



Enhancing Social-Ecological Resilience in Indonesia: A Case of North Pekalongan District, Central Java

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Abstract: In the last eight years (2008-2016), some areas in the northern part of Pekalongan have been experiencing coastal inundation. There have been social, economic and physical disruptions caused by coastal inundation particularly on built environments, paddy fields, and fishpond. The capacity of these areas to provide support for community livelihood has decreased significantly. This accumulative environmental change leads to the emergence of vulnerable regions which are characterized by limited social and ecological capacity to respond hazards. In order to enhance the social-ecological resilience, it is necessary to identify how the community has elevated their capacity and improved their livelihood. This paper presents empirical evidence of various pathways on how the community has transformed their capacity to respond to the changing environment due to coastal inundation. Following case study approach, this paper explores how the community has learned from their experiences, knowledge, and efforts from the past, and transformed them into a better understanding to cope with, to adapt to, and to become resilient from coastal inundation. The research applied in-depth interviews involving key persons selected through purposive and snowballing samplings. They represented the most capable person in each sub-district whose important data and information related to coastal inundation at the individual, household, and community organization levels belong to. The scope of area observation was limited to six sub-districts adjacent to the coast in the North Pekalongan District. The results showed that social-ecological resilience is likely to enhance in a community with flexible networking

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building capability. Such networking is beneficial to spreading out the important information, novel knowledge and practical tools and solutions to the community. These are the key elements for new transformative pathways. However, there remain various community capacities with different achievements on transformative pathways necessary to the future empowerment initiatives. Only a few communities in Kandang Panjang Sub-district who have performed a short-term resilience due to their awareness on establishing social networking and several actions on environmental quality improvements.

Keywords: coastal inundation, community capacity, livelihood, social-ecological resilience, transformative pathways

Abstrak: *Dalam delapan tahun terakhir (2008-2016), bagian utara Kota Pekalongan terpapar oleh genangan pesisir (rob). Banyak gangguan sosial, ekonomi dan fisik yang terjadi akibat genangan pesisir tersebut terutama pada lingkungan terbangun, sawah dan tambak. Kapasitas wilayah untuk mendukung penghidupan masyarakat menurun secara signifikan. Akumulasi perubahan lingkungan yang terjadi mengakibatkan munculnya kerentanan wilayah yang dicirikan oleh keterbatasan kapasitas sosial dan ekologi terkait bahaya yang terjadi. Guna penguatan ketahanan sosial ekologis diperlukan identifikasi tentang bagaimana masyarakat menaikkan kapasitasnya untuk memperbaiki penghidupan yang dimiliki. Artikel ini menyajikan bukti empiris dari variasi dalam jalur jalan menuju kapasitas merespon perubahan lingkungan akibat genangan pesisir. Pendekatan studi kasus digunakan dalam artikel ini untuk menggali informasi bagaimana masyarakat belajar dari pengalaman, pengetahuan dan usaha dari masa lalu sehingga mengubah pemahaman masyarakat menjadi lebih baik untuk bertahan hidup, adaptasi atau menjadi tangguh terhadap genangan pesisir. Wawancara mendalam dilakukan dengan beberapa informan kunci di tiap kelurahan yang dipilih dari purposive dan snowballing sampling. Informan kunci merupakan orang yang dianggap paling menguasai data dan informasi terkait genangan pesisir, baik sebagai individu, anggota rumah tangga maupun komunitas. Lingkup observasi dibatasi pada enam kelurahan di Kecamatan Pekalongan Utara yang terletak di pinggir pantai. Hasil penelitian menunjukkan bahwa ketahanan sosial ekologis akan meningkat pada komunitas yang mampu membangun jejaring yang luwes. Jejaring tersebut menjadi alat praktis pembuka penularan informasi dan pengetahuan baru kepada seluruh anggota komunitas. Hal ini menjadi elemen kunci bagi menguatnya proses transformasi. Namun, masih ada variasi kapasitas komunitas dengan perbedaan pencapaian tingkat transformasi yang perlu diperhatikan dalam inisiatif pemberdayaan ke depan. Hanya sebagian kecil komunitas Kelurahan Kandang Panjang yang mencapai proses ketahanan jangka pendek karena kepedulian dalam membangun jejaring sosial dan aksi-aksi perbaikan lingkungan.*

