Humanitarian Aid Driven Recovery of Housing after Cyclone Aila in Koyra, Bangladesh: Characterization and Assessment of Outcome

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Abstract

After cyclone Aila, which caused devastation in Bangladesh in 2009, humanitarian agencies extensively supported the housing recovery with in-situ housing provisions. This research aimed to characterize the housing recovery measures adopted by the NGOs and local people in Koyra Upazila of Bangladesh after cyclone Aila and also assessed the outcome of the housing recovery. The methodology was developed to conduct the research from a perspective of peoples' perception and expert opinion. It included focus group discussions, an expert opinion survey, and an institutional survey. The result shows that NGOs and local people adopted protective measures only for windstorm and regular tidal floods ignoring measures to ensure safety against storm surges. The result also reveals that the recovery measures for housing were short-term and low to moderately contributing to pre-disaster vulnerability reduction. The housing recovery curve constructed from peoples' perception indicates a

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development inheriting pre-existing vulnerabilities. This research is critical of the present approach of in-situ housing recovery and advocates a land-use-based approach.

Key words : Bangladesh, Cyclone Aila, Housing Reconstruction, Disaster risk reduction, Build back better

1. INTRODUCTION

Housing recovery after a natural disaster is considered as one of the prioritized components in recovery (NRC and IFRC 2016; Rolnik 2010). This sector is complex and critical due to its links with multi-dimensional issues, which include human rights and security (Rolnik 2010), pre-existing political and social conflicts (Fan 2014), sectoral planning and allocation of resources (M. Z. Islam, Kolade, and Kibreab 2018), culture and heritage (Lin and Lin 2016), land availability (Murao 2015), the supply chain of construction material (Murao 2015), disaster risk reduction (Mallick and Islam 2014), and land-use policies (Faure Walker and Anna Crawford 2017; Wen et al., 2017). The "build back better (BBB)" approach proposes that the housing recovery should be planned considering safety, security, livelihood, equity, permanent housing, risk reduction, improving the self-recovery capacity of the owner, effective implementation, and monitoring. (Kennedy et al., 2008; Mannakkara and Wilkinson 2014). In order to achieve a safe and resilient future as a goal of BBB, the housing recovery should follow a long-term, comprehensive and integrated approach (Kennedy et al., 2008). The number of researches on proposing frameworks to guide housing recovery towards the goals of BBB has been increasing with an increasing global focus on housing in post-disaster recovery (Taheri Tafti and Tomlinson 2015).

The Bangladesh government has prioritized housing recovery after two recent devastating cyclones (cyclone Sidr in 2007 and Aila in 2009) (K. Alam 2010; Mallick and Islam 2014). With a long history of cyclone disaster and response (E.

Alam and Collins 2010), the practice of supporting affected communities in the reconstruction of their houses in Bangladesh has been changed from the past practices. Earlier, it was limited to the provision of traditional housing materials (e.g. CI sheets, bamboo, etc.). Later, the government adopted a strategy of developing cluster villages for landless disaster-affected families (World Bank 2014). After the 1991 cyclone, international humanitarian organizations and development partners first became involved in housing-related humanitarian aid (K. Alam 2010). Past housing recovery initiatives of Bangladesh were unsuccessful due to a lack of resources, coordination, community participation and a lack of standards (Beck 2005). In the absence of national policy on housing recovery guidance and standards, the humanitarian aid-driven post-Aila housing recovery in Bangladesh was most mostly influenced by the past practices and experience of post-Sidr housing recovery (World Bank 2014). In-situ housing reconstruction with limited participation of owners in decision making is a new trend that appeared recently after cyclone Sidr and Aila (K. Alam 2010; Mallick and Islam 2014). Several studies have investigated the Aila housing recovery from the perspective of community participation (K. Alam 2010); designing and planning (Mallick and Islam 2014); and access to resources to build cyclone resilient houses (M. Z. Islam, Kolade, and Kibreab 2018). None of them attempted to evaluate or assess the outcome of the housing recovery, which motivated us to conduct this research aiming at investigating the housing recovery after cyclone Aila and assessing its outcome based on the people's perception. Failure (in

improving safety from cyclone hazard) of housing recovery after cyclone Sidr (M. Z. Islam, Kolade, and Kibreab 2018; Nadiruzzaman and Paul 2013) further influenced us to conduct this research to assess the outcome of the new approach of housing recovery adopted after cyclone Aila (S. Islam 2012; Mallick and Islam 2014). This research particularly investigated the housing recovery to characterize the implemented measures and to assess the outcome of the recovery from the context of "build back better (BBB) (Mannakkara and Wilkinson 2014)." Among the diverse aspects and attributes of BBB, this research only took safety into consideration. However, other attributes are also discussed in a subjective manner.

2. CYCLONE AILA AND THE STUDY AREA

Cyclone Aila hit the Bangladesh coast on 25 May 2009 with a maximum wind intensity of 65 knots and a 2 m～ 6 m storm surge (Sadik et al., 2017). It washed away 243,191 houses and left 370,587 houses partially damaged. Housing was prioritized for recovery. In different affected areas, NGOs and development partners (World Bank 2014) implemented housing reconstruction programs such as creating disaster resilient habitats, affordable housing, core housing, transitional shelters, core family shelters etc. Besides, local peoples who were not provided housing from the NGOs reconstructed their houses by themselves.

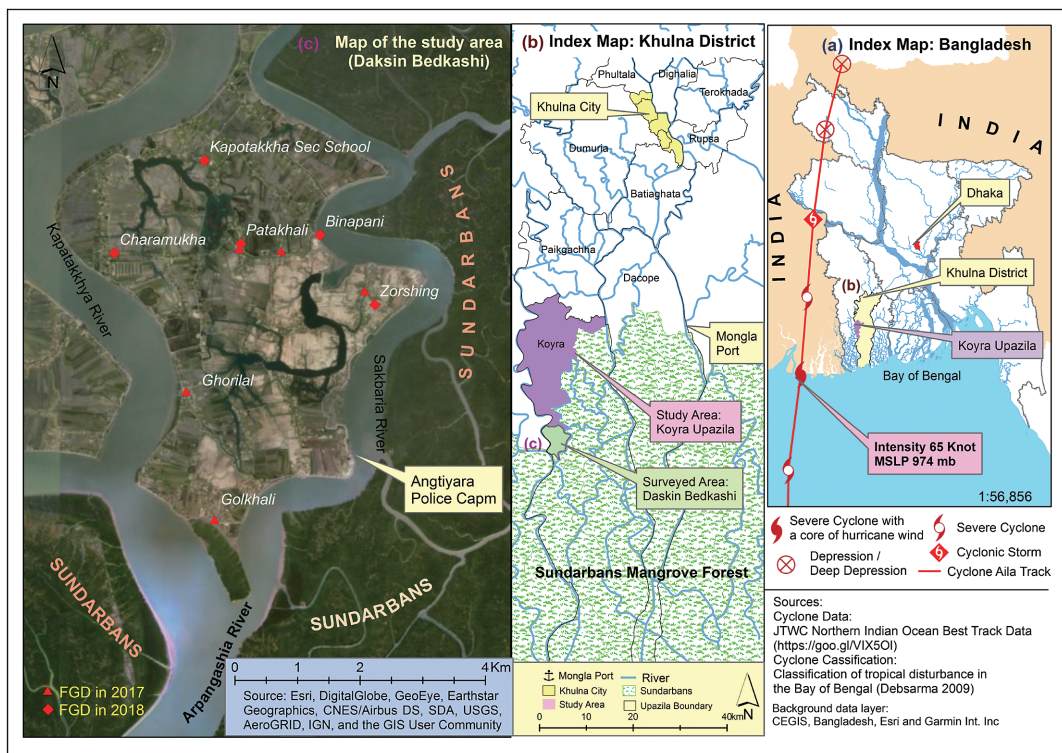Koyra upazila[1] of Khulna district (**Fig. 1**)

