Creating an ecosystem that enables acceleration of housing self-recovery in the post-disaster context

Arwin Soelaksono*

Shelter and Settlement Practitioner, https://www.humanitarian-development.org/

Abstract. During reconstruction, the recovery actors might overlook the connections between external and internal push factors. These factors can positively impact the processes to accelerate and produce long-term benefits beyond construction. Consequently, the ecosystem which should strengthen the self-recovery initiatives cannot be formed. Whereas, inside the ecosystem, the function of the market can be amplified by government policies and strategies. External push, such as using contractor companies and imposing deadlines, can speed up the reconstruction but will have problems both in sustainability and inclusivity. Government or aid agencies might set deadlines for the reconstruction program. It might happen if all support systems are in place. A deadline is inevitable since the recovery program might be ended due to program closure. Expecting that imposing the deadline will accelerate the process will only be partially effective. On the other hand, applying the push factors needs to pay attention to the nature of the genuine housing recovery, i.e., self-recovery initiatives and local market capacities. Hence, those initiatives and capabilities should be strengthened by internal push. The capacities of the market actors, which are the architects, engineers, builders, hardware stores, and even homeowners, should be strengthened to meet the demand for massive reconstruction. The data for this research was collected through field observations to interview the market actors, government officers, and other recovery actors, such as service providers and aid organizations. The data was analyzed by referring to the relevant academic and grey literature to find the relation of actors' capacities with timelines and the quality of houses constructed.

Keywords: Housing recovery, reconstruction, self-recovery, post-disaster, construction market.

1 Introduction

1.1 Concern about the slow pace of housing recovery

In most housing recovery post-disaster, the affected people, government, and social society share the same feeling that the process is always prolonged. For instance, the recovery from Hurricane Ike in Texas, USA, might take 2 to 7 years. The recovery time depends on the damage level and housing type [1]. It might take more than ten years, as happened in Haiti post-2010 earthquake. This is due to the disaster's magnitude and poor coordination in international aid interventions to optimize the efforts [2]. Meanwhile, following the 2011 Great East Japan earthquake in Japan, the government planned a 10-year recovery timeframe. Even after 6 years, some areas have lagged due to 134,000 evacuees remaining displaced, affected by the Fukushima radiation [3]. Hence, other factors besides construction activities can impede the recovery process.

But without seeing those hindering factors, the longer the process, the higher the pressure for a quick fix due to pressing needs and political agenda [4]. This phenomenon happens globally, not only in a particular country, and it will worsen if it is closer to the government election. These pressures will obscure that the housing recovery needs to follow its natural path. In fact, natural paths of housing construction should be respected in business as usual of post-disaster recovery. This natural path will be discussed further in section 1.3.

This paper will focus on the self-recovery approach where the homeowners build their houses with their resources. They have the freedom on the house design, construction material, and the pace of construction. This approach is the opposite of the donor or government-driven implemented in Aceh post-2004 tsunami. Many recovery actors provide housing as a turnkey project in that setting. There were sustainability issues since the homeowner had just received the houses; hence, there was no skills transfer, so it was difficult for homeowners to maintain or expand their houses.

1.2 Improving system and modality for better recovery

During the last two decades, housing recovery actors gradually improved the strategy, approach, and

* Corresponding author: arwinsoelaksono@gmail.com

modality. From the engineering perspective, the government issued regulations, i.e., a new building code. For instance, following the 1999 Gölcük, Türkiye earthquake, Türkiye had a new building code in 2007 and then revised again in 2018 [5]. Therefore, all new houses constructed or seismically strengthened should abide by the code to achieve robust structure. Aside from the engineering approach, the socio-economic approach also has been introduced. The affected people will work as a group to build their houses together. Start from someone's house, then take turns until all houses are completed. The group will receive cash support in tranches and technical assistance [6]. This reconstruction modality was used in Yogyakarta following the 2006 earthquake. Combining engineering assistance with the socio-economic approach was proven successful, and the Nepal government replicated the modality for the housing recovery after the 2015 Gorkha, Nepal earthquake. The Nepal government and the partner organizations completed the housing recovery program for over six years. Yogyakarta, Indonesia, and Nepal have the same approach, i.e., owner-driven setting. Homeowners built their houses with technical and cash support from the government or aid agencies. They will have responsibility for the house design, budgeting, construction pace, and quality.

Aside from the pressing needs of those who lost their houses, government and aid agencies have time limitations, and all houses should be built during the recovery programs. The government and partner organizations program may end at some point, but people may continue to rebuild using their resources. However, they may not receive similar support as offered during the recovery program implemented. Therefore, some quality issues occurred.