Kata Kunci: *genangan pesisir (rob), kapasitas masyarakat, penghidupan, ketahanan sosial-ekologis, jalur jalan transformatif*

Introduction

Indonesia is among a number of countries exposed to climate change impacts such as sea-level rise (SLR). Having many large urban settlements in coastal areas, it is prone to bigger disturbance so that people living in the coastal areas would be more vulnerable to hazard. Pekalongan is considerably one of the coastal cities in Java Island which suffered from tidal inundation hazard. Since 2008 it has been worsening particularly the northern part of Pekalongan to destroy the agriculture land sand the built environments as well (Setiadi et al., 2010).

In fact, the existing urban settlements are not well-prepared to anticipate it yet. For the past eight years (2008-2016), some areas in the northern part of Pekalongan suffered

from coastal inundation covering six sub-districts, i.e. Bandengan, Kandang Panjang, Panjang Baru, Krapyak, Padukuhan Kraton, and Degayu. It entered from the estuary to lowland areas through the rivers and drainage canals. It firstly flowed to the beach and fishponds, and then contaminated paddy fields with higher salinity levels. Many physical buildings were damaged and so as socio-economic accesses and human activities. These areas had lost services to support their livelihood. As a result, the emerging vulnerable regions multiplied because of fewer social and ecological capabilities of the local communities to respond the hazard.

Since then, their paddy fields have some difficulties and gave limited production. Therefore, farmers could not be able to cover their production cost. Increasing disruption occurred when inundation flows to build environment and affected their settlement services. Furthermore, coastal inundation has entered their house in two ways. First, the inundation comes from slow capillary flows through ceramics floor. Second, it comes from sea water flows through sanitation channels on their bathroom. The depths of coastal inundation are varying from 10-20 cm in average to 30-40 cm due to their house location. The most vulnerable area is located near the river bank and on lowland.

In order to enhance the social-ecological resilience, it is necessary to identify the variability of:

1. How do people learn from their experience in the past events, finding new options to reduce their vulnerability and encourage transformation for better future?
2. How do people enhance their social-ecological resilience and elevate their capacity to improve their livelihood?

This paper presents some empirical evidence of communities' transformation capacity dealing with exposure of coastal inundation. By analyzing some critical points of transformation capacity base on communities' learning process from their past events, we hope to gain some findings on how communities determined their new options to cope with, adapt and enhance their social-ecological resilience.

Having resilience considered novelty and innovation to create a new direction of development. This paper focused on the communities' gradual changes process to minimize their vulnerability on coastal inundation. The community can enhance their resilience by learning from their experience in the past event. That past event may encourage a new option for tackling their vulnerability, changing the problems into opportunity, learning a new thing, developing community networking and encouraging social learning.

Transformative Pathways on Social-Ecological Systems Context

Anderies Marco, and Ostrom (2004) defined Social-Ecological Systems as the subset of social systems in which some of the interdependent relationships among humans are mediated through interactions with biophysical and non-human biological units. Those interdependent relationships among human are illustrated by important variables, namely resource, resource users, public infrastructures and public infrastructures providers. In the case of a coastal area in Pekalongan, 'resource' refers to agriculture land, as natural environment asset that consists of rice crops on paddy field and milkfish, shrimps or seaweed cultivation on fishpond. It also refers to housing and residential areas, or human settlement as built environmental asset. Public infrastructures consist of public facility and utility services. Most of those are provided by Pekalongan Municipal Government Agencies. Few of them, particularly on education facilities are provided by private sector.

People who live in particular risk and hazard are being categorized as vulnerable people. This includes the type of livelihood which is people engage in and the impact of different hazard (Cannon, Twigg, & Russel, 2001). How they struggle for living to reduce

their vulnerability and create such coping strategies and adaptations attempt, shows the process of community achievement in term of transformation and resilience thinking. Learning the lesson from experiences of past events can help community preparedness for turning crises into opportunities for a prosperous sustainable development is a key feature of resilience thinking and adaptive governance. Agencies such as leadership and actor groups with the capacity to develop, nurture and mobilize social networks are instrumental in adaptation processes (Boyd & Folke, 2011).