Fig. 1　Map of the study area and FGD villages

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[1] Upazila is the third level of administrative unit in Bangladesh. Since it functions as a subunit of a district, it can be defined as a sub-district.

was one of the worst affected areas by cyclone Aila (UNDP 2010). It is the most southern upazila of Khulna, bordered by rivers and Sundarbans mangrove forest (**Fig. 1**). Within Koyra upazila, Dakshin Bedkashi union (an administrative sub-unit of an upazila) was one of the most severely affected areas, which also suffered from prolonged inundation due to breaching of polders (earthen embankment) by the storm surge (Kumar et al., 2010; Roy et al., 2009). This research broadly considered Koyra as the study area with a special focus on Dakshin Bedkashi to assess the recovery progress. In Dakshin Bedkashi, cyclone Aila and the induced storm surge killed 33 people, washed away 3520 houses, partially damaged 1800 houses, and inundated almost the entire union (Kumar et al., 2010). The storm surge overtopped the coastal embankment, breached it in six places and damaged 20.55 km of embankment (out of 27.37 km) (Koyra Upazila Council 2010). Villages were inundated twice a day by tidal water until the rehabilitation of coastal polders in 2013. As a result, housing recovery along with the recovery of other sectors was delayed.

3. METHODOLOGY

3. 1 Methodology for Characterizing Recovery Measures

A composite methodology involving an institutional survey, expert interview, household questionnaire survey and criteria-based mapping of recovery measures was developed to characterize the housing recovery measures. Firstly, implemented recovery measures were identified by an institutional survey and literature review, which included cash grants, the provision of housing materials, the provision of transitional houses, and the provision of permanent housing, in 2016-2017 (Sadik et al., 2017, 2018). Thereafter, we attempted to characterize each measure from the perspective of BBB (Mannakkara and Wilkinson 2014; UNISDR

2017).

3. 1. 1 Adopting the BBB concept for defining criteria for characterization

The United Nations defined the approach of BBB as "the use of the recovery, rehabilitation and reconstruction phases after a disaster to increase the resilience of nations and communities through integrating disaster risk reduction measures into the restoration of physical infrastructure and societal systems, and into the revitalization of livelihoods, economies and the environment" (UNISDR 2017). This definition highlights the integration of disaster risk reduction in all sectoral recovery processes to increase resilience. This subjective definition of BBB can be further explained with the BBB framework developed by Mannakkara and Wilkinson (2014) where they describe the BBB with four major attributes: risk reduction, community recovery, implementation, and monitoring. A number of attributes of BBB have been proposed by different authors, which include safety, security, livelihood, risk reduction, vulnerability reduction, equity, community participation, long-term successfulness, comprehensiveness, and mainstreaming of recovery works in the development process (Clinton 2006; Kennedy et al., 2008; Maly 2018). Among these diverse attributes of BBB, disaster risk reduction and effectiveness as a long-term measure are two frequent attributes directly related to a safer community with enhanced resilience. This safer community is the most important goal of BBB (Clinton 2006; Kennedy et al., 2008; Maly 2018). While defining criteria for characterizing the housing recovery measures, this research considered this goal of the safer community. Accordingly, we considered two criteria – i) effectiveness as a long-term recovery measure, ii) its contribution to disaster risk reduction.

3. 1. 2 Characterization technique

The first criterion, "the effectiveness" of a recovery measure was defined as the degree of success to improve their housing as a safe shelter for the long-term. This degree of success was assessed based on peoples' perception (**Fig. 2**). A total of 150 households were interviewed in 2017 to grasp the beneficiaries' judgment on "the degree of success" of each housing recovery measure. The interviewees were requested to give their judgment on the "degree of success" following a quantitative scale ranging from "0 (not successful at all)" to "5 (highly successful to improve the house as a safer shelter for the long-term i.e. >10 years)" (**Fig. 2**).