1.3 Additional external and internal push to accelerate the construction process

Several attempts to speed up the construction process have been made. For instance, government and partner organizations deployed construction companies. The basis for awarding the job to construction companies is their experience. It will enable them to work faster than the homeowners if they build the houses by themselves. This is a different modality from that implemented in Yogyakarta, Indonesia, and Nepal. But there is a limitation. Contractor companies are primarily interested in modular structures and houses located in a compound or a location that is not widely scattered. Constructing private houses with various designs and various building materials in scattered areas will add operation costs. Also, it reduces the profit obtained from bulk discounts if they use the same building materials for all houses. In these landed houses, turnkey projects mean homeowners who have not participated in the construction process will have problems when they want to upgrade or work on maintenance. Hence, sustainability has become one of the issues [7].

On the other hand, attempting to accelerate the recovery can be done by giving an internal push. The capacities of homeowners, local builders, and local hardware stores will be stretched to the maximum. This additional intervention is likely for the self-recovery context since those affected by this intervention are primarily homeowners.

Nepal's government issued a policy on government tranche deadlines to increase the speed of reconstruction [8]. The homeowners have to reach completion at certain stages in order they are eligible to receive cash support. It was three installments from the foundation up to the house completion. To some extent, the deadline was effective and accelerated the construction. However, it was adequate for those with capacities such as builder availability, local vendors, and personal savings.

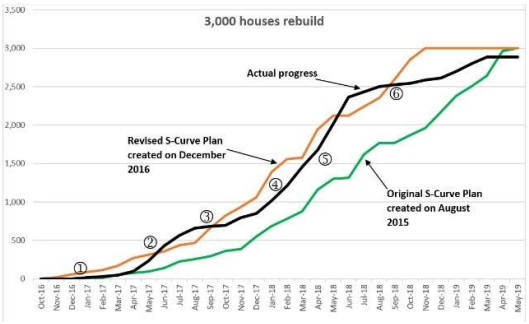

Fig. 1. S-Curve Plan vs. Actual on houses built of 3,000 households in 4 villages, i.e., Kaule, Balche, Thulogaun and Gogane in Nepal. [9]

In construction project management, a mathematical graph, known as S-curve, is commonly used to show the progress of a project over time. The bottom curve (green) is the original planned S-curve, which show the 3,000 houses designed with an owner-driven approach that will be completed in 32 months. This S-curve is a natural path built in a non-disaster setting since the flat and steep slope depicts the season and holidays. During the planning, it was designed that technical assistance and cash support would bring the progress to normal conditions. Those interventions are expected to be an internal push since the homeowners' and builders' capacities improved.

The middle curve (black) is the bi-weekly recorded actual progress in which 95% of houses are completely constructed at the end [10]. The top curve (brown) was the revised S-curve. The revision was made soon after the Nepal government issued a deadline. The modification is to accommodate the change of plan to tap any opportunity that might improve the construction pace. The actual (black) curve shows the government deadline policy is only partially effective.

1.4 Towards more sustainable recovery

This paper is not written as an excuse that recovery always takes considerable time but to ensure that recovery will be done fulfilling its natural course. This paper will clearly distinguish between reconstruction and recovery. Reconstruction is part of the recovery. Therefore, construction should follow the building code, and the homeowners should be able to expand or maintain the house. This ability should be formed during

the recovery program, which covers the construction and all aspects involved. Hence, the ability to self-recover not only those with the capacities but also provides access that most vulnerable groups can participate in housing recovery.

2 Methods

This paper is written to provide recommendations on how to accelerate housing recovery organically. This recommendation will be an input to the current modalities to strengthen sustainability, which needs improvement. The information will form or enhance the ecosystem that connects every aspect to function optimally.

2.1 Research questions

To obtain the information mentioned above, hence, the research question is the following:

Who are the stakeholders, and what subjects need to be present that might create a multiplier effect to accelerate the housing recovery process in a self-recover setting, even if there would be no external push? Also, what are the missing parts that are still untapped but might contribute to accelerating the process?

2.2 Data Collection

The study will cover the housing recovery modality from the 2004 Aceh, Indonesia tsunami until the 2023 earthquake at Türkiye. Within that period, recoveries in Nepal post-earthquake 2015 and Lombok and Central Sulawesi, Indonesia post-earthquake and tsunami 2018 were ongoing. I was on the ground in those disaster-affected areas mentioned earlier. The detailed numbers shown here are from the Nepal post-2015 earthquake.

The primary qualitative data was collected from field observation. The observation was conducted during field visits for the construction monitoring process, training government officers, builders, and homeowners, and conducted several discussions with local vendors and construction companies. Meanwhile, the aid agencies and authorities were observed during coordination meetings and seminars.

Below is the list of stakeholders and the object of observation.

Table 1. List of stakeholders and object of observation.