Resilience is being used in the field of human-environmental interaction which includes vulnerability reduction to the natural hazard (Marrero & Tschakert, 2011). Social-ecological resilience systems support communities' attempts in learning to live in the hazardous environment, using all types of knowledge for learning and adapting (Boyd & Folke, 2011).

As social and ecological systems, resilience was defined as the ability of the system to absorb disturbance and reorganize while undergoing change so as to still retain essentially the same function, structure, identity and feedbacks (Folke, 2006 in Bahadur & Tanner, 2014). Resilience is seen as a function of balancing human services and ecological services. Bahadur & Tanner emphasize that transformation is a coupled concept with resilience thinking which is important to bridge the gap. This statement was learned from empirical examples of ACCCRN initiatives building resilience in urban poor in India. Other such features need to be embedded to further initiatives for enhancing resilience and minimize previous inadequate engagement with people, power, and politics.

Wamsler and Brink (in Satterthwaite, 2014) added that how the individual, household and community adaptation practices could enhance resilience cities, does not necessarily depend on the effectiveness of individual coping strategies but on the flexibility and inclusiveness of coping/adaptation systems at the individual, household, and community level. Success and failure of urban society in building resilience determined by the flexibility of urban societies in building resilience and moving towards transformation.

Therefore, there are important keywords on building resilience, namely, minimize the vulnerability, increasing communities' capacity, embedded engagement on people, power and politics, flexibility and inclusiveness of coping/adaptation systems, ability to reorganize and move forward transformation. Hence, building social-ecological resilience considered types of transformations which represent capability achievement as resilience milestones where people take into account. Those milestones referred to an enhancement capacity process instead of status. At least, there was 4 milestones that illustrated the transformative pathways, namely vulnerability, coping strategy, adaptation and short-term resilience. Vulnerability related to the condition when community experiencing the hazard exposure, shock, and stress, and have less sensitivity and also the loss of assets, access, and activity. Coping is the next process on transformative pathways, which consider as a survival attempt. Adaptation is a higher process which indicated the need for cooperation between community and other stakeholders on every attempt for minimizing all risk. Short-term resilience is the highest process on transformative pathways, which indicated by achievement on communities' lesson learned for determining a new direction as anticipation of future actions.

Research Method

Using case study research we explored how communities bring their experiences, knowledge, and efforts in which gradually enable to change their vulnerability into an opportunity to cope with, adapt and resilient to coastal inundation and determine a new direction for well-being. In-depth interviews were employed to several key persons who selected by purposive and snowballing sampling method. Those key persons represent the

most capable person in their sub-district who could give some important data and information as individual, household and community member. They are consists of local community figure, as neighborhood (RT or RW) leaders, Sub-district Self-reliance Agency (BKM) Leader, Farmer or fishery Group Leader and Activist in Pekalongan Greening Initiatives. Table 1 illustrated several questions on in-depth interviews which were conveyed to key informants.

Table 1. Questions on In-depth Interview

Transformative Pathways	Questions
Vulnerability	<ul style="list-style-type: none"> • I have informed that these neighborhoods are frequently inundated. Can you tell me since when the inundation has occurred? From where those water flows are coming from? Can you distinguish the cause of tidal inundation and flood? When does the inundation frequently occur? • Can you tell me your experiences when coastal inundation starts entering your assets? What kind of disturbance do you recognize? How many losses, damage, or dysfunction of your assets? • What kind of shock and stress do you have? How do you manage your household member from shock and stress? • Do you recognize the scope of area where has been exposed by coastal inundation in your surrounding neighborhood? How much the average, minimum or maximum depth of inundation? • Are there any particular household's attempts you notified? Are there any community's initiatives related to coping with or adapt to minimizing the impact of coastal inundation?
Coping	<ul style="list-style-type: none"> • How could you afford to pay any expenses for your house improvement, furniture, home appliance and vehicle repair/replacement? Are there any insurance, loan or saving as household financing resource? Please explain. • Why did you prefer to stay in here instead of moving out to other settlement which is free from inundation? Is there any particular reason? • Is there any household who decide to move out from this neighborhood? Why and how? • Since when you decide to start making community networking and cooperation with other parties in order to tackle the impact of inundation? Why and how?
Adaptation	<ul style="list-style-type: none"> • In terms of economic activity, what kind of responses do you have to overcome any disturbances coming from coastal inundation? Did you force to looking for new ways of living? Is there any consideration related to possible benefit, cost or obstacle when finding a proper livelihood? Why and how? • In terms of social activity including education and health, what kind of responses do you have to overcome any disturbances coming from coastal inundation? • In terms of housing and its environment including public facility and utility, what kind of responses do you have to overcome any disturbances coming from coastal inundation? Did other households have the same responses?
Short Term Resilience	<ul style="list-style-type: none"> • How do people elevate their knowledge, skill, and capacity to persist from any disturbance caused by coastal inundation? Are there any novel knowledge, skill, and information coming from community networking? • What kind of benefit and cost did you perceive regarding the existing community networking and cooperation? Is there any particular