The other criterion, "contribution to PAVR," was assessed by expert judgment. Since the reduction of pre-disaster vulnerability is a goal of disaster risk reduction and an important objective of BBB (Clinton 2006; Sadik et al., 2017), this criterion represents an attribute of BBB. To measure the "degree of contribution to PAVR" experts were selected from NGOs that were directly involved in the cyclone Aila recovery through a process of institutional survey (Sadik et al., 2018). A total of 13 NGOs were identified by the institutional sur-
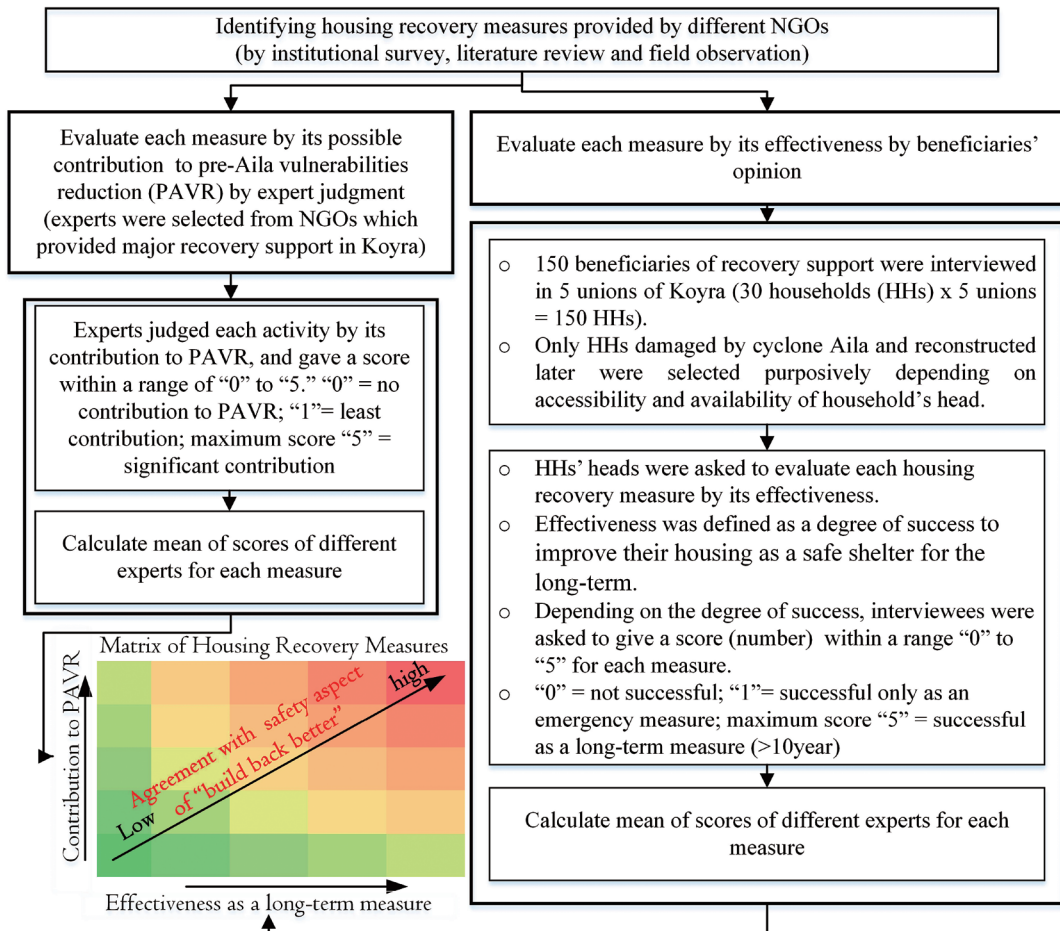

Fig. 2　Methodological steps for characterizing recovery measures

vey in 2016, among them six (6) were major NGOs that had implemented large-scale projects in Koyra (Sadik et al., 2018). Among these six major NGOs, we interviewed an expert from four NGOs who were directly involved in Aila recovery in Koyra. Additionally, we interviewed another international expert who also directly involved in research on Aila recovery in Koyra. These interviews were conducted in 2017. Experts were asked to quantify the "degree of contribution to PAVR" of each recovery measure by their judgment following a scoring approach (Gain et al., 2015; Giupponi, Giove, and Giannini 2013) and using a quantitative scale (Sadik et al., 2018) ranging from "0 (no contribution)" to "5 (significant contribution)."

3. 1. 3 Mapping of recovery measures

Each housing measure was mapped according to the two criteria in a matrix (**Fig. 2**). The matrix represents the characteristics of recovery measures according to their recovery outcome. While collecting experts' opinions on PAVR and peoples' perceptions on the effectiveness of recovery measures, respondents took both attributes of a measure and outcome on overall society into account. Therefore, this characterization matrix illustrates the overall outcome of the housing recovery along with a subjective evaluation of recovery measures.

3. 2 Assessing Recovery Progress from People's Perception

This research was designed to assess the recovery progress based on peoples' perception, which offers synthetic data along with a true insight of the overall context. A similar stakeholders'opinion-based approach can be frequently seen in vulnerability assessment (Dutta et al., 2013), scenario development for planning (Dong, Schoups, and van de Giesen 2013), and resilience assessment studies (Parvin and Shaw 2011).

3. 2. 1 Administrating FGD and designing the questionnaire

This part of the research on assessing recovery progress focused on only Dakshin Bedkashi union of Koyra. With the aim of collecting peoples' perception-based data a total of 10 focus group discussions (FGD) were conducted at 10 different villages of Dakshin Bedkashi (**Fig. 1**) in 2017-2018. FGDs were conducted at places where a large number of settlements were found in close vicinity. The numbers of participants and the male-female ratio are shown in **Fig. 3**.

A structured questionnaire (which was developed, trialed, and verified with local people beforehand) was followed to administer the FGDs. While assessing the progress of recovery we considered how many houses adopted DRR measures during reconstruction rather than considering how many houses have been reconstructed. In coastal areas of Bangladesh, a cyclone event generally possesses three hazards: cyclonic winds, induced storm surges and flooding due to excessive rainfall (Shah Alam Khan 2008). Cyclone Aila exceptionally introduced a new disaster: repeated tidal inundations due to breached embankments leading to delays in recovery. Therefore, participants of FGD were asked how many houses were built adopting protection measures for: i) cyclonic winds, ii) storm surges and iii) continued tidal floods in six differ-
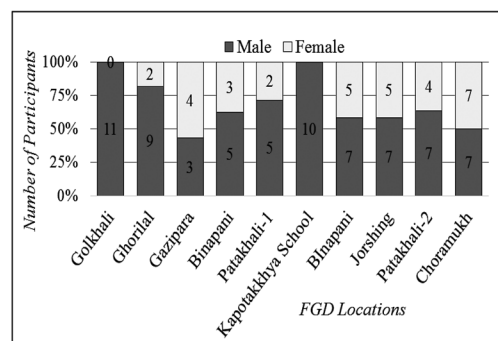

Fig. 3   Number of participants of FGD

ent time periods (before Aila, immediately after Aila, 1 year after Aila, 3 years after Aila, 5 years after Aila and at present) with the aim of measuring recovery progress towards the safety aspect of BBB (**Fig. 4**).

While collecting this time series data, milestone years (**Fig. 4**) were selected to refer to the completion year of different phases of coastal polder recovery (e.g. the completion of emergency recovery works, the completion of rehabilitation). Recovery of different sectors including housing and economy was dependent on the completion of the recovery of coastal polders (repair, reconstruction, and rehabilitation) (Sadik et al., 2018). The recovery of coastal polders was critical for local people because they could not return to their homes and could not initiate house reconstruction until the polder was recovered to prevent the daily tidal flooding. Therefore, local people could easily recall their past livelihood events and situation corresponding to the year different phases of polder recovery were completed (e.g. emergency repair, restoration, rehabilitation).