Stakeholder	Object of observation
Homeowners	The aspects affecting their preference included design, building material selection, limitation, and timeframe.
Builders	Aspects that motivate them to work and willingness to deliver their job fulfilling the code.
Local vendors	Capacities, supply chain, and preferred construction material.
Service providers (Local banks, post office, transportation, and telecommunication)	Aspects that motivate them to participate in the recovery program
Construction companies	Preference on type of project and construction methodology
Aid agencies	Preference on modality, type of assistance, and beneficiaries
Local authority	Capacities to provide support to local actors, monitoring, and quality assurance
Government reconstruction authority (national level)	Capacities for developing guidance, policy, and flexibility to adjust according to the needs.

The secondary qualitative data were collected from relevant academic and grey literature, government policies, guidelines, and selected project reports.

The limitation of this study is the housing self-recovery or owner-driven reconstruction. This study will not discuss donor or government-driven reconstruction, whether the houses rebuilt are in-situ location or in new resettlement. To be more specific, the study only covers landed houses; therefore, this study will not discuss a multistorey apartment building that should be built by a construction company.

2.3 Data analysis

Data and information gathered in the data collection process will be analyzed using qualitative analysis. The data from observation will be compared to the literature to find its relevancy, understand the context, and find the trend and possible similarities in other areas. The trend and similarities are crucial since the occurrence of some phenomena will help anticipate some events, whether it results in a better impact or the opposite direction.

On proposing the ecosystem, all stakeholders listed above will be connected based on their tendency to operate and modality in some events. To find the expected ecosystem, this study will highlight untapped connections that can ensure all actors can absorb and distribute resources efficiently. Therefore, all stakeholders' capacities can be scaled up and more sustainable.

3 Factors in the ecosystem that impede the housing recovery

3.1 Insufficient capacities of local market actors

Four parties on the local level form business activities of the housing reconstruction. To begin with, affected people whose houses are damaged due to the hazard. These homeowners are expecting that their houses can be rebuilt or repaired very soon. There are also builders who are skilled or unskilled but willing to work in construction. There might also be local construction companies that can participate in reconstructing those affected houses. Then, the local hardware stores sell the construction material. Lastly, the service providers can

provide finance, transportation, and telecommunication systems for the construction work.

3.1.1 Homeowners whose houses need to be repaired or rebuilt but have capacity challenges

Those directly impacted by the disaster are the homeowners. They might flee to take refuge or stay near their damaged houses. The damage also varies from light damage to totally collapsed. The effect also depends on the economic capacity in that area; for instance, the poor area of Türkiye's earthquake might suffer 3.5 times [11] more damage.

Those houses might be repaired or rebuilt on the existing land, or they have to be relocated due to being unable to rebuild or being unhabitable due to liquefaction, landslides, or tsunamis. But the affected people have something in common: they want to have their houses back to get their lives back to normal.

But how fast they can recover depends at least on their unique recovery pathways and capacities. Every household has its preference for its recovery. Some of them prefer to rebuild slowly with available materials or change their type of construction material. Due to living abroad or having other priorities, some will save their earnings and rebuild on their favored time.

To those with financial capacities or builders' skills that can repair or rebuild as soon as building materials or labor are available in their areas. But capacities are not only finance and skills; there are also capabilities to follow the building code during the design or construction of the houses. This is critical as they will repeat the same mistakes to build a vulnerable structure similar to their damaged houses. It is counter-productive to the idea that Build Back Safer (BBS) is a goal for post-disaster reconstruction [12].

Even though there is a massive campaign of BBS and they have safe land to rebuild their house, they must compete with their neighbors when the government launches the recovery program. Tens or hundreds of thousands of houses will be rebuilt in a specific recovery period. After a large-scale disaster, housing reconstruction projects are susceptible to numerous resource bottlenecks inherent in post-disaster circumstances, such as a lack of suitable resources and alternatives [13]. Market laws of supply and demand prevail, as seen in inflation.

Lest we forget, those with vulnerable criteria or no legal land ownership have more considerable challenges to self-recover. Only with external support can their houses be rebuilt.

3.1.2 Builders whose current construction practices lead to structure vulnerability

Builders have a significant role in reconstruction, but in developing countries, many builders need proper and formal training. They learned construction from their friends, who are also builders, and set their skills through internships in construction projects. Their friends, usually their mentors, are the foremen who give them job orders.

As builders are primarily unfamiliar with proper construction and fulfilling the code, they will entertain the homeowner's request to have economical houses even though it is unsafe. For instance, the homeowner might ask to reduce cement or steel rebar volume to reduce cost.

The senior builders will pass their construction practices to their apprentices and become standard norms. Even if it is a wrong practice, as it has been implemented for years, it will be difficult to break the poor practices. Both parties, the homeowner and the builders, agreed to the normalized construction practices. Therefore, this construction market cannot be naturally effective in self-recovery as they will repeat the poor construction quality in the newly rebuilt houses.

