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Socio-economic, Ecological and Institutional Impacts of Super Typhoon Reming: on a Community-based Mangrove Rehabilitation Project in Malinao, Albay, Philippines

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Abstract

Arresting the decline of mangrove forests and mainstreaming people's participation in their management provided the rationale for community-based mangrove rehabilitation in the Philippines. In the context of coastal resource management, the risk that typhoons could alter socioeconomic and institutional goals of community-based mangrove rehabilitation and the dearth of information on impacts of typhoons presents a great challenge. This paper analyzed the economic effects of a typhoon and its impact on a community-based mangrove rehabilitation project in the coastal municipality of Malinao, Albay province Philippines. Key informant interview, household and mangrove transect surveys were used in data gathering. Valuation of damaged crops and lost assets were used in quantifying direct economic effects. A time-one, time-two comparison technique was used in quantifying impacts. The results showed the direct damage on crops was highest in rice. The damage to physical assets was highest in fishing gear while damage to livestock was highest in small animals. The cost of repair was highest for concrete houses, although native houses had the highest proportion of damage. Total direct damage cost valued at PhP 24.33 million justifies public investment in disaster risk management. Per capita damage cost at PhP 12,581, equivalent to a 3-month household income shortfall, can derail early recovery. The indirect social impacts of the disasters included opportunities characterized by increased access to social services. The old mangrove forest population was slightly impacted but the reforested mangrove area was dramatically reduced. The ecological impacts showed a decline in the fish catch and reduced production of nipa palm for shingle making. The institutional performances in resource management and livelihood sustainability plans were negatively impacted. Livelihood projects with live production assets were more vulnerable and incurred heavy losses from the typhoon. In regard to overall NRM goals, the typhoon resulted in slight positive changes to stakeholders influence on mangrove resource management, control over resources, collective decision-making, and knowledge. Coping mechanisms and implications for disaster mitigation and sustainable management were discussed.

Keywords: Socioeconomic impacts of typhoon, climate change, mangrove rehabilitation. Coastal resource management

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1. Introduction

Natural hazards such as super typhoons are recurrent phenomena with devastating effects on the socio-economic development and environmental conservation programs in a disaster area. Understanding these effects is pivotal in environmental conservation studies because they can drastically alter the agro-ecological and political-economic landscape (Huigen and Jens 2006) and the short-term and long-term motivation and options of households. In November 30, 2006, one of the worst disasters in history of Albay, super typhoon Reming directly hit the province causing huge devastation to properties, infrastructure, livelihood assets, and the loss of lives. Severely impacted the environmental rehabilitation efforts in Malinao, in particular, the Community-based Mangrove Rehabilitation Project, a sub-component under the Community-based Coastal Resource Management (CBCRM) Project funded by the Department of Finance-Community-based Resource Management Project.

In the Philippines, no study has been conducted on the socioeconomic, institutional and ecological impacts of typhoons on community-based mangrove rehabilitation projects. Although the impact of a typhoon on die-offs of mangrove forests has been described elsewhere (see Finn et al, undated) similar information in the Philippines in the context of reforested mangrove area is lacking. No studies linking social and ecological resilience of mangrove communities and ecosystems in the context of CBCRM using mangrove rehabilitation as development strategy have been done.