3. 2 .2 Measuring the progress using synthetic data

Participants of FGDs were asked to provide perception-based scores following a numeric scale as illustrated in **Fig. 4**. The minimum score "0" corresponded to " 0 % houses" and maximum score "5" corresponded to "100%" houses. Thus the FGD helped to collect time series data of housing recovery of the last nine years. Finally, this perception-based score allowed us to construct a synthetic recovery curve to illustrate the progress of housing recovery up to the present.
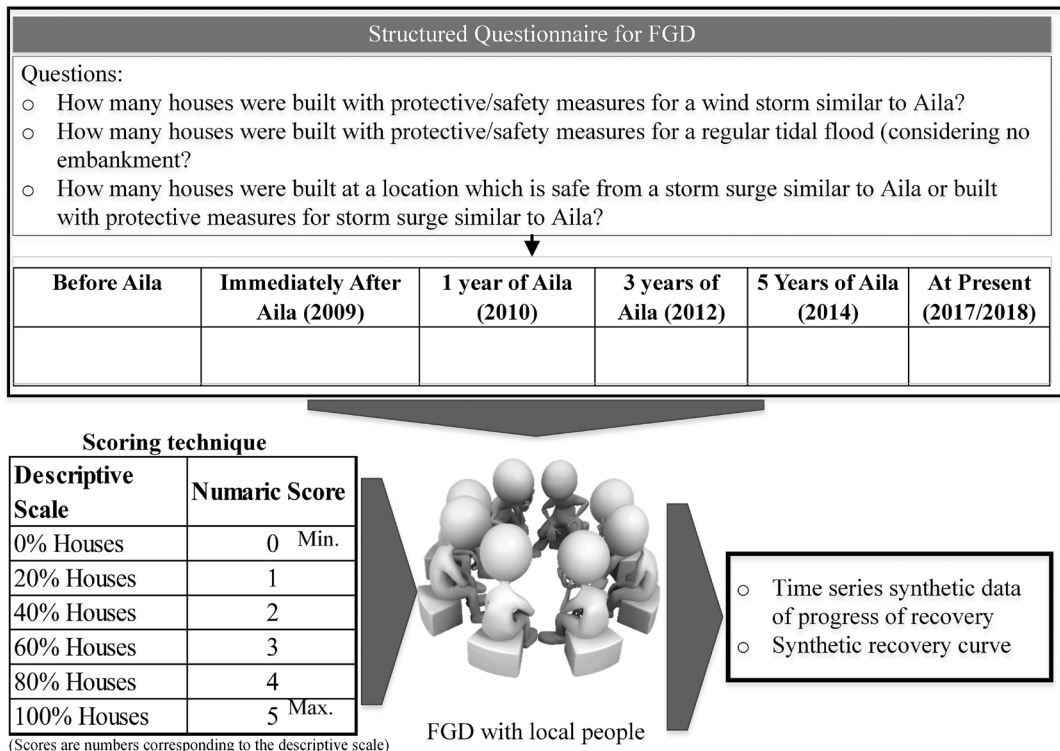

Fig. 4   Methodological framework of peoples' perception−based approach of measuring recovery

4. CHARACTERIZATION OF HOUSING RECOVERY MEASURES

Cyclone Aila and the induced storm surges caused long-term continued inundation damage to almost 80% of houses (3520 completely destroyed, and 1800 partially damaged) in Dakshin Bedkashi (Kumar et al., 2010). The growth of scattered and isolated settlements along the rivers and in low lying areas, traditional housing structures, the weak condition of earthen coastal polders, and the lack of risk-based land use policies for housing, were major vulnerabilities that resulted in devastating damage during cyclone Aila (Mallick and Islam 2014; Sadik et al., 2017, 2018; World Bank 2014). Cyclone Aila forcefully displaced around 95% of the total population of Dakshin Bedkashi (Kumar et al., 2010). People were mostly living on higher roads, embankments, and cyclone shelters. To enable self-recovery, the government provided 250 USD cash for the affected families, although it reached an average of 68% of households in Dakshin Bedkashi (Fig. 5). Humanitarian organizations initiated in-situ housing provision where different NGOs constructed different types of houses (Table 1). In the first phase, several NGOs (mostly Prodipan, Caritas and Islamic Relief) provided "emergency"

or "transitional" type houses to around 32% families of Dakshin Bedkashi (Fig. 5). Later, around 4% of households received provision of "core family shelters" from UNDP-led "Early Recovery Facility (ERF) Project" (Fig. 5). Village-wise distribution of direct housing support is shown in Fig. 5. While selecting beneficiaries NGOs followed a participatory process maintaining communication with NGO coordination mechanism at upazila.

Houses provided by NGOs were of mostly three types (Table 1). The cost and structural strength of these houses were different (World Bank 2014). At the time of selecting eligible candidates (beneficiaries) for receiving emergency or transitional shelters, both groups of implementing agencies (local NGOs) and local people were unaware of the coming provision of core family shelters. When the provision of core family shelter (CFS) arrived, local NGOs excluded people who had already received other housing provision (i.e. "emergency shelters" and "transitional shelters") from the selection process. While providing "emergency" and "transitional" houses to people the process failed to address the "transition to what" aspect (Kennedy et al., 2008) of BBB. People who had received a "emergency" and "transitional"
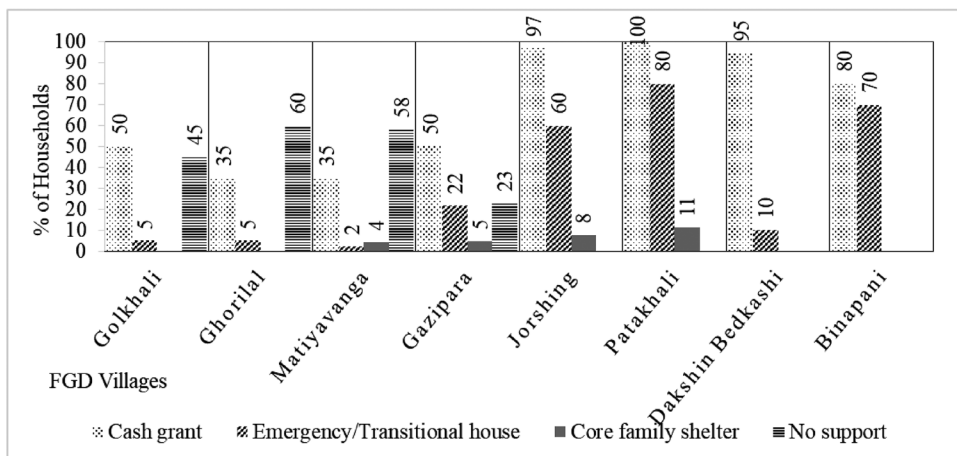
(Source: FGDs in 2017–2018)

Fig. 5   Distribution of housing recovery initiatives in Dakshin Bedkashi, source: FGD

houses could not reconstruct their permanent houses. Therefore, people who received "emergency shelters" or "transitional shelters" felt unfortunate, and a victim of favoritism and political influence compared with beneficiaries who received "core family shelters." Evidence from the Aceh recovery suggest that blind aid (without considering social dynamism and the multi-disciplinary nature) may create new inequalities and exclusions, which may lead to social conflicts (Fan 2014). Aila recovery in Koyra similarly led to social conflict due to the creation of new inequalities in the community by providing different types of houses to different people. This social conflict was a result of a lack of an effective mechanism for coordinating recovery projects and a lack of inadequate consideration of BBB attributes (i.e. "fairness and equity" and "transition to what") as suggested by Kennedy et al., (2008).