3.1.3 Local hardware stores which sell mostly favorable construction material

Depending on the economic level in the affected area, there will be local hardware stores. The type and quality of the material are according to the preferred building material commonly used in that area. But in this case, the vendor has a dominant position and can only provide material to deliver a more significant profit. Many times, homeowners and builders have to adjust their needs to the available material provided.

The hardware store owners have mutually beneficial interactions with the builders. The builders will inform homeowners' preferences, i.e., the price and familiarity with a brand or a product. On the other hand, the store owners also give a bonus to builders if they can market a product or material with a particular brand to the homeowners; similarly, such relationships also happen between hardware store owners and wholesalers. The wholesaler's interest is the transaction volume; on the other hand, the store owner's interest is punctuality to replenish the purchased material and the discount.

This relationship is purely economic, but the issue is the building material; there is no guarantee that specific materials that should be used to achieve a robust house are always available. For instance, finding deformed steel rebar in areas where reinforcing smooth steel rebar is commonly used will be challenging. While from the building code, the deformed steel rebar is a prerequisite for earthquake-resistant structures. Another example is the sand for concreting. It is sometimes difficult to find sand free of saline and mud. In reality, local hardware stores in the market correlate differently than the proper building material availability.

3.1.4 Service providers for whom local actors work can effectively function

Aside from the local hardware stores mentioned earlier, other service providers must also be present. Their services should be located or close to the reconstruction areas. These service providers are financial institutions, transportation, and communication. They are needed to ensure there is always a sufficiency of construction

materials and that money can be distributed safely and accurately.

There are various means to send money, such as through banks, cooperatives, post offices, or mobile apps. Depending on the infrastructure and market actors' preferences, they can select which option will work best for them as long the service providers can serve market actors individually.

Whether the reconstruction uses cash-based intervention (CBI) or other methodologies, these service providers are crucial because they can maintain market stability to reduce delays, material scarcity, and inflation. The problems that might hamper the provision of these services are poor infrastructure and poor security; hence, not all areas can have such services.

3.2 Unmatched systems and policies for connecting resources and actors

Following the Asian Tsunami (2004), the Build Back Better slogan was introduced [14]. However, the implementation could have been more complex due to misinterpretation of its meaning. More aesthetically appealing was the most popular among the beneficiaries. As the housing recovery assistance went toward a self-recovery setting, the slogan changed to BBS. But the idea of a housing recovery that is more oriented toward livelihoods, more resistant to natural hazards, faster, stronger, and more equitable [15] persists. The need for more quickly due to political pressure and more environment friendly due to climate change can be highlighted here.

Therefore, the policymakers tried strategies and policies on how those components are present in recovery planning. There are still some challenges that those initiatives can be fully achieved.

3.2.1 Policy for quick-fix solutions

As housing is one of the most essential parts of living, housing recovery post-disaster is always the top priority of the governments. Since its recovery will positively impact political and economic stability, it can have a ripple effect on the local economy since it will absorb local resources and create job opportunities. On the other hand, to reduce social jealousy, providing uniform assistance is going along well with the idea of faster recovery.

The policy to provide modular houses with prefabricated material is an example of faster and uniform assistance. It is proven that construction using a modular system is more time-efficient [16] than conventional systems, such as building brick houses at on-site construction. As it is prefabricated, it gives more control over the quality of components and the safety of the construction [17]. This fabricated modular housing was delivered in Niger Delta, Nigeria [18] and Lombok and Central Sulawesi, Indonesia, following the 2018 earthquake [19].

But there are some challenges with that particular assistance. Not all beneficiaries are in favor of the design and the construction material. They are also not involved in the construction process; therefore, working on the maintenance or extending the house will be challenging. Some of the modular houses are difficult to construct due to land availability. If the land is too small, the prefabricated material should be changed to fit in the land. Local actors only partially benefit from this system since the material and the installer are outside the affected area. There are other issues if the road is inaccessible; therefore, delays will be inevitable since delivering the fabricated material to each house is difficult.

However, modular prefabricated houses are fit for donor or government-driven reconstruction in relocation areas with a turn-key project system. But the problem of extending the house or working for maintenance persists.

Another effort that may speed up the recovery is by providing core houses. A core house is an incrementally expandable form of housing. The core, which can be built quickly, needs fewer resources for initial construction; later on, residents can leverage their own funds or donations for expansion [20]. However, there are challenges if this support delivers a product of core house to the affected people as a turn-key project—no skills transfer, which is actually needed for future expansion. Moreover, the core house as a product usually has a uniform design applied to everyone.

On the other hand, if core housing focuses on the capability of homeowners or builders to improve construction practices to achieve BBS, this approach is in line with this paper. Training and oversight as a process of developing capacities will ensure they can continue rebuilding with proper practices even after the recovery program has ended.