Transformative Pathways	Questions
	<p>experience which should be considered to enhance community resilience?</p> <ul style="list-style-type: none"> • Are there any behavior and institutional improvement? Can you indicate the emerging community awareness particularly on maintaining their environment quality? • It has been more than 8 years you have to experience coastal inundation, what kind of lesson learned do you have that may inspire others to elevate their ability to tackle their problems related to the hazard?

The scope of area observations is limited to 6 sub-districts, namely Bandengan, Padukuhan Kraton, Kandang Panjang, Panjang Baru, Krapyak, and Degayu, where located adjacent to the coastal boundary in North Pekalongan District, Central Java, Indonesia. Some triangulation conducted on BINTARI (Non-Government Organization) and several Pekalongan Government Agencies. Those Government Agencies are consists of Planning and Development Agency (BAPPEDA), Environmental Agency (BLH), Community Empowerment Agency (BAPPERMAS), Public Works Agency (DPU), Farming, Fishery and Marine Agency (DPPK), Head of each Sub-district respectively and Head of North Pekalongan District.

Data analysis was being done by the inductive approach and manual coding technique. The analysis process begins with categorizing the critical points of transformation from which community withdrew their experiences, knowledge, and efforts to minimize their vulnerability on coastal inundation. After that, the analysis focused on important lessons based on each process of transformative pathways respectively and summarized on the novel information and innovation for enhancing social-ecological resilience.

Result, Findings, and Discussion

The exposure of coastal inundation has been changing in terms of location and time. Hence, total influenced population and social economic assets have changed. However, there are various responses to household and community attempts for tackling coastal inundation impact, from did nothing until tried to minimize the risk by coping, adaptation and enhancing resilience. This paper focused on critical points of transformation, which are revealed when people decided to move forward for getting a better quality of their natural and built environment. Table 2, 3, 4 and 5 illustrated some critical points of transformation in every process which categorized by the nature of each relevant variable respectively.

Table 2. Critical Points of Transformation on Vulnerability

Vulnerability	Critical Points of Transformation	Lesson from the Past Events
Exposure	How to minimize the uncertainty by recognizing place and time of coastal inundation occurrences	Anticipate the next event and start to get access tolerated information dealing with coastal inundation prediction
Shock & Stress	Increasing hazard threats not always followed by the ability to control shock and stress. Such perceiving and forgiveness for surrounding ill-structured have opened new idea to gain better	Many households learn that not only themselves who were suffering but also everyone else. Those conditions build such togetherness and cohesiveness which encourage them

Vulnerability	Critical Points of Transformation	Lesson from the Past Events
	opportunity	to leap from vulnerability to cope with.
Sensitivity	As time goes by, the sensitivity could be reduced when community accustomed to their changing environment	

In line with Anderies et al. (2004), disturbance on an ecological system such as household resource and public infrastructure, have given disrupted interaction with its users and providers as socio system. A community who could withdraw some lessons from bad or best experiences of past events comes to a better understanding of their changing environment. They also increase preparedness effort and decide to look for possible action to cope with. This evidence also enhanced Boyd & Folke (2011) statement about the community preparedness. However, there were not all household could bring those lessons from the past events that illustrated in Table 2. Some of them still face up their shock and stress and response to limited actions due to their ignorance, hopeless, and denial to see any possible alternative actions in reducing their vulnerability. Such perceiving and forgiveness for surrounding ill-structured have opened new idea to gain better opportunity. Therefore, most of them were ready to move forward and take the next process to cope with or adapt, as soon as they reveal some important lesson learned, withdrawn from their past events.