NGOs also organized several training programs on how to protect houses from cyclonic winds. People who were not provided housing by NGOs tried to build houses either following the training or design of neighbors' houses constructed by NGOs. People decided the plinth level of their houses on the basis of their own judgment on the maximum height of the tidal flood that they observed in the last couple of years when the em-

bankment was open. Thus, these safety measures (**Table 1**) cannot ensure safety from storm surges such as Aila nor even any flood due to breaches to the embankment by an extreme tide. Despite the weakening of coastal polders (Sadik et al., 2017, 2018), houses have been constructed considering the coastal polder as a safety measure for storm surges. Since these coastal polders can only act as a first line of defense, which can give a few more minutes for evacuation (Kibria and Khan 2017), reconstructed houses are still exposed to storm surges with similar pre-existing vulnerabilities. **Figure 6** characterizes the housing recovery where each recovery initiative has been mapped in a matrix with respect to: i) its contribution to pre-Aila vulnerability reduction and ii) effectiveness (**Fig. 6**). These two criteria together represent the safety aspects of the BBB as it has been discussed earlier in the methodology section. The matrix (**Fig. 6**) therefore also represents the degree of agreement of each recovery measure/initiative with the safety aspect of BBB.

The characterization according to PAVR and effectiveness classifies recovery into: i) "retreat/new construction reality is required" (dark green to light green cells in **Fig. 6**), ii) "struggle to reach normalcy" (yellow to light orange cells in **Fig. 6**), iii) "returning to normalcy with PAVR" (orange

Table 1　Key features of different types of house constructed by NGOs

Housing Type	Design Feature	Implementing Agencies	PAVR features (from perception of experts and local people)
Emergency Shelter	Timber frame, cement stump or timber post with isolated T-footing for foundation, bamboo mat wall, timber-framed pitch roof with corrugated iron (CI) sheet, earthen plinth and floor	Prodipan, Caritas, UNDP	Protection from a wind storm and the usual tidal flooding. Replacing traditional earthen wall to prevent the rapid collapse of houses during a tidal flood or storm surge.
Transitional Shelter	Timber frame, cement stump or timber post with isolated T-footing for foundation, bamboo mat wall, timber-framed pitch roof with CI sheet, earthen plinth and floor with foundations of brick masonry	Islamic Relief	
Core Family Shelter	Reinforced brick column, with foundations of brick masonry, earth filled plinth, mezzanine floor, metal roof truss,	UNDP (Early Recovery Facility Project)	Protection from wind. The plinth level is above the tidal flood level. A storm surge might inundate the house but cannot wash away.

Source: (World Bank 2014), FGDs and expert interview
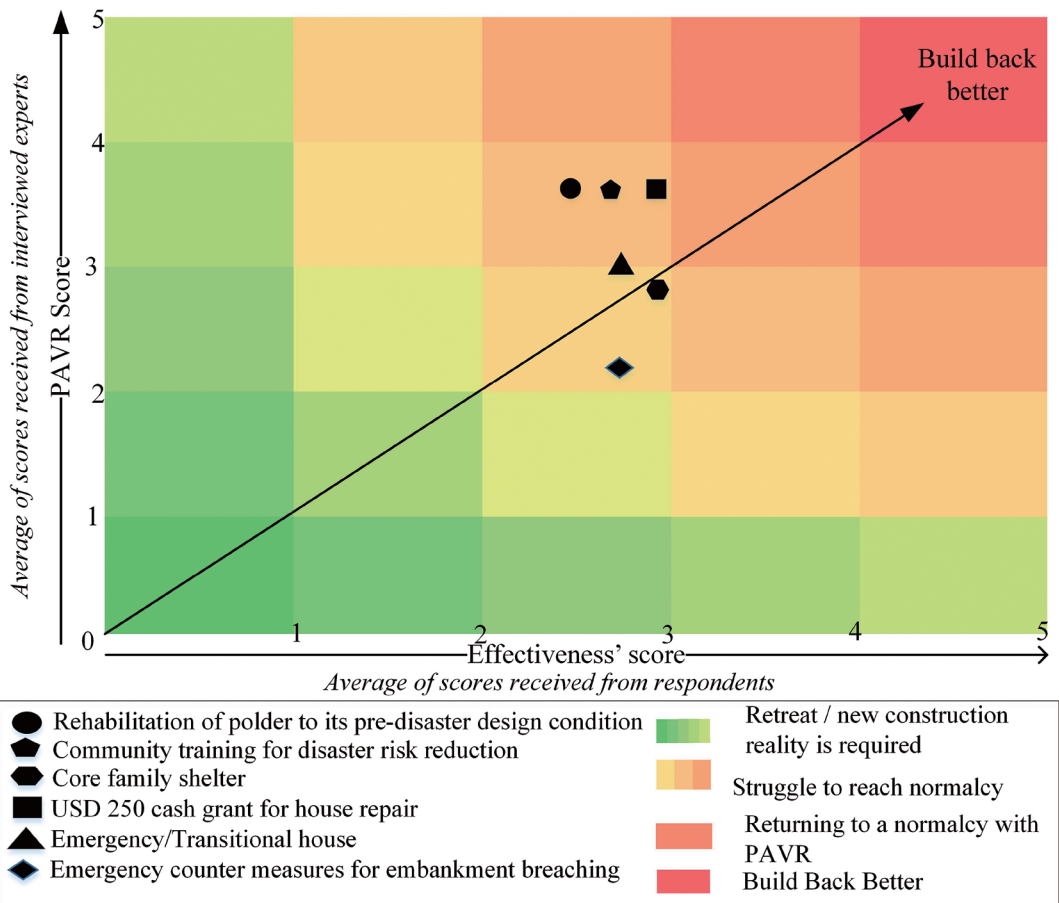
Note:
Effectiveness' score quantifies the degree of successfulness which was measured by how long a measure was (would be) effective, by peoples' perception.
A PAVR score quantifies the degree of contribution to Pre-Aila vulnerability reduction (PAVR), which was measured by expert judgment

Fig. 6   Housing recovery characterization matrix showing its agreement with build back better

cells in **Fig. 6**) and iv) "a safer community with the attributes of BBB" (red cells in **Fig. 6**). The first three types are theoretically similar to recovery patterns developed from the social context of Kobe recovery (Tatsuki 2007) where the author explained three typologies of recovery depending on how the society felt about their lives after the recovery. The assumption on recovery progress and outcomes in the recovery types proposed in this paper are similar to those of Tatsuki (2007).

