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## **Scientific Knowledge Transfer on Mangrove Used Attraction in Segara Anakan Lagoon, Central Java, Indonesia**

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### **Introduction**

The Segara Anakan lagoon is located in Central Java, Indonesia. Its ecosystem is made up of a variety of habitats: mangrove, saltwater marshes, inter-tidal mud flats, and open water. Mangrove becomes estuary for the spawning ground, nursery ground, and feeding ground of the fish, shrimp and other water biota. However, condition of Segara Anakan Lagoon is having massive damage. One of the reasons is illegal logging of mangrove forests that leading Segara Anakan Lagoon for no longer becoming a conducive-habitat of various species of fish and other wildlife. Many researches was conducted and policy was implemented to save the lagoon and mangrove forest, thus conflicts of interests involving economics, conservation, and welfare lead to the shrinking of the lagoon continuing up to now. The research questions of the paper are: 1) was there a good scientific research for mangrove management? 2) What has science contributed to designing this solution? 3) How was the solution implemented in practice? For answering this question, the RIU model of scientific knowledge transfer is applied to analyze the interests and interactions between actors of the science-policy-interface. RIU model illuminates the importance of integration activities as the key to successful scientific knowledge transfer from science into political practice.

### **Material and Methods**

“Science-policy interfaces” can be defined as social processes which encompass relations between scientists and other actors in the policy process, and which allow for exchanges, co-evolution, and joint construction of knowledge with the aim of enriching decision-making (van den Hove, 2007). Science-based policy advice is an important precondition for a successful scientific knowledge transfer between practitioners and scientists (Sarewitz and Pielke, 2007). We used a new model of science-based policy advice, namely the RIU model (Böcher & Krott, 2014a). The analytical RIU model defines scientific policy advice as a connection between Research (R), Integration (I), and Utilization (U), with each following an individual logic (Böcher & Krott, 2014a). RIU model reveals bi-directional, non-linear process of switching between research and integration activities to create scientific policy advisory products. This model is used to analyze the unique activities shared between production of scientific expertise and utilization

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of science by politicians. Integration is a very important concern because it can selectively link science and politics—which are separate, independent, and follow different forms of reasoning—for the science-based solutions (Böcher & Krott, 2014a).

In our case study, the need of science for policy advisory was depicted in scientific research in mangrove management. “Integration” was the process when the government selected scientific finding which fit with their interest and purposes. “Utilization” was to know the scientific advice used actively by government for policy making in mangrove management. We have 3 hypotheses in structuring our paper: 1) hypothesis 1: assessing current scientific information, good scientific practice, cooperation with external scientific projects, and independent meaningfulness of scientific findings are factors to know a high quality scientific research in mangrove management, 2) hypothesis 2: relevance for problem solution, relevance in regard to allies, and target-group oriented intermediation are factors to know the implementation of scientific findings, 3) hypothesis 3: contribution to democracy, contribution to rule of law, contribution to “good governance”, appropriate solutions to problems are factors to know the scientific advice used actively by actors in mangrove management.

## Results and Discussion

Mudflat was created from material that derived from eruption of Mount Galunggung in the 1980s and heavy riverine sediment input from upland activities (Dudley, 2000; BPKSA, 2003). Sedimentation becomes tense due to environmental damage in the upstream of Citanduy, Cimeneng, and Cikawung Rivers which brought five million cubic meters of mud per year into the estuary, i.e. Segara Anakan Lagoon. Dredging activities started since 1996 and dump it to mudflat, therefore mudflat become more solid (Ardli, 2007). Mudflat turned into new land that can cultivated by any plant.

For citizen who was living surround Segara Anakan and very much depend on fish production in the lagoon, the emergence of new land restricted their fishing areas. They had been doing fishing activity since many years ago. Previously, to avoid conflicts between fishermen, they divided the sea areas into plots under private management rights of each fisherman. The village administrative issued a certificate of land on water as its legal basis. When the new land arises in the plots then citizen consider that they have a right to the land. Therefore, until 2000s many of these fishermen changed their profession to become farmers by utilizing new land. However, their effort created conflict towards local government because local government also proposing mangrove conservation project on the new land.