Table 3. Critical Points of Transformation on Coping Process

Coping Strategy	Critical Points of Transformation	Lesson from the Past Events
Depend on others	Poor people depend on others support. Unfortunately, only a few household with certain standardized poverty criteria which enable to receive government support	Determine to survive by them.
Struggle for Survival	<ul style="list-style-type: none"> Optimizing the utilization of household assets for the house adjustment/improvement. Avoid of bank credits due to interest rate and lack of ability to pay. 	Released some asset for rent or sell; Accessed flexible loan from relatives and neighbor; Tried to allocate some savings for future household need.
Occupation Change	Being forced to left rice cultivation and tried to learn a new skill on milkfish/ shrimps/ seaweed cultivation, batik production/ distribution, and informal sectors.	Start to gain a new knowledge/ skill for livelihood alternatives from possible person or communities in their own neighborhood or others
Housing Modification	Actions for improvements: <ul style="list-style-type: none"> Partially/fully floor lifting regularly (every 4-5 years) Build attic or store for securing household asset. Elevate paved path in the front yard for better access and avoid any disturbance from the inundation. 	The most important thing is household member security. How to make their house as feasible as possible to live in by minimizing risks of coastal inundation exposure. Determined to stay rather than move to uncertain place, and keep their inheritance asset and tried to cope with all possible household capabilities and resources

From Table 3, we inferred that there are various decisions on which community determine their possibility to move forward in gaining higher adaptation actions. When the community decides to stop their dependencies on government support, for example, they looked for other possibilities to survive by themselves and cope with all available capabilities and resources. They also start to rent or sell their asset or try to access feasible/flexible loan from relatives. Those resources are used for housing modification and improvements to reduce some coastal inundation's risks.

Refer to 'Coping Cascade Diagram' (Pelling, 2011), such household collapsed and entered to high-risk livelihood when they lost productive economic and physical assets. Furthermore, broken up with their social unit would push them for selection migration. There was one household in Bandengan Sub-district who moved out because of their paddy field have been sold for financing their house improvement. Unfortunately, after a short time enjoyed free inundation house, finally they have unwillingly sold their house in lowest price for covering their daily need. This bad experience on how the household collapsed, give an important lesson for other households in the community to keep the productive assets as long as possible whatever it takes. Hence, they have to push themselves to find some better opportunity to develop their economic capacity through sustainable livelihood alternatives. Then, they start with exploring novel knowledge from others in their own neighborhood, especially looking for any possible livelihood alternatives.

Table 4. Critical Points of Transformation on Adaptation Process

Adaptation	Critical Points of Transformation	Lesson from the Past Events
Collaboration/ Cooperation	<ul style="list-style-type: none"> Recognizing and understanding either household or community problems context. Being realized that actor networking either household, neighborhood or community collaboration will accelerate significant improvement Increasing environmental awareness in line with cohesive actions, at least on the neighborhood unit. 	Networking development is important for gaining other supports.
Knowledge Transfer	<ul style="list-style-type: none"> Neighborhood interactions as informal and formal social institution for learning basis. Knowledge transfer was increasing in line with expanding social and technological networking on the wider neighborhood. 	Start to build thematic communities for economic and environmental activities which elaborated as indirect efforts for Social Learning initiatives.
Behavior Improvement	Local champions' have affected wider community beyond his neighborhood when his leaderships could give some practice examples as success evidence instead of promising improvements.	Establish neighborhood self-help group/ institution and scaling up to sub-district or district or cities group/institutions.
Economical & Environmental Adaptation	Develop some economical and environmental activities: <ul style="list-style-type: none"> Learning for creating home-based SME's and scaling up into inter-communities attempts. Trials for milkfish/ shrimp/ seaweed cultivation. 	Determine to adjust their livelihood shifting/ altering/ diversification.