This research considered that the "retreat/new construction reality" would appear if recovery measures were either short-term but contributed highly to PAVR; or long-term but contributed poorly to PAVR. In both cases, the safety goal of BBB would not be achieved. In cases where both effectiveness and contribution to PAVR would be moderate or below moderate, the community would struggle to reach a level that was normal before the disaster. When both criteria would be

Table 2 Typologies of recovery developed from the safety aspect of BBB

Terminology	Definition
Retreat/new construction reality is required	When a sector/community at non-functioning or near non-functioning state, which is performing far below its normal pre-disaster level despite recovery (Kuromiya et al., 2006). The following conditions are in the state-"retreat/new construction reality is required" · Recovery measures failed to restore pre-disaster normalcy · People are more vulnerable than before
Struggle for reaching a normalcy	When a sector/community is struggling to reach normalcy with recovery efforts. If the following conditions prevail, the status of the sector/community can be referred to as "struggling to reach normalcy": · Recovery measures did not adequately consider DRR People are living in similar conditions to those pre-disaster or higher than pre-disaster vulnerability.
Returning to normalcy with PAVR	When a sector/community has reached normalcy (pre-disaster status) or is evidently showing a trend toward reaching normalcy with recovery efforts (Kuromiya et al., 2006). If the following conditions prevail, the status of the sector/community can be referred to as "returning to normalcy with PAVR": · With recovery efforts the sector has been (or will soon be) performing as it had been before the disaster · Recovery measures moderately addressed disaster risk reduction (pre-disaster vulnerabilities) · People are living in conditions similar to those pre-disaster with less vulnerability
A safer community with the attributes of BBB	When a sector/community's recovery efforts have established a new normalcy ensuring DRR and effective implementation of long-term measures to eliminate pre-disaster vulnerabilities. (This is an adoption of the BBB concept as defined by the UN (UNISDR 2017) and explained by the BBB framework (Mannakkara and Wilkinson 2014)). More details about the adoption are presented in Section 3.1. If the following conditions prevail, the status of the sector/community can be referred as "a safer community with the attributes of BBB": · A new normalcy ensuring disaster risk reduction has been established · The sectoral condition is improved compared to the pre-disaster time · People are living in a safer community

better than moderate, the resulted recovery would be in a process to returning to normalcy inheriting PAVR. However, the goal of BBB would only be achieved when recovery measures would be long-term and significantly contribute to PAVR. A further description of the recovery categories is provided in **Table 2**. The mapping of housing recovery measures of Koyra (**Fig. 6**) shows that the recovery matches the condition of "struggle to meaning" class. The housing recovery initiatives so far implemented were of short-term to mid-term and low—moderately contributing to PAVR. The coastal polder (which is directly linked with the protection of settlements from tidal flood) has been rehabilitated to the pre-disaster condition without resolving the root causes of pre-Aila vulnerabilities (e.g. unsustainable growth of saline water shrimp farming, illegal breaching of embankments by

shrimp farmers, lack of community participation, land zoning to regulate unsustainable growth of shrimp farming etc.) (Sadik et al., 2018). Consequently, the polder was weakened again and failed to prevent tidal floods in recent years. Similarly, most of the NGOs-provided transitional houses and self-constructed houses are becoming weaker, and peoples' capacity for regular maintenance and rehabilitation is limited. Therefore, the housing recovery has placed the community in a condition where pre-existing vulnerabilities are prevailing. The goal of BBB has not yet been achieved. This research further investigated the outcome of the recovery by the direct approach of measuring, by people's perception.

5. MEASURING THE PROGRESS OF RECOVERY

Figure 7 illustrates the synthetic recovery recurves constructed from peoples' perceptions. Cyclone Aila caused damage to almost all houses in Dakshin Bedkashi. Only 10-15% people in Dakshin Bedkashi could reconstruct their houses in the 1 year after Aila. People started reconstructing their housing when the Bangladesh Water Development Board (BWDB) (a government organization) installed emergency countermeasures for coastal embankment recovery. However, the attempts to close all openings of the embankment were not successful. NGOs extended their help by constructing temporary ring dikes around the deep inundated areas and embankment openings, which somewhat controlled tidal flooding in some areas. Thereafter, people started reconstructing houses in those controlled flooding areas. By 2012, only 50% of people could reconstruct their houses. Finally, in 2010-2013, BWDB recovered the embankment

to its earlier condition and NGOs (with funding from development partners) could start constructing in-situ "transitional shelters" and "emergency shelters" (with cost recovery from beneficiaries). While constructing those houses, NGOs adopted protective measures against cyclonic winds and tidal floods. People who constructed their houses by themselves tried to follow that practice to some extent. In 2013, under the ERF project, "core family shelter" type in-situ houses (see **Table 1** for description) were provided to 265 families (UNDP et al., 2013). In between 2013 to 2015, the rest (around 40%) of the people reconstructed their houses.

Figure 7 shows a slight improvement in three criteria at the present time. The trend of improvement started one year after Aila and it returned to the pre-disaster level five years after Aila. Thereafter, with a little improvement, it settled. However, "the number of houses protected from windstorm" was an exception. It showed a remarkable improvement and it returned to the pre-disaster condition
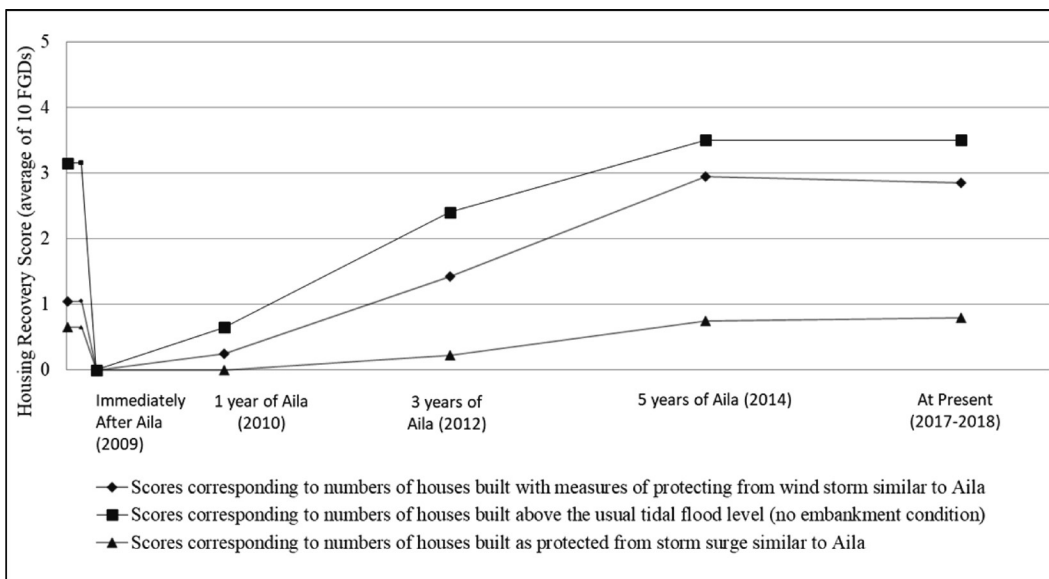
Note: housing recovery scores are a number that defines the level of recovery. "0" = 0 houses, "1" = 20% houses, "2" = 40% houses, "3" = 60% houses, "4" = 80% houses and "5" = 100% houses. The graphs have been constructed by the average of scores received from 10 FGDs.

