facilities for the effectiveness of collaboration project.

5. Conclusion

Collaboration is an approach that has been introduced to reduce the gap between entities to progress and also to ensure sustainability. As there are a number of benefits of collaboration, the Malaysian government are implementing policies to encourage collaboration. However, despite there have been many studies of collaboration, little has been published on what exactly is the level of collaboration, specifically dealing with environmental concern in Sarawak and little consideration has been given in examining the level of structural linkages among U-I-P entities. This, raises a question of the study that is to look on the level of collaboration in Sarawak and barriers that impede it. The research are subjected to several limitations. The limitation includes are the cooperation from the respondents. This is because, not everyone from the organization or company are willing to cooperate in the survey. Second limitation is the lack of previous research study on the particular topic. Thus, it is vital that more research or study on collaboration are conducted and researched to have a deeper understanding of the concept. Lastly, it is suggested that the government should enforced a strict policies on collaboration and reward those who managed to collaborate and contribute to environmental benefit.

Acknowledgements

The paper was prepared with the financial support of the Geran Universiti Putra Malaysia GP-IPS /2018/9649100 under grant no 9649100. Many thanks to my supervisory members for assisting and support during the study period.

References

[1] Sato, S. “Climate change, the built environment and triple – helix innovation.” *Elsevier*. Vol 143, pp 843 – 850, 2017.
[2] Larrson, M-L. “Legal definition of the environment and of environmental damage.” *Stockholm institute of Scandinavian law.* 2009.
[3] Gerland, P., Raftery, A. E., Ševčíková, H., Li, N., Gu, D., Spoorenberg, T., and Wilmoth, J. “World population stabilization unlikely this century.” *Science.* pp 234-237, 2014.
[4] Mokthsim, N and Salleh, K.O. “An appraisal of environmental management strategies in Malaysia’s towards achieving sustainable development goals”. *International Journal of Applied Environment Science.* Vol 11, pp. 1569-1579. 2016.
[5] Moses, K. “Power, profit and pollution: dams and the uncertain future of Sarawak.” MongaBay, New York. 2009.
[6] Swinbanks, D. “Forest fires cause pollution crisis in Asia.” *Nature.* Vol 389, pp. 321. 1997.
[7] Yusof, N.S., Zawawi, E. M. A., and Ismail, Z. “Disaster waste management in Malaysia: Significant Issues, Policies and Strategies.” in Proc. MATEC Web of Conference. Vol 66, 2016.
[8] Beaver, D. “Reflections on scientific collaborations (and its study): Past, present and future.” *Scientometrics,* Vol 52, No. 3, pp 365 – 377, 2001.

Technium Social Sciences Journal
Vol. 12, 316-329, October 2020
ISSN: 2668-7798
www.techniumscience.com

[9] Rigby, J., and Edler, J. "Peering inside research networks: Some observations on the effects of intensity of collaboration on the variability of research quality." *Research Policy* Vol 34 (6), pp. 784 – 794, 2005.
[10] Garousi, V., Peterson, K., and Ozlan, B. "Challenges and best practices in industry - academia collaborations in software engineering: A systematic literature review." *Information and Software Technology.* Vol 79, pp. 106 – 127, 2016.
[11] Gajda, R. "Utilizing collaboration theory to evaluate strategic alliances." *American Journal of Evaluation.* Vol 25 (1), pp. 65 – 77, 2004.
[12] Bodin, O. "Collaborative environmental governance: Achieving collective action in social ecological systems." *Science,* Vol 357, 2017.
[13] Rasiah, R., and Govindaraju, C. "University - Industry R&D collaboration in the automative,
biotechnology and electronics firms in Malaysia." Seoul Journal of Economics. Vol 22, 2019.
[14] Krejcie, R. V., and Morgan, D. W. "Determining sample size for research activities". *Educational and physhological measurement.* Vol 30, pp 607-610. 1970.
[15] Teshager, B. "The link between university research and industry: The case of Addis Ababa Institute of Technology" M.A thesis, Addis Ababa University, Addis Ababa, Euthopia, 2014.
[16] Guimon, J. "Promoting university-industry collaboration in developing countries", Innovation Policy Platform, Policy Brief, OECD and World Bank, 2013.
[17] Dasgupta, P., and David, P. "Towards a new economics of science." *Research Policy*. Vol 23, pp. 487 – 522, 1994.
[18] D' Este, P., and Perkmann, M. "Why do academics engage with industry? The entrepreneurial university and individual motivations." *Journal of Technology Transfer.* Vol 30(3), pp. 316-339, 2011.
[19] Link, A. N., and Siegel, D. S. "Generating science-based growth: An econometric analysis of the impact of organizational incentives on university–industry technology transfer". European Journal of Finance, vol. 11, pp. 169 – 181, 2005.
[20] Brown, J.S., and Duguid, P. "The social life of information." *Harvard Business School Press.* 2000.
[21] Teece, D. "Profiting from technological innovation: implications for integration collaboration, licensing and public policy." *Research Policy*. Vol 15, pp. 285 – 305, 1986.
[22] Singh, A. "Challenges in developing university - industry relationship: Quantitative evidence from higher education institutions in the UAE." *Emerald Open research.* Vol 1. 2019.
[23] Hamdan, H., Yusof, F., Omar, D., Abdullah, F., Nasrudin, N., and Abullah, I. C. University industrial linkages: Relationship towards economic growth and development in Malaysia. *International Journal of Economics and Management Engineering* Vol 5, pp. 1284 -1291, 2011.
[24] Brimble, P., and Doner, R. F. "University - Industry Linkages and Economic Development: The case of Thailand". *World Development.* Vol 36(6), pp. 1021-1036, 2007.
[25] Fontana, R., Geuna, A., and Matt, M. (2003, Sept). "Firm size and openness: The driving forces of university - industry collaboration." Working paper. No 103. Available: https://www.sussex.ac.uk/webteam/gateway/file.php?name=sewp103.pdf&site=25[Sept 2, 2020].
[26] Li, K. "Successful Academia - Industry Collaboration Research Project". IEEE Review. 2005.