Adaptation	Critical Points of Transformation	Lesson from the Past Events
Communal Space Modification	Encouraging household participation on: <ul style="list-style-type: none"> Cleaning the environment. Implement communal solid waste management and greening. Improving drainage channels. Elevating local roads. 	Start to elaborate communal participation on planning activities to determine their future actions

People who were either ready to open their mind or learn from others could transform their capability to fulfill their household and community need. Learning new information, knowledge, and skill in any possible livelihood alternatives such as fishpond cultivation, batik production, and distribution, informal sectors, home-based SMEs and industries etc, has broadened their resilience thinking. This result enhanced the perspective of relational space that actor networking, such as social, technological or other networking facilitated space construction on living with risk (Yusuf, 2014).

Table 5. Critical Points of Transformation on Short Term Resilience Process

Short Term Resilience	Critical Points of Transformation	Lesson from the Past Events
Increasing Capacity	Environmental awareness and health security have been built through Solid Waste Management Initiatives in Kandang Panjang which initiated by Community Empowerment from NU <i>Peduli Lingkungan</i> (local NGO) & STAIN (local Higher Education). These actions encourage increasing community capacity.	<ul style="list-style-type: none"> Community ignorance on their bad quality environment has brought some disease related to floods, such as skin itchy, vomiting and diarrhea. The most important thing was how people confidence to proof that they were able to afford and manage their environment by themselves.
Self Help Institution/ Organization	Establish and run a Community Self-help Group on: <ul style="list-style-type: none"> Greening, to manage housing environment capacity recovery Fishpond Farmers to cultivate milk-fish/ vaname-shrimp/seaweed in order to gain optimum socio-economic and ecological benefit. 	<ul style="list-style-type: none"> Public attention will lead to broadening social networks and supports. Without displaying any community achievement to prove their success in managing environment or socio-economic and ecological benefit, there were no public attentions at all.
Social Learning	Displaying social & economic benefit from a better environmental condition which has been managed by a local community group was the best example in attracting others to be engaged on the same goals. This effort was being spilled over to the wider community and has become useful social learning tools.	<ul style="list-style-type: none"> Social networking has opened some novel knowledge and skill which would lead to building community awareness and future positive actions. Increasing number of people who engage in some communities' activity related to socio-ecological system improvement would encourage better social learning process. The most important thing on community empowerment is preparing the community to be ready for maintaining the sustainability of community activity, giving energy, commitment and resiliency from people jealousy on our succeed.

Short Term Resilience	Critical Points of Transformation	Lesson from the Past Events
Livelihood Alteration	<ul style="list-style-type: none"> Experiencing with salinity, paddy and jasmine cultivation has become unproductive. So, farmers have to find another possible livelihood. Experiencing with high risk and cost of vaname-shrimp, and prawn cultivation gave such motivation to find another livelihood with low risk and cost. 	<ul style="list-style-type: none"> Considering environmental change, possible sustainable livelihood and food security, farmer changed their paddy field into fishpond and then learned to cultivate milkfish and tilapia fish Seaweed cultivation has become a better option for altering their livelihood, which gave more social, economical and ecological benefit.
Livelihood Diversification	<p>To gain multiple incomes, besides fishpond cultivation, some farmers have side job/part time job in informal sectors, such as:</p> <ul style="list-style-type: none"> Grocery stalls or vendors which sell food & beverage, cigarette, rice, sugar, cooking oil, etc for fulfilling their neighborhood daily need. Home-based SMEs such as snack, syrup & fish-chips production, greenery & nursery. Seasonal artisan, brick builder or handyman on public infrastructure development. Batik production, sales & distribution. 	<p>When somebody ready to learn a new thing, there are many possibilities to gain multiple incomes. The effective way is utilizing the potential local economic resource.</p>

Based on the nature of every process on those transformative pathways, there are some important research findings. In terms of the transformation process, there are 4 types of achievement, namely vulnerability, coping, adaptation and short terms resilience. Drawing from Pelling's Coping Cascade Diagram (Pelling, 2011), this finding builds simultaneous interlink root cause of vulnerability, coping, adaptation and short-term resilience. Coping Cascade Diagram illustrated how people utilized their economic-physical and social assets for avoiding household collapse. Those 4 types of transformation process underlined critical points when community decides to move on from one process to another. Transformation process would be a move to elevate from 'Vulnerability' as a beginning process to 'Coping' as survival mode, then to 'Adaptation' as a willingness to develop some collaboration and networking and Short-term Resilience as social learning to achieve social, economic and ecological reliance which bought of community's readiness to live with risk.