Fig. 7 Progress of housing recovery

three years after Aila and reached its highest level five years after Aila. However, after five years, it showed a slight downward trend. Local people mentioned that houses that had been reconstructed earlier including those provided by NGOs (except CFS) were becoming weaker due to a lack of maintenance and the expiring lifetime of some housing materials. Specially, houses made with CI sheets were weakening faster due to salinity (according to local people).

Although there are general signs of returning to a better condition than before, the goal of BBB (i.e. a safer houses against cyclone hazards including storm surges) has not yet been achieved. Specially, the safety aspects of BBB i.e. adoption of structural measures for improving safety (of housing) against cyclone hazards including storm surges, long-term effectiveness of measures, etc. are insufficient. The root causes of the housing-related vulnerabilities i.e. absence of a risk-based land-use policy for housing, weak housing structure, absence of safety measures for storm surges, growth of isolated housing in vulnerable areas, etc. (Sadik et al., 2018) still prevail.

6. OUTCOME OF HOUSING RECOVERY: FROM THE SAFETY ASPECT OF BBB

6.1 The Fuzziness of Risk Perception due to the Role of Coastal Polders

With the trend of constructing coastal polders in 1961—late 1970s, peripheral earthen embankments along rivers in coastal areas, coastal polder No. 14/1 was constructed in Dakshin Bedkashi of Koyra in 1967 to 1970 as a protection against high tides (CEIP-I 2012; Shah Alam Khan 2008; van Staveren, Warner, and Shah Alam Khan 2017). At the time of constructing coastal polders, the objective was to prevent salinity intrusion and flooding due to high tides. Those polders were not constructed to prevent storm surges. However, those polders

were found to be somewhat effective in preventing low-intensity storm surges during weak cyclone events (Shah Alam Khan 2008). Following a cyclone event in 1985, under a foreign-aided project entitled "cyclone protection project II," the BWDB started considering rehabilitation of damaged embankments across coastal areas, claiming they played a structural role in preventing storm-surges. Meanwhile, the government took other initiatives of coastal afforestation, constructing multi-purpose cyclone shelters, developing a vast network of volunteers to facilitate evacuation, raising community awareness, and improving dissemination of cyclone warnings, which improved the country's performance in saving human lives during cyclone event (Haque et al., 2012; Shah Alam Khan 2008). However, with the success in saving human lives, BWDB's claim that earthen coastal polders are highly effective in preventing storm surges became more widely accepted. Local people started believing coastal polders to be a strong measure to prevent storm surges. Moreover, BWDB recently initiated another project for rehabilitating coastal polders considering increasing tide levels and climate complexity due to the changing climate and justified the project on coastal polders as a protective measure for storm surges in the project document (World Bank 2017). While constructing in-situ housing provision for Aila affected families, ERF also considered coastal polders (to be constructed by BWDB) to be structural measures against storm surges. On the other hand, the national disaster management plan of 2010-2015 (DMB-MFDM 2010) and the new draft national plan for disaster management (2016-2021) (MoDMR 2017) avoided the issue of coastal polders. Thus the true role of coastal polders in managing cyclone disaster is unclear. These coastal polders can act as a first line of defense and can slow down the intrusion of a surge in protected areas (Kibria and Khan 2017). But perceiving it as a savior may give a false sense of

security and affect the evacuation behavior during a disaster event (Paul and Dutt 2010). The role of coastal polders should be clearly mentioned in policies, plans and especially in polder recovery plans. The implementing agency of polder rehabilitation should also clearly explain the possible function of coastal polders at the time of storm surges to the local people.

6. 2 Insufficient DRR Measures for Housing Improvement

Table 3 compares the present scenario of adopting DRR measures in housing reconstruction with the situation before Aila. Before Aila, almost 90% of houses were built by earthen walls and thatched roofs (by Nypa Palm). When the induced storm surge overtopped and breached the embankment, it flooded the entire area and left almost 80% of houses in Dakshin Bedkashi damaged (3520 completely destroyed and 1800 partially damaged). When the surge water flooded the houses, the earthen walls collapsed. The thatched roofs of most of the houses were also blown away by the cyclonic winds. Therefore, during housing reconstruction, local people perceived that replacing the earthen walls and thatched roofs of their housing would reduce their risk. Another important DRR measure that people adopted was to raise the plinth level of

their houses. When 20.55 km of embankment was damaged (including 6 large openings) (Koyra Upazila Council 2010) by Aila, and the rehabilitation work was delayed, the tide continued to inundate the area twice a day for almost four years. Which, influenced the people and NGOs to raise the plinth level of houses above that usual tidal inundation level. People believe that replacing the earthen wall with either a bamboo or wooden frame or CI sheet would prevent their houses suddenly collapsing during inundation by surge water. People living in remote coastal areas such as Koyra practiced traditional safety measures e.g. raising the plinth level, changing the orientation of the house, roof fitting, and adding corner bracing(Hossain et al., 2008). In the Aila recovery, these perceptions of possible DRR measures were not only inherited through indigenous knowledge, people also followed the housing construction techniques of NGOs (Table 1). However, the performance of these DRR measures (Table 3) during a real disaster situation is unknown and have rarely been scientifically evaluated. The function of these improvements, e.g. replacing thatched roofs with CI sheets, is also uncertain and controversial. CI sheets, may become health hazards if they are blown away by cyclonic winds (Nadiruzzaman and Paul 2013).