3.2.2 Policies that are incomprehensive to the actual and dynamic conditions

Government policy [21] on housing recovery is essential for every market actor and aid agency to guide and ensure the implementation will align with the government plan. There will be no accountability if there is no policy or the policy is too loose. But if the procedure is too tight, it will not be easy to implement.

Rebuilding houses and revitalizing communities through mobilizing affected people can be more effective if aid agencies are supported by policies that enable them to work more flexibly according to their mission or expertise [22]. Some agencies do not have expertise in construction, such as women empowerment organizations, but if they can contribute, they can encourage women to work in construction. Therefore, the policy should be able to invite any unique capacity since natural disasters always go beyond what people can predict, especially if action is not taken [23].

For instance, in the earthquake housing recovery, the policy primarily focuses on the amount of money and type of housing assistance. Then, the government and aid agencies can provide for the repair or rebuilding of houses. Most of the assistance emphasis on the total collapse or heavily damaged houses. The policy is to support the people to rebuild after receiving government or aid agencies' assistance. In fact, people might repair

or rebuild their houses once they think they can do it. As written earlier, the house is built by the local market with insufficient capacities with their traditional practices; hence, vulnerability to disaster persists.

Another issue of incomprehensiveness is covering the most vulnerable. As the policy emphasizes equality, all affected people will receive the same support according to the level of damage, but the most vulnerable people will potentially be left behind. Those who fall in the vulnerability criteria need more support and should be prioritized. They have challenges if they approach the recovery program with similar modalities to their neighbor. Moreover, repairing or rebuilding their houses takes longer than their neighbor.

Inequality was also seen when people reacted to the government and aid agencies' deadlines. It is understood that the recovery program should end at some point, but the deadline is only effective for those with the capacity and resources to build. When the Nepal government issued a series of deadlines for house reconstruction following the 2015 earthquake [24], many homeowners started their house construction to catch up with the deadline. It was reported that the deadline successfully motivated homeowners as several house construction jumped to a certain level [25]. But setting an expectation around time for the most vulnerable is impractical.

Table 2. House rebuilt in Nepal during the 2015 earthquake recovery program in 4 villages supported by the Nepal Red Cross, the American Red Cross, and Build Change [26].

Housing self-recovery program with the achievement and its specific condition	Kaule	Balche	Thulogaun	Gogane
The target number of house	953	1,005	443	637
Completion status on 19 Dec 2018	918	905	354	438
Percent completion	96%	90%	80%	69%
Transportation and access	Good	Fair	Poor	Poor
Phone and internet	Good	Fair	Fair	Poor
Financial service provider	Good	Fair	Fair	Fair
Other actors provide complementary support.	Yes	N/A	Yes	N/A
Social cohesiveness	Fair	Fair	Good	Poor

The type of support to the homeowner and the community is the same across those villages. They received cash support and technical and project management assistance. Social mobilizers were also deployed to educate people about the recovery context with social language. From the Fig. 1, on 19 December 2018, shows the S-curve already passed the steep curve, which means the impact of the government deadline has disappeared.

Table 2 shows areas with higher completion are villages with better access to services and additional support from other actors. These aspects can improve the quality and construction pace.

4 Principles that might support forming an ecosystem for acceleration

4.1 Program and modalities in the ecosystem that might create a multiplier effect on the economy

Creating a multiplier effect should be based on a bottom-up approach, locally led and empowering the most vulnerable. From this perspective, local people have the ownership and responsibility to make the recovery faster and more sustainable.

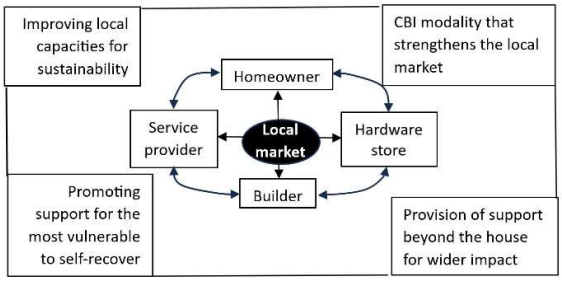

Fig. 2. 4 actors and 4 principles in the ecosystem of post-disaster housing self-recovery

4.1.1 Improving local capacities for sustainability

This is the basic idea; the local affected community or the local market can create significant long-term improvement if they can be changed fundamentally from their poor construction practices. It can be achieved by continuous training and socialization of the homeowners, builders, and hardware store owners.

In the self-recovery setting with the BBS approach, the first step is to build the capacity of builders and homeowners. They need to be trained on how to construct robust houses. The training should include the whole community since community marginalization from reconstruction exacerbates local vulnerabilities and associated disaster risks and impacts [27]. Homeowner participation has been crucial since the early stage of the project. There are important decisions to make, for instance, house design, choice of technologies and procedures [28]. If government and aid agencies respect their choices, transferring the responsibility to the local market can be assured. Even though the local market still needs continuous monitoring and assistance since the post-disaster reconstruction period does not end with the handover of the houses, it should also cover preparation for the next pre-disaster [29].