The positive socioeconomic, institutional and ecological impacts of mangrove rehabilitation as primary intervention in CBCRM have been well documented in the Philippines (see Katon et al, 1997; Katon et al, 1998). The human factors that influence the outcome of mangrove restoration in the Philippines has also been well described elsewhere (see Walters, 1997). The rehabilitation strategies and management schemes of mangrove related projects have been evaluated in recent years (see Salmo et. al, 2007) and of late, the performance of mangrove reforestation in the Philippines extending various programs of the government have been comprehensively described and reported (see Primavera and Esteban, 2008; Samson and Rollon; 2008). In a few studies, the issues constraining the success of mangrove rehabilitation have not only been described (Primavera, 200; Walters, undated), but also the performance of various species in reforestation efforts have been evaluated (see Melana et al, 2000). The beneficial effects of rehabilitated mangrove on fisheries productivity in the country and even in Southeast Asia have been confirmed in various studies (see Pinto, 1998; Baran and Hambrey, 1998). Recent hazards literature in the Philippines focused on the socio-economic effects of Typhoons on farming households (see Huigen and Jens, 2006; Lansigan et al., 2000). Much more recently, the impact of typhoon on agricultural crops was comprehensively evaluated (see Lansigan et al, 2000). Contemporary research dealing with the vulnerability and adaptation and coping strategies of farming households regarding typhoons (see Predo, 2009; Pulhin and Lasco, 2009; Sawada, 1999;), and the impact of typhoons on coastal livelihood (see Campos, undated) contributed to the growing body of knowledge on the income and asset shocks from rapid onset hydrometeorological disaster on marginalized communities within the context of vulnerability and resiliency.

This study analyzed the direct and indirect impact of typhoon Reming on households, community livelihood, projects and ecological systems of the community-based mangrove rehabilitation project in Malinao, Albay, the direct and secondary effects of the typhoon on mangrove ecosystems, the effects of the typhoon on project sustainability plansas well as their coping strategies.

2.Materials and Methods

1) The Study Area

The municipality of Malinao, Albay province situated in the southeastern part of Luzon (Figure 1), has been a recipient of the Community-Based Resource Management Project (CB-CRMP) - a national strategy that ensures sustainable development of our mangrove forests by empowering forest-independent communities to rehabilitate, protect, and develop the country's forests and mangrove areas. The project was implemented in 2004 by the Department of Finance (DOF) and the municipality of Malinao, Albay, in collaboration with the Department of Environment and Natural

Resources (DENR), the Bureau of Fisheries and Aquatic Resources (BFAR) and non-government organizations (NGOs). The Php 6.0 million projects were designed to strengthen the local government units (LGU) and capacitate the community towards increased production simultaneous with sustainable resource utilization, protection and management.

Fig.1. Spot map of the study area

The CB-CRMP includes natural resource management (NRM) and livelihood support as major components. Under the NRM were four sub-project components such as riverbank stabilization, coastal buffer forest establishment, mangrove rehabilitation, protection and management and marine fishery reserve-sanctuary establishment and management.

The coastal buffer forest establishment using Agoho and Talisay trees covered 28.5 hectares involving four barangays of Jonop, Baybay, Balading and Bariw. The livelihood components include six projects, namely duck raising (35 beneficiaries), native chicken raising (21 beneficiaries) bangus gathering (17 beneficiaries), swine raising (three beneficiaries) commodity vending (15 beneficiaries) and weaving (61 beneficiaries).

For mangrove rehabilitation, protection and management component, a community-based mangrove rehabilitation and management project covering the five barangays of Bariw, Balading, Baybay, Balza and Jonop with 1507 households as direct beneficiaries was established. This covered 15.5 hectares for rehabilitation and enrichment and more than 126 hectares for protection and management. Three of the five barangays:Bariw; Balading; and Baybay, were involved in the mangrove rehabilitation, protection and management. There were five people's organizations (POs) organized and parties participating in the project: Bariw Mangrove Reform Association (BAMARA); Balading Environmental Protection Management Inc. (BEPMI);Baybay Fishermen and Vendors Association (BFVA);Balza CBRMP Beneficiaries Association (BCBA); and Jonop Women Weavers Association (JOWWA). Community-based mangrove sustainability plans were drafted for these POs and the LGUs to ensure the long-term sustainability of the project and achievement of CB-CRMP goals. The sustainability plan for the POs consisted of seven key result areas with a total of 17 indicators under the NRM component and six key result areas (KRAs) and seven indicators under the livelihood component. The sustainability plan for the LGU under the livelihood component consisted of five KRAs each having a single indicator, while there were seven key result areas under the NRM component.