Some gaps in community capacity were being indicated by evidence that not all of households could elevate their capacity and jump to the next process. Those capacity differences depend on knowledge and awareness which come up from their ability to take some lesson learned with drawn from their experiences in the past event. Each process on those transformative pathways needs some knowledge development, especially on tackling any disturbance and reducing the risk, which leads to further awareness and encouraging strong motivation. An important or appropriate momentum forced people to have a strong determination for creating an enabling socio-ecological system.

Conclusion

Some critical points of transformation illustrated how community bring their experiences in the past event into some important lesson learned in which they move forward to 4 types of process on transformative pathways for enhancing social-ecological resilience. Those 4 types of process on transformative pathways were initiating with vulnerability, followed by coping, adaptation and short-term resilience. The most critical point of transformation from vulnerability to coping was any household with such perceiving and forgiveness for surrounding ill-structured, and start opened new idea to gain better opportunity and preparedness. Housing modifications proved community's ability on Coping Process. While people were either ready to open their mind or learn from others, they were able to enhance their capability to make collaboration for fulfilling their household and community need. This readiness proves the adaptation process. Social learning which comes from communities' flexible social networking has become important practical tools for finding sustainable livelihood, which enhanced community persistence to live with risk

However, there is an important note for Municipal Pekalongan Government due to many programs initiatives have taken place at the neighborhood units and end up merely as piloting project, with a limited benefit on supporting communities' capacity. In order to replicate the community's capacity improvement, the government agencies need to scaling-up of those initiatives into feasible city-wide socio-economic and environment activities. Community capacity on multi-stakeholders networking is a key step for delivering new options, access to novel knowledge and opportunities for better future improvement. Community future challenge is how to create community's feasible transformative pathways based on community's readiness on each process respectively.

Human and biophysical vulnerability are needed to consider accordingly. The lesson learned from community experiences in the past event is come up from all interaction between human and their biophysical environment. All community knowledge, awareness, and actions are important things which build a strong determination instruments on transformative pathways in enhancing social-ecological resilience.

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References

- Anderies, J. M., Marco, A. J., & Ostrom, E. (2004). A framework to analyze the robustness of social-ecological systems from an institutional perspective. *Ecology and Society*, 9(1), 18.
- Bahadur, A., & Tanner, T. (2014). Transformational resilience thinking: Putting people, power, and politics at the heart of urban climate resilience. *Environment & Urbanization*, 26(1), 200-214. doi:10.1177/0956247814522154.

- Boyd, E., & Folke, C. (2011). *Adapting institutions governance, complexity and social-ecological resilience*. Cambridge, UK: Cambridge University Press.
- Cannon, T., Twigg, J., & Russel, J. (2001). *Social vulnerability, sustainable livelihood, and disaster*. Report to DFID.
- Marrero, T. L., & Tschakert, P. (2011). From theory to practice: Building more resilient communities in flood-prone areas. *Environment & Urbanization*, 23(1), 229–249. doi:10.1177/0956247810396055.
- Pelling, M. (2011). *Adaptation to climate change: From resilience to transformation*. New York: Routledge, Taylor and Francis Group.
- Setiadi, R., Artiningsih, A., Wijaya, H. B., Ali, M. M., Werdiningtyas, R., & Claudia, C. (2010). *Planning and assessment initiative: City-wide spatial identification of vulnerability and resilience in Pekalongan City*. The cooperation between P5 UNDIP, UN-HABITAT, and the Government of Pekalongan City.
- Satterthwaite, D. (2014). Editorial: Getting local governments, residents, and enterprises to respond to the new IPCC assessment. *Environment & Urbanization*, 26(1), 3–10. doi:10.1177/0956247814522386.
- Yusuf, Y. (2014). Hidup bersama risiko bencana: Konstruksi ruang dalam perspektif ruang relasional. *Jurnal Perencanaan Wilayah dan Kota*, 25(1), 58-76. doi:10.5614%2Fjpwk.2014.25.1.4.