4.1.2 Cash-based intervention (CBI) that strengthens the local market

Several concerns make some organizations are not using the CBI. One of the issues is the potential misuse of cash received by the homeowners. The situation is valid. After receiving the cash assistance, homeowners might use the money to pay debts or pay for medicine for their sick families instead of purchasing building materials. But the risks can be reduced with a sense of urgency and opportunity. Hence, CBI should always provide technical assistance and community mobilization. Moreover, cash and voucher assistance has grown rapidly in international humanitarian assistance since 2016; hence, this trend pushes the humanitarian system to change, which may scale up cash assistance [30].

The technical assistance will help them to decide what kind of houses they want to build. They will be informed of the budget and the timeframe. This will build confidence that they can build a safer structure. Since the technical assistance also includes the project management element, the homeowner can be advised to maximize their available resources, such as reusable material, which can save costs. On the other hand, community mobilizing will create pressure on highlighting their neighbor's success in good quality construction. Those particular houses and their owners can be examples of BBS.

The community mobilizing can work well with technical assistance to encourage builders to follow the code. These initiatives also can be consumer pressure on the hardware store owners to provide proper building materials since the quantity meets the minimum purchase to the wholesaler. If builders adopt the new practices and the local hardware stores sell suitable construction materials, the renewed local market might be sustained after the recovery program.

4.2 Integrated recovery programs across actors to create internal push factors

As mentioned earlier, reconstruction is only a part of the recovery program. Other actors and activities beyond house construction must fulfill the entirety to speed up and sustain recovery. And those actors and actions need to be integrated to create a multiplier effect on the economy.

4.2.1 Promoting support for the most vulnerable to self-recover

Housing self-recovery mainly focuses on those eligible and able to fit with the criteria and terms for participation. However, some people with specific social characteristics lack access to resources in the community. These people fall into vulnerability criteria, such as very young or very old, pregnant women, and people with disabilities [31]. These people will need help to compete with their neighbors in building houses. Their challenges are even more complicated if there is no top-up assistance policy. At least there should be additional assistance to ensure they can participate. To begin with, additional funding is needed since they might need help to work physically on building their houses. And also, they need a longer time frame to build.

This group can still participate in the recovery program based on Nepal's recovery experience [32]. Those vulnerable people still have the capacity if they still have neighbors who might help them [33]. However, this initiative cannot automatically materialize; it requires a community-facilitation process [34] that a project management system and additional funding should support [35].

Aware that supporting the most vulnerable needs a longer time frame; therefore, supporting them should be done as soon as possible. This will be an opportunity as a pilot project in all areas and could be funded by government and aid agencies.

4.2.2 Provision of support beyond house for wider impact

Housing recovery should not only be seen as housing reconstruction. Other elements should also be implemented parallel with the construction. Those assistance are mentioned above, such as access to livelihood, land titling support, and access to health and education [36]. The common problem in housing reconstruction is that assistance will be initiated after completion. It will take a wide time gap from finished construction to initiate new complementary services such as market revitalization and access to livelihood, clinics, and school facilities.

As this initiative is self-recovery, the community should be able to connect with the local government. Then, through coordinated efforts led by the local government, all stakeholders within the area will deliver those services through the government budget or additional funding from aid agencies. However, it will take considerable time; therefore, local government structures should be present even during reconstruction planning [37].

If recovery can also be focused on access to public services, the house reconstruction will be perceived as an intermediate target. The ultimate goal is to provide assistance, goods, and resources to those communities in that area. Therefore, all stakeholders might press on to complete the construction work soon using a fast-track system with the support of project management services. The community needs to have those facilities so they might have more confidence to protect their families and assets from future risks.

5 Conclusion

Even if it is supported by various assistance, post-disaster housing with a self-recovery setting must acknowledge the nature of construction work. It takes time to ensure that robust houses can be built or repaired; also, negative impacts can be minimized.

The quality of recovery should not be seen in how many houses are built but in their impact on the community by providing access to livelihood, health, and education. As seen in Fig.2, these complete sets are the ecosystem of the post-disaster housing with a self-

recovery setting. The core of the ecosystem is the local market, which consists of homeowners, builders, local hardware stores, and service providers. The core can grow bigger in correlation to their capacities getting stronger. Therefore, continuous efforts to strengthen capabilities should be made through training, collaboration, and sensitization programs. Growth of the core is also correlated to the speed of recovery, and the outcome is organically even if there is no pressure from the policy, such as deadlines.