For the POs that participated in the Community-based Mangrove Rehabilitation Project, a Certificate of Mangrove Stewardship (CMS) based on and in accordance with the Mangrove Stewardship Agreement (MSA) was awarded by the DENR. They were registered as non-stock and non-profit organizations either in the Securities and Exchange Commission (SEC) or in the Department of Labor and Employment (DOE) with the oldest being established in 1992 and the most recent in 2001. The formation of these POs was the offshoot of the community organizing and mobilizing activities of environmental non-government organizations (NGOs). The community organizing process was funded by the Ecosystems Research and Development Services (ERDS) of the DENR through the Fisheries Sector Program-Community Based Mangrove Forest Management (FSP-CBMFM). The Certificate of Mangrove Stewardship (CMS) gives them exclusive rights to reforest and/or rehabilitate, protect and manage a mangrove forestland within Barangay Bariw, Balading and Baybay, containing an area of 15.5 hectares. The unnumbered CMS given to them were enforceable for 25 years and renewable based on satisfactory performance (Malinao Project Area CBCRM Project Profile, 2001).

2) #Research Design

A damage assessment approach using cost of losses, and replacement and repair was used in quantifying direct impacts of hydro-meteorological disasters on households, modifying slightly the method prescribed in the Handbook for Estimating the Socio-economic and Environmental Effects of Disasters-Economic Commission for Latin America and the Caribbean (ECLAC) (2003).

A baseline independent technique for typhoon impact assessment was used to compare perceived social and economic conditions before the typhoon (2004-2006) and after the typhoon (2007-2010). This technique was adopted due to the absence of baseline data and the difficulty of finding a similar site with no project intervention for an analysis of "with and without project" situations. Damages to crops and effects on fishery production in mangrove were based on respondents' memory recall of changes in the parameters used. Project performance was based on user perceptions of impacts using a visual, self-anchoring, ladder-like scale which allowed ordinal judgment, placed little demand on the respondent's memory, and could be rapidly administered (Pomeroy et al. 1996).

A rapid mangrove assessment technique was used to generate post-typhoon data on key parameters of old mangrove stands and replanted mangroves after the typhoon as basis for comparing them with pre-typhoon data documented under the project technical reports.

3) Household Survey

A household survey using two sets of questionnaires was done simultaneously in June and July 2010. The first set of questions consisted of four sections namely: 1) socio-demographic information; 2) direct effects; 3) indirect effects of typhoon on households; and 4) coping mechanisms. The direct effects of typhoon on households included: agricultural production losses and estimated cost; lost production capital in agriculture and fishing and costs of replacement; livestock losses and estimated costs; damaged houses and estimated costs or repair. The indirect effects of typhoons on households included an impact on access to credit and financial systems and purpose of credit, social networks and services and emergency and relief systems. The indirect effects on mangrove ecology included that on inventory of fishing gear used and catch per unit effort gleaning and nipa gathering.

The second set of questions consisted of perceptions on impacts of typhoon on CBRM performance indicators both before and after. The performance indicators cover three general success measures of CBCRM: equity; efficiency; and sustainability. The equity performance indicators consisted of the following: a) participation in community affairs and participation in coastal resource management; b) influence over community affairs, influence over coastal resource management; c) control over resources; d) fair allocation of harvesting rights; e) satisfaction with mangrove management; f) benefits from mangrove areas; g) household well-being; and h) household income. The performance indicators under efficiency consisted of a) collective decision making, and b) quickness in resolving conflicts, while the sustainability performance indicators consisted of the following: a) overall well-being;b) compliance on mangrove rules; c) knowledge of mangroves; and d) mangrove management information exchange.