Local people who did not receive housing pro-

Table 3   Adoption of DRR measures for housing improvement

DRR Measure	Perceived Functions	Before Aila	Present Day
% of houses built above the surge level of Aila	Protected from a storm surge like Aila	< 1 %	< 1 %
% of houses built above the usual flood level	Protection from tidal flooding during spring and neap during the post-cyclone period tide (if the embankment is extensively damaged by storm surge)	60%-70%	70%-80%
% houses with an earthen wall	Prevent rapid collapse of houses during inundation by a storm surge or tidal flooding	>90%	Around 10%
% houses with a thatched roof	Protection from heavy rain and strong winds	>90%	Around 10%
% houses with a special technique for roof fitting	Protection from heavy winds/cyclonic winds	<10%	50%-70%
% houses with concrete pillar / isolated concrete T-footing	Protection from cyclonic winds/heavy winds	<10%	40%-60%

Note: all the data and information provided in the table were collected by FGDs. The functions of the DRR measures mentioned in the table were also perceived by local people during FGD, which were not possible to validate by engineering experiment or survey.

vision from NGOs constructed their houses either by themselves or by hiring local laborers and carpenters. None of them had any institutional training in house construction. Therefore, uncertainty about the proper installation of DRR measures and their desired function at the time of disaster remains. Moreover, the local people do not know the maximum wind speed that is safe for the housing type. Hence, there is a chance of appearing false sense of security in peoples' mind that would influence them to stay at home and reluctant to heed cyclone warnings. Ultimately, people may decide not to evacuate. Although some DRR measures against the cyclonic wind and tidal flood (Table 3) have been implemented, housing safety measures (e.g. risk-based land-use-based planning for housing, resilient infrastructure, a buffer zone for storing surge water) for storm surges have seldom been adopted.

6. 3　Land use-based Disaster Management Plans and Practices, A Missing Link

　　Hazard-based land use planning is one of the six basic principles of BBB as proposed by Mannakkara and Wilkinson (2014) in their BBB framework. Along with the principle- "improvement of structural design," land-use planning shapes the risk reduction aspects of the BBB (Mannakkara and Wilkinson 2014). One of the critical sources of housing-related vulnerabilities in Koyra before cyclone Aila was the absence of risk-based land use planning for housing (E. Alam and Collins 2010; Mallick and Islam 2014; Sadik et al., 2017, 2018).

　　Unfortunately, such land use planning ensuring no growth of settlement in highly vulnerable areas was not considered in Aila recovery. In-situ reconstruction of houses was the core of housing recovery in Koyra, which did not take any location-specific vulnerabilities into account. Rising of the plinth level (to a high tide level) only cannot ensure safety from a storm surge. The housing

recovery should be well connected with the reconstruction of roads, infrastructure, cyclone shelters, and coastal polders. Thus, the in-situ housing reconstruction without those connections would end up inheriting pre-existing vulnerabilities, which in fact happened in the Aila recovery case in Dakshin Bedkashi. For a developing country like Bangladesh, ensuring the connection of roads, cyclone shelters, infrastructure, etc. to each house; and the safety of each house are difficult. The growth of isolated settlements after Aila further challenged disaster management practices (M. Z. Islam, Kolade, and Kibreab 2018). The north-eastern part of Bangladesh faces a similar situation due to deep monsoon flooding and people traditionally developed their villages on elevated lands (BHWDP and CEGIS 2012). This practice looks promising for the coastal area as well. It would be easier to ensure protection of a small village developed on a higher platform rather than ensuring protection to each scattered settlement on low lying areas. In such case, when a storm surge would strike the area, agricultural lands would be flooded but villages on elevated land would be flood free. Although housing relocation is the greatest challenge for implementing such concept in coastal areas, a post-disaster recovery could be considered an opportunity to initiate such relocation. Relocation of settlements to a safer area following a new hazard-based land use planning was a key principle in the Great East Japan earthquake recovery (Nakabayashi 2014) and typhoon Morakot recovery in Taiwan (Wen et al., 2017). Unfortunately, such opportunity was not taken in Aila recovery. Hazard-based land use planning for housing is a missing link in the Aila recovery in Koyra.

7. CONCLUDING REMARKS

　　This research characterized the implemented housing recovery measures in Koyra from the safety perspective of BBB and assessed the out-

come of the housing recovery. Characterization of the housing recovery revealed that recovery initiatives were mostly successful for the short to mid-term period. Those measures ꞌlow to moderatelyꞌ contributed to PAVR. This research concludes that from the safety perspective of BBB, the overall recovery resembles the pattern of ꞌstruggle to reach normalcy,ꞌ which indicates the adoption of effective DRR measures for a successful recovery towards safer housing is yet to be achieved. This research also found signs of social conflict created by the humanitarian aid driven housing recovery. In Koyra, NGOs provided three types of houses to around 36% families. Since the types of these houses differ in structure and cost, recipients of low cost (weaker in strength and structure) houses feel like victims of favoritism, political influence, and corruption. Families who did not receive any housing support have a similar feeling. However, these in-situ houses and DRR training provided by NGOs led to a trend of adopting few DRR measures for housing reconstruction.

This research also attempted to assess the overall recovery progress from people's perception. The constructed synthetic recovery curve shows a clear sign of recovery to the pre-disaster condition. Although the recovery curve shows an improvement of housing conditions (to secure them from windstorm and tidal flood), safety from storm surge is still ignored. A return to normalcy with improvement is an achievement. However, insufficient adoption of DRR measures for housing improvement, the absence of hazard-based land use planning, reconstruction of houses in vulnerable areas and fuzziness about the role of coastal polders undermine the overall outcome of the housing recovery and may lead to a false sense of security during an evacuation.

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要　　旨

　2009年にバングラデシュを直撃したサイクロンアイラは多くの被害をもたらし，人道的組織により，現地の住宅規定に基づいた住宅再建支援が大々的に行われた。本研究はサイクロンアイラの被災地コイラ郡において，NGO や現地被災者による住宅復興方法の特性を明らかにし，その結果を被災者の認識と専門家の意見に基づいて評価した。具体的には被災者とのグループディスカッション（Focus group discussion），専門家への聞き取りと，制度の調査を行った。その結果，NGO と被災者は高潮による洪水に配慮せず，暴風と通常の潮汐による洪水のみを考慮した安全対策をとっていたことが明らかとなった。また住宅再建にかける時間は短く，災害前の脆弱性を低度から中度ほど軽減する程度であった。被災者の認識に基づいて作成された住宅復興カーブは，災害前の脆弱性を引き継いでいることを示していた。これらのことより，本研究は現在の住宅復興のあり方に一石を投じ，土地利用を基にした住宅復興方法を提案する。