Some services should also be in the ecosystem to ensure the core can grow. The first is improving local capacities to meet the regulation and have a sustainable impact, then the modality that maximizes the use of cash to strengthen the local market and job creation. Another element is prioritizing supporting the most vulnerable for pilot projects and ensuring they stay caught up. Lastly, it assists in construction, i.e., public services that can benefit the communities. All these need a program integration of all recovery actors, led by the local government, which can minimize risks and negative impacts of recovery activities.

This ecosystem should be created and planned from the very beginning. Thinking recovery merely on construction will lead to slow progress and incomplete outcomes. On the other hand, a more robust ecosystem will create houses built according to the code and sustainable recovery since the community will have access to services for their well-being.

References

1. S. Hamideha, W. Gillis Peacock, S. Van Zandt. *Housing type matters for pace of recovery: Evidence from Hurricane Ike*. International Journal of Disaster Risk Reduction. Available online: https://bit.ly/3D2q3j5 (2021)
2. The Conversation. *A decade after the earthquake, Haiti still struggles to recover*. Available online: https://bit.ly/44b8wBd. (2020).
3. Internal Displacement Monitoring Centre and Norwegian Refugee Council. *Recovery postponed: The long-term plight of people displaced by the 2011 Great East Japan Earthquake, tsunami and nuclear radiation disaster*. Available online: https://bit.ly/43tthXP (2017).
4. Bose, B. P. C. *The Politics of Disasters*. The Indian Journal of Political Science, vol. 55, no. 2, 1994, pp. 119–34. JSTOR, Available online : http://www.jstor.org/stable/41858801 . (1994)
5. N. Atmaca1, A. Atmaca, s. Kılçık. *Comparison of 2018 and 2007 Turkish Earthquake Regulation*. The International Journal of Energy & Engineering Sciences, 2019, 4 (2) 19-25.Available online: https://bit.ly/44yx9Ys (2019).
6. E. Maly, T. Kondo, Y. Shiozaki, *An Incrementally Expandable Core House for Disaster Reconstruction: Two Cases in Yogyakarta, Indonesia after the Central Java Earthquake*. Memoirs of the Graduate Schools of Engineering and System Informatics Kobe University No. 4, pp. 1–7, 2012. doi:10.5047/gseku.e.2012.001 Available online: https://bit.ly/3D2Jlou (2013).
7. A. Soelaksono. *Big push to accelerate reconstruction post-disaster*. Blog. Available online: https://bit.ly/3ELYQm7 (2023).
8. S. Subedi, R. Khanal, G. Kumar Panthi, A. Raj Bajracharya. Impact of Government Tranche Deadline in Housing Reconstruction: A Case Study of Nepal. Government of Nepal National Reconstruction Authority website. Available online: https://bit.ly/3ND3LcF
9. The S-Curve image is from *Improving post-disaster housing reconstruction based on Nepal recovery S-curve.* Blog. https://bit.ly/3oEsLSL
10. Nepal Earthquake Recovery Program – Utthan | End of Program Evaluation Report. July 2019.
11. The Economist. *Poor areas suffered 3.5 times more damage in Turkey's earthquake*. https://www.economist.com/graphic-detail/2023/02/16/poor-areas-suffered-35-times-more-damage-in-turkeys-earthquake . 16 February 2023. Accessed on 23 July 2023.
12. G. Fernandez, I. Ahmed. "Build back better" approach to disaster recovery: *Research trends since 2006.* Available online: https://bit.ly/3Kq4Eof (2019).
13. Y. Chang, S. Wilkinson, D. Brunsdon, E. Seville, R. Potangaroa. *An integrated approach: managing resources for post-disaster reconstruction*. Available online: https://bit.ly/3Dnt1Pg (2011)
14. Sendai Framework Terminology on Disaster Risk Reduction. Build Back Better (BBB): 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. UNDRR website : https://www.undrr.org/quick/11988
15. G. Fernandez, I. Ahmed. "Build back better" approach to disaster recovery: *Research trends since 2006.* Available online: https://bit.ly/3Kq4Eof (2019).
16. T. Gunawardena, T. Ngo, P. Mendis, L. Aye, R. Crawford. *Time-efficient post-disaster housing reconstruction with prefabricated modular structures*. Open house international 39.3 https://bit.ly/3O2Tub9 (2014).
17. J. Molavi, D. L. Barral, Drew L. *A Construction Procurement Method to Achieve Sustainability in Modular Construction*, Procedia Engineering Volume 145 pages 1362 – 1369. Available online: https://bit.ly/44sU5s9 (2016)
18. A. Ibim Amadi. *Perceptions of Modular Construction as a Tool for Incorporating Resilience in Post-disaster Housing Reconstruction in the Niger Delta Environment*. Journal of Energy, Environment & Carbon Credits. Volume 12, Issue 3. Available online: https://bit.ly/3D3UiGc (2022)
19. K.S. Pribadi, R.G. Pradoto, E.A. Hanafi, I. Made Adhi Bayu Rasmawan. *Lombok earthquake, one*