The respondents were shown a ladder-like diagram with 10 steps, where 1 represented the worst possible scenario and 10 the best possible scenario for every indicator. For example, with respect to the overall well-being of coastal resources, the respondent was informed that Step 1 indicated a situation without any fish, nipa leaves and other coastal resources, while step 10 corresponded to a situation where fish, nipa leaves and other coastal resources were abundant. The respondent was asked to indicate where the project situation was before and after the typhoon.The questionnaires were pre-tested and revised before they were administered to a total of 360 respondent households. The population sample size was determined using the Slovin sample formula (n = N / (1 + Ne^2) where n = Number of samples, N = Total population and e = Error tolerance). The respondents were selected through stratified random samples of household population in the five coastal barangays of Baybay, Balza, Jonop, Balading and Bariw.

4) Key Informant Interviews

Interview of key informants was conducted in July, 2010 using key informant guide question.

The guide questions consisted of six parts namely: 1) the perceived impact of the typhoon on NRM; 2) the perceived impact on mangroves; 3) the impact on maintenance and protection of reforested mangroves; 4) the perceived impact on livelihood; 5) the perceived impact on organizational development; and 6) socio-demographic information. The guide questions focused on the changes in key result areas and performance indicators of PO and LGU mangrove rehabilitation and resource management sustainability plans as well as profitability of alternative livelihood projects granted to beneficiaries and members of the people's organizations (POs).

A total of 30 key informants were selected which included barangay captains, two barangay council members, Sangguniang Kabataan Chairmen, three officers from existing PO's and CBO's in Bariw, Balza, Balading, Baybay and Jonop, a Municipal Agricultural Officer (MAO), two Municipal Agricultural and Fishery Technologists who once served as CBRMP workers and coordinators, a municipal social work and development officer and three mangrove protected area caretakers.

5) Mangrove Transect Survey

Three barangays, namely Barangay Bariw, Balading and Baybay, were evaluated using the Transect Line Plot Method (TLPM) as described in English et al. (1994. The coordinates of the transect sites were established using a GPS (Global Positioning System) and resource maps from the Malinao Municipal Agriculture Office. The transect length ranged from 100 to 310 m with a plot area measuring 10 x 10 m at 10 meters interval. Mangrove stands within the plots along thetransect were measured. Those that measured 12.5 cm in circumference or four cm diameter at breast height (DBH) were recorded as trees, while those that measured less than 12.5 cm but over 1 m in height were classified as saplings. The ones with a height of less than a meter were counted as seedlings.

6) Data Analysis

Economic Analysis of Direct and Indirect Damages of Typhoon

Qualitative and quantitative analysis were used for data generated from the household survey and key informant interview. The direct damage of typhoon on agricultural crops, livestock loss and damage houses was calculated following Huigen and Jens (2006).Agricultural crop loss is the difference between the amount of crop harvested during a normal cropping cycle and the amount harvested after the typhoon. These included damages for rice, root crops, and orchard trees.

The lost income for root crops was computed as = (normal harvest * normal price - normal harvest * transport cost per unit) - (typhoon harvest * normal price - typhoon harvest * transport cost per unit).

The lost income for rice was computed as:= (normal harvest - typhoon harvest) * price

The lost income for orchard trees was computed as: = 12 * (normal harvest month * price - normal harvest * transport costs per unit) - (typhoon harvest * price - typhoon harvest * transport costs per unit).

The average land size or number of trees per household and average damage (crop loss) per farm size was calculated for each crop.Livestock losses were calculatedas the costs of animals that died or were lost during the typhoon. These included small and large animals. Damaged or lost physical assets were productive assets used in farming, fishing and other economic activities of the household. The cost of the damage to property was calculated from the cost of house repair or replacement.

The lost or dead livestock and lost or damaged productive physical assets in each respondent household after the typhoon was determined as a percentage of lost or damaged livestock and productive physical assets before the typhoon. This was then multiplied by the total sample size to estimate the number of respondent households that incurred losses or damages in the sample. The total number of households that incurred lost or died livestock and lost or damaged productive physical assets in the project area was estimated by multiplying the number of respondent households that incurred losses or damages in the sample by the total number of household population .