We use RIU model to identify the three important activities in scientific knowledge transfer and their relationship on land use. By knowing the characteristics of each activity, i.e. research, integration, and utilization, the contribution of research to the integration and utilization phases could be known. Table 1 shows the success factors for scientific knowledge transfer using RIU model.

**Research.** In 2000, research on “Segara Anakan mangrove action plan” was conducted to develop mangrove management model in Segara Anakan (Hanley and Hariyanto, 2000). It was carried out by BCEOM French Consulting Group in association with P.T. Ardes Perdana and P.T. Bhawana Prasasta. The purpose of the research was to support the goals from Part B and C of the Segara Anakan and Conservation Development Project (SACDP). The research and SACDP project was funded by Asia Development Bank (ADB). Research was assessed current scientific information, i.e. national and international scientific sources. One of the sources that become basis of the research was initial research carried out by the consultants’ team of ATC Engineering Consultants Inc. (ECI), DELFT Hydraulics, and PT EXSA International in conjunctions with PT Indah Karya as counterparts from Indonesia (ECI, 1994). Research was conducted to support the goals from Part B of SACDP, i.e. to enhance community development in regards to implement mangrove rehabilitation and management. Research procedures and results clearly documented,

and it followed good scientific practice. However, it had not been reviewed by any researcher because ADB only funded research project. Research cooperated with research on Segara Anakan fisheries management plan for exchanging data and information. Sharing data and assistance occasionally done to support each result. The cooperation is important to detect knowledge gap and can help to avoid overlapping research (Böcher & Krott, 2014a). Nevertheless, the cooperation had not been evaluated by other research group. Scientific finding on mangrove conservation was independent. Reforestation and illegal logging on mangrove had already been established before the research project started. We have proven in hypothesis 1 that the scientist did good science since most of the factors in high quality scientific research was fulfilled.

**Integration.** The direction that connects scientific knowledge to political activity occurred in integration activity (Böcher & Krott, 2014a). Research had public goals orientation since it was suggesting to plant mangrove on new land of lagoon for ecological sustainability, however, the land that used was still in disputation due to the citizen also claimed the land as their property. It made conflict between citizen and local government. Illegal logging on mangrove happened a lot on this land and citizen let this activity run without warning. Research result was relevance for problem solutions due to decreasing of mangrove made less production of fish and reforestation will bring the fish habitat back. For this reason, local government as the powerful allies in this area was supporting research by incorporating its result into regulation. Meanwhile, local government neglected the potential conflict as resulted from the conservation project. Therefore, there was no target-group oriented intermediation for the right media since the respective actors as the target was abandoned (Böcher & Krott, 2014a). Hypothesis 2 showing us that local government plays important role for the integration activity and they gave support for the result.