year later: housing sector recovery. E3S Web of Conferences 156, 01012 Available online: https://bit.ly/3O31xET (2020)
20. E. Maly, T. Kondo, Y. Shiozaki, *An Incrementally Expandable Core House for Disaster Reconstruction: Two Cases in Yogyakarta, Indonesia after the Central Java Earthquake*. Memoirs of the Graduate Schools of Engineering and System Informatics Kobe University No. 4, pp. 1–7, 2012. doi:10.5047/gseku.e.2012. 001 Available online: https://bit.ly/3D2Jlou (2013).
21. Y. Chang, S. Wilkinson, E. Seville, R. Potangoroa. *Resourcing for a resilient post-disaster reconstruction environment.* Available online: https://bit.ly/3QkUIAb (2010)
22. L. Ming Lam, V. Khanna, R. Kuipers. *Disaster Governance and Challenges in a Rural Nepali Community: Notes from Future Village NGO*. HIMALAYA, the Journal of the Association for Nepal and Himalayan Studies. Vol. 37. Available online: https://digitalcommons.macalester.edu/himalaya/vol37/iss2/11 (2017)
23. L. Ming Lam, V. Khanna, R. Kuipers. *Disaster Governance and Challenges in a Rural Nepali Community: Notes from Future Village NGO*. HIMALAYA, the Journal of the Association for Nepal and Himalayan Studies. Vol. 37. Available online: https://digitalcommons.macalester.edu/himalaya/vol37/iss2/11 (2017)
24. S. Subedi, R. Khanal, G. Kumar Panthi, A. Raj Bajracharya. Impact of Government Tranche Deadline in Housing Reconstruction: A Case Study of Nepal. Government of Nepal National Reconstruction Authority website. Available online: https://bit.ly/3ND3LcF
25. P. Gill. *Nepal's Desperate Race to Rebuild Saddled with debt and deadlines, Nepal's earthquake victims scramble to rebuild their homes*. The Diplomat. https://thediplomat.com/2018/04/nepals-desperate-race-to-rebuild/
26. The data of completed house was collected bi-weekly with Build Change team in the field then it was analyzed by the American Red Cross project team. Those number of completed houses compared to the planned S-curve to find whether change of strategy is needed.
27. Jonas Imperiale, F. Vanclay. *Top-down Reconstruction and the failure to "build back better" resilient communities after disaster: lessons from the 2009 L'Aquila Italy earthquake*. Available online: https://bit.ly/3XTSEAP (2020).
28. M. Lyons, T. Schilderman, and C. Boano. *Building Back Better. Delivering people-centered housing reconstruction at scale*. Practical Action Publishing Ltd. Available online: https://bit.ly/3rscFCa (2010)
29. B. Baradan. *Analysis of the Post-Disaster Reconstruction Process Following Turkish Earthquakes, 1999*. Faculty of Architecture, Izmir Institute of Technology, Turkey Available online: http://bit.ly/2skg5q2 (2006).
30. CALP Network. *Increasing the Use of Humanitarian Cash and Voucher Assistance Opportunities, Barriers and Dilemmas*. (2022).
31. B. Wisner. Marginality and vulnerability Why the homeless of Tokyo don't 'count' in disaster preparations. Applied Geography, Vol. 18. No. I, pp. 25-33, Available online: https://bit.ly/3Q22Rt2 (1998)
32. A. Soelaksono. *Supporting the most vulnerable in owner-driven house reconstruction setting – Lessons learned from Nepal*. Blog. Available online: https://bit.ly/37pursr (2019).
33. D. P. Aldrich. *Building Resilience: Social Capital in Post-Disaster Recovery*. The University of Chicago Press. (2012).
34. M. Vahanvati, B. Beza. *An owner-driven reconstruction in Bihar.* International Journal of Disaster Resilience in the Built Environment, Vol. 8 No. 3, pp. 306-319. Available online: https://doi.org/10.1108/IJDRBE-10-2015-0051 (2017)
35. A. Soelaksono. *Supporting the most vulnerable in owner-driven house reconstruction setting – Lessons learned from Nepal*. Blog. Available online: https://bit.ly/37pursr (2019).
36. InterAction, USAID. *The Wider Impacts of Humanitarian Shelter and Settlements Assistance*. Available from: https://www.humanitarianlibrary.org/resource/wider-impacts-humanitarian-shelter-and-settlements-assistance-key-findings-report (2019)
37. D. Sanderson. *Implementing area-based approaches (ABAs) in urban post-disaster contexts*. Environment and Urbanization. Volume 29, Sage Journals. Available online : https://doi.org/10.1177/0956247817717422 (2017)