The direct cost for each category was calculated by multiplying the mean damage or replacement costs by the estimated total number of household that incurred lost or died livestock and lost or damaged productive physical assets in the project area. These were computed for the following four main categories of direct economic damages: damages for crops, lost/damaged productive physical assets, livestock loss, and damaged houses. The per capita cost was estimated by dividing the total direct cost in each category by the total number of households in the project area that incurred such losses and damages.

Time-One, Time-Two Comparison Analysis

A time one-time two (normal situation before typhoon-situation after typhoon) analysis was done on quantitative data to determine effects and impacts. The indirect effects of typhoons on access to social networks, services and credit were seen as number of changes observed calculated from the differences between pre and post typhoon data:

% Change = proportion of response to total no. of respondents in T^2 - proportion of response to total no. of respondents in T^1

% Change = (mean value in T^2- Mean value in T^1 / mean value in T^1) x 100

Where, T^1=before typhoon

T^2=after typhoon

The impact of the typhoon on the mangrove rehabilitation project was calculated from the differences in the targets set forth in the sustainability plan before the typhoon, and the outputs after the typhoon. The impact on the expected deliverables was analyzed within the context of the CB-CRM performance indicators.

Secondary impact on mangrove ecological resource productivity was calculated as the difference between the amount of products harvested from mangroves during normal times and the amount harvested after the typhoon. These included fishes, invertebrates, and nipa shingles harvested per household per month.

The effect of typhoons on mangrove ecology was based on the changes in the mean diameter and mean number of stems of the old mangrove stands. This was given by the following: % change in growth parameters = (mean value of growth para-

T^1 / mean value in T^1) x 100

Where: Growth parameters= mean diameter at breast height, number of stems

T1=before typhoon T2=after typhoon

The effect on rehabilitated mangroves was based from the changes in the number of reforested mangroves before and after the typhoon. In the absence of pre-typhoon information on the density of reforested mangroves, a number of propagates planted a number of stems of the reforested mangrove to serve as benchmark data in the impact evaluation, and the 2004 CBRMP Accomplishment Report was used for extrapolation. The report documented an estimated 4,680 pieces of Rhizopora species planted in Bariw and 2,437 pieces planted in Balading. The occurrence of Typhoon Dindo in 2005 significantly damaged the propagules planted in the flood prone areas of Balading and Bariw and left an average survival rate of 61.8 percent of the reforested mangrove in the affected areas. These translated to a remaining 2, 892 pieces per hectare in Bariw, and 1,506 pieces per hectare in Balading. These were then used as pre-typhoon benchmark data on the number of reforested mangroves in the analysis. The following calculations were used:

Number of reforested mangrove in T1= (Total Remaining replanted mangrove after Typhoon Dindo in 2005/3) x (% survival)

% Change in reforested mangrove = (number of reforested mangrove in T2- number of reforested mangrove in T1 / number of reforested mangrove in T1) x 100

Where:T1= number of reforested mangrove before typhoon Reming

T2 = number of reforested mangrove after typhoon

Total Remaining replanted mangrove after Typhoon Dindo in 2005 = 4,680 pcs (Bariw), 9,750 pcs (Balading) 0 pc (Baybay)

% Survival = 61.8

The effect of typhoons on livelihood was calculated as the difference between the pre and post typhoon economic performance of the IGPs. Economic performance was evaluated using benefit-cost analysis.

The impact of typhoons on outcomes of CBCRM was determined from the differences in the mean values of the respondents' perception between the pre-calamity and the post calamity periods. The significance of the differences was calculated using the paired comparison t-test.