**Utilization.** Local government was issuing regulation No 17/2001 on mangrove management of Segara Anakan. It was in line with national law on natural resources management that protects mangrove forest a long side Indonesian coast. This regulation prohibits activities such as illegal logging and farming on the mangrove forest. Besides that, they also formed Segara Anakan Planning and Management Agency (SAPMA) through Cilacap district's regulation No 28/2000. The agency's authorities were doing the planning and management of Segara Anakan independently and self-financing. The implementation of the rule was facing objection from the citizen who also used the land. It was lack of contribution to democracy seeing that citizen claimed that the land was their property. However, local government still plant mangrove on this land by ignoring their existence. It was also lack of contribution to "good governance" since no community participation in constructing local government regulation. The consequence was the mangrove reforestation program was not secured in long term. The increasing demands of mangrove's charcoal from many cities stimulated the high rate of illegal logging of mangrove in Segara Anakan area. Illegal logging was not only involving local citizen but also people from neighboring district. To enforce the regulation, the local government has already made group of community controls (pokmaswas) as the sub division of SAPMA in village level. Nevertheless, pokmaswas was not well equipped with adequate facilities to control illegal logging activities and no support from citizen. Law enforcement approach was top down as the pokmaswas was not well-organized. The citizen action against mangrove illegal logging was also almost non-existent. According to them, the control against illegal loggers was the duty of local government. In fact they felt the illegal logging activity was helping them in clearing the land area because they had already utilized the area since it was water and come up into land. The proposed appropriate solutions to problems were not working. Mangrove's illegal logging on new land still exists up to now. Hypothesis 3 resulted that government was actively using scientific advice in mangrove management. It was proven by two regulations they issued and conducted mangrove reforestation program. Unfortunately, this effort was not very much successful since other important actors, i.e. citizen who also owned the land was resisting the reforestation program and let the illegal logger to cut mangrove on new land.

Table 1. Results of analysis by using the RIU model

Activities of the RIU model	Criteria	Occurrence*	Description
Research	● Assessing current scientific information	+	Research was assessed national and international scientific sources.
	● Compliance with the procedures of good scientific practice	±	Research procedures and results clearly documented. However, the research's result had not been reviewed by other researcher.
	● Cooperation with external scientific projects and institutions	±	Research had cooperated with research on "Segara Anakan fisheries management plan" (Dudley, 2000). The cooperation had not been evaluated by other research group.
	● Independent meaningfulness of scientific findings	+	Scientific finding on mangrove conservation is independent.
Integration	● Orientation toward public goals	±	In one hand research suggested to plant mangrove on new land of lagoon for ecological sustainability but in other hand the land used was "belong" to citizen; therefore it was not categorized as social sustainability.
	● Relevance for problem solutions	+	Mangrove reforestation would become habitat of fish and other water species.
	● Relevance in regard to allies	+	Local government was supporting the research by incorporating its result into regulation.
	● Target-group oriented intermediation for the right media	-	Local government knew that new land of lagoon still in disputation, however, they still insist to plant mangrove on the land as part of the conservation project.
Utilization	● Contribution to democracy	-	Citizen claimed that new land of lagoon is their property; therefore, they resist if there any assertion of the land from local government or the ministries.
	● Contribution to rule of law	+	Local government issuing regulation on mangrove management of Segara Anakan and Segara Anakan planning and management agency (SAPMA).
	● Contribution to "good governance"	-	Lack of community participation in constructing local government regulation.
	● Appropriate solutions to problems	-	Local government regulation of planting mangrove on new land of lagoon was abandoning citizen "ownership" on the land. They neglected that citizen had already utilized the area since it was water and come up into land.
	● Participation in the scientific discourse	-	No scientific discourse established.

\*(- not given; ± partly given; + given)

## Conclusions

The conflict of mangrove reforestation program on new land was involving three aspects in RIU model, i.e. research, integration, and utilization. Each aspect has their own success factor for the successful of scientific knowledge transfer. Research on Segara Anakan mangrove action plan was done with almost fulfilling whole criteria of scientific research's success factors. Although it was lacked of peer review but it was following the other criteria of good scientific research. In other hand, research did not involve citizen interest who felt owning the new land. They were just doing research on natural conservation basis. Starting from this point there was a gap from researcher perspective and citizen perspective. This gap was increasing since government incorporated the research result directly to the regulation. Citizen's right on land was

abandoned. Hence in political action, local government was losing their power since big resistance exist from the citizen and mangrove's illegal logging activity on new land.

RIU model has proved could analyze the actual processes of scientific knowledge transfer. It also delivers normative criteria to assess the success or failure of existing scientific knowledge transfer processes (Böcher & Krott, 2014b). From the study we could trace how often and important of science in decision making process, and also the response of involving actors towards science-based policy.

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