3. Result and discussion

Direct Effects of Typhoon on Households

Average Lost Income from Damaged Crops On a household basis, the average lost income from rice was PhP 444 which is equal to the average income in a 0.71 hectare production area. A reduction of 1.09 sacks of rice on the average was noted after the typhoon. For coconuts, an average income lost per crop was estimated at PhP 250 per household. An average of 50 pieces of coconuts was reduced after the typhoon (Table 1).

Fruit trees posted the highest average income lost, estimated at PhP 16,752 per farming household due to temporary stoppage of fruiting of fruit trees. Root crops posted the next highest income lost from the typhoon, estimated at a mean value of PhP 1,760 per household and PhP 5,987 from vegetables with banana posting the lowest at PhP 180 per farming household.

Table 1. Average normal harvest, typhoon harvest and average lost income from rice and coconut crops per household.

Commodity	Normal Harvest	Typhoon Harvest	Difference	Price	Ave. Lost Income/HH (PhP)
Rice (sacks) (0.71 has)	40.38	39.29	1.09	407.16	444.00
Coconut	200	150	50	5.00	250.00

It should be noted, however, that due to the small proportion of households that grow them in the study area coupled withdiscarded questionnaires with incomplete information from relevant respondents thus left very few utilizable samples for analysis (Table 2), these findings may not be so robust owing to the statistically smaller number of respondent samples.

Table 2. Normal harvest, typhoon harvest and average lost income from vegetables, root crops, orchard and banana crops per households.

Commodity	Normal Harvest				Typhoon Harvest				Ave.
	Ave. Harvest	Price	Transport Cost	Total	Ave. Harvest	Price	Transport Cost	Total	Lost Income/ HH (PhP)
Vegetables (kilos)	17.33	18	24	7,487	3	25	20	1,500	5,987
Root crops (sacks)	22	85	-	1,870	1	110	-	110	1,760
Fruit trees (kilos)	22.06	67.5	11.25	16,752	-	-	-	-	16,752
Banana	15	12	-	180	-	-	-	-	180

Cost of Replacement/ Repair of Lost Assets and Damaged Houses

In terms of loss or replacement cost of physical assets, motorized banca posted an average of PhP 2,544 per household, followed by non-motorized banca with an average cost of PhP 2000 per household. Damages toother physical assets such as fishing gears, plows, tricycles and padyak ranged from PhP 700 to PhP 1,800 per household. For livestock, the highest damage was noted in pigs with an average of 2.5 heads estimated at PhP 9,000per household, followed by carabaos with an average PhP 7,500 per household. The average household incurred a loss of 7.9 heads of chicken pegged at PhP 860, while for ducks; each reporting household incurred 4.9 heads valued at PhP 424. The average cost of repair for damaged native houses was estimated at PhP 8,420. The highest cost for repairs was posted among concrete houses with each household incurring an average repair cost of PhP 19,542. Intermediate between these values is the cost of repair for semi-concrete houses at PhP 13,572 (Table 3).

Table 3. Mean numbers of lost assets and mean cost of lost physical assets and livestock and cost of repair of houses per household.

	Mean No. Lost/HH	Mean Cost of Lost Asset/HH (PhP)
Physical Assets		
Motorized Banca		2,544.00
Fishing gears		821.00
Non -motorized Banca		2,000.00
Plow		700.00
Tricycle		1,084.00
Padyak		1800.00
~~Livestock~~		
Chicken	7.9	860.00
Carabao		7,500.00
Pigs	2.6	9,000.00
Ducks	4.9	424.00
Type of House		
Native		8,410.00
Concrete		19,542.00
Semi-concrete		13,572.00

Total Cost, Proportion by Sector and Per Capita Cost of Direct Damage from Typhoon Reming in Malinao

The aggregated cost of direct damage to crops was the highest in rice (PhP 150,000), followed by fruit trees (PhP 800,000). In terms of productive assets, the highest was noted in non-motorized banca (PhP 170,000); in livestock's, from chickens (PhP 310,000) with the lowest in carabao (PhP 7000). For repair of houses, the highest cost was noted for semi-concrete dwelling structures valued at PhP 13.5 million (Table 4).

The total cost of the direct damages from Typhoon Reming in the project area was estimated at PhP 24.33 million. Among the sectors, the economic cost of repairing or replacing damaged dwellings posted the highest proportion, comprising 92 percent. The cost of damages from agricultural crops comprised five %, followed by livestock with three percent. The cost of replacing lost physical assets comprised a measly one percent. On a per capita basis, each household on the average incurred a total direct damage cost of PhP 12,581. Of this, the per capita repair cost for house replacement or repair was PhP 11,540, while for agriculture and livestock, the per capita costs were PhP 569 and PhP 339, respectively.

Table 4. Total Cost of direct damages in crops, lost livestock and physical assets and house repair.

Commodity	No. of HH Respondents	% To Total (n=355)	Estimated No. of HH for Malinao Project Area (N=1934)	Ave. cost of damaged crop /HH	Total Cost of Damaged Crops for Malinao Project Area
Rice (0.71 has)	62	17.46	338	444	149,903
Coconut	1	0.28	5	250	1,362
Vegetables (1 ha)	3	0.85	16	5,987	97,850
Root crops	3	0.85	16	1,760	28,765
Fruit trees	9	2.54	49	16,752	821,358
Banana	1	0.28	5	180	981
Total					1,100,218
Physical Assets					
Banca	14	3.45	67	2,544	169,765
Fishing gears	3	0.28	5	821	4,475
Motorized Banca	2	0.56	11	2,000	21,792
Plow	3	0.85	16	700.00	11,441
Tricycle	9	0.99	19	1,084	20,788
Padyak	3	0.85	16	1800	29,419
Total					257,679
Livestock					
Chicken	76	18.70	362	860	310,928
Carabao	1	0.05	1	7500	6,810
Pigs	5	0.32	6	9000	55,717
Ducks	13	2.98	58	424	24,377
Total					655,512
House					
Native	92	24	457	8,410	3,839,483
Concrete	52	14	263	19,542	5,140,536
Semi-concrete	189	51	983	13,572	13,338,840
Total					22,318,858

The per capita cost for physical assets is PhP 133 (Table 5).

Table 5. Total and per capita costs of direct damages from typhoon on the Malinao project area.

Assets	Estimated Total Cost (PhP)	%	Per capita cost (PhP) (1,934 HH)
Damaged Agriculture Crops	1,100,218	5	569
Lost/Damaged Physical Assets	257,679	1	133
Lost/Damaged Livestock	655,512	3	339
Damaged Houses	22,318,858	92	11,540
Grand Total	24,332,268	100	12,581

Indirect Effects of Typhoon on Household

Changes in Access to Social Networks and Services

The number of households with access to social services increased by one fourth (26%) after the typhoon. Of those social networks that were accessed, a slight increase was noticed in the proportion of households accessing government institutions, with the national government relatively higher (2.8%), followed by the barangay government (1.53%). Very slight changes were noted in the proportion of households accessing services from the church, NGOs and foundations which used to provide social services in CBCRM project sites before the typhoon. The project termination antedated the occurrence of the typhoon, and this indicated that the national and barangay government became more accessible to the respondentsand assumed a more dominant role than the NGO's following the typhoon. Consistently, relief assistance increased by 31 percent, while house rehabilitation increased by 3 percent.There were almost no changes in organizational support, production promotion, recreation and coastal resource management (CRM) after the typhoon. The 25 percent decrease in the proportion of respondents accessing health services could be explained by the shift of institutional focus from emergency response to disaster management, relief and rehabilitation in the post typhoon scenario.

There was an increase in the proportion of households that had access to credit and financial systems after the typhoon, though the increase was relatively lower at 13%. A less than 10 percent increase was observed in the number of households availing loans for repair of houses (6.94%), followed by repair of assets (2.06%).A very slight decline in the proportion of households availing credit for the purpose of starting or improving a livelihood, for medical needs, education and farm inputswas observed after the typhoon. This indicated that the typhoon resulted ina slight increase in the demand and access for repair of abodes and livelihood assets but had almost no effect on other purposes related with the more basic needs of the respondents (Table 6).

Table 6. Changes in proportion of households that have access to social services, social networks accessed and type of social services accessed before and after the typhoon.

	Before Typhoon		After Typhoon		% Change
	No. of response	%	No. of response	%	Increase (Decrease)
Access to Social Services					
With Access	165	55.37	284	81.84	26
Without Access	133	44.63	63	18.16	(26)
	298		347		
Social networks Accessed					
Church	60	18.46	99	16.36	(2.1)
GO national	21	6.46	56	9.26	2.8
GO municipal	114	35.08	215	35.54	0.46
GO barangay	117	36.00	227	37.52	1.52
NGO	8	2.46	4	0.66	(1.8)
PO	2	0.62	3	0.50	(0.12)
Foundation	3	0.92	1	0.17	(0.75)
	325		605		
Access to Credit					
With Access	162	45	206	58	13
Without	195	55	170	48	(7)
Total	357		376		
Availed credit	40	27	43	30	3
Not Availed credit	109	73	101	70	(3)
Total	149		144		

Direct Effects of Typhoon on Mangrove Ecology

Changes in Population and Average Girth of Old Mangrove Forest

The gains in mangrove conservation and management efforts initiated by the CBRMP in 2004 were evident in the increased number of existing old mangrove stands even after the calamity. Comparing data generated from this study with that taken in the pre-typhoon period showed an increase in the population of key mangrove species, R. apiculata, S. alba and A. marina. Presumably, the abundant regeneration of these mangrove species documented in a 2004 study (Malinao LGU, 2004) explained why the old mangrove forest did not manifest a negative population in the pre and post (2010) typhoon data. Among the species, Nipa fruticans understandably manifested a reduction in number of stems per hectare after the typhoon, because it is commonly used as cheap source of roofing materials for the damaged houses of poor coastal dwellers. The increase in girth of selected old mangrove species as a natural consequence arising from their development was still evident even immediately after the typhoon (Table 7).

Table 7. Changes in number of stems per hectare of old mangrove forest species.

Parameters /Mangrove Species	Before Typhoon 2004	After Typhoon 2010)	% Change
No. of stems			
*R. apiculata**	68	563	728
*S. alba****	1,095	3,778	245
*A. marina***	74	1,117	1,409
N.fruticans	84,720	1,3516	(84)
Average Diameter at Breast height			
R .apiculata (cm)	5.33	6.35	19
S. alba (cm)	3.69	8.04	118
A. marina (cm)	5.97	7.71	29

***With recorded average 34 regenerations in 2004**
**** With recorded average 106 regeneration in 2004**
*****With recorded average regeneration 368 in 2004**

Changes in Population and Girth of Reforested Mangrove Trees

Changes in the number of pieces and girth of reforested mangrove tree species are presented in Table 8.An estimated 1, 520 pieces of reforested mangroves were accounted for during the survey for Bariwafter the reforested mangroves in Baybay and Balading were wiped out due to the inundation of silts, and strong wave action. Comparing post-typhoon data with the pre-typhoon data extrapolated from project reports, a 47.44 percent reduction in the population of the reforested mangrove was calculated. The agronomic characteristics of surviving reforested mangroves were mean diameter of 0.69 cm (lower part) and 2.50 cm (upper part) and a mean height of more than a meter. This suggests that the remnants of the reforested mangrove that survived from the previous stresses, among them the mortalities inflicted by Typhoon Dindo, by unruly fishermen and by fishing gears had been devastated by almost one half by Typhoon Reming, although those from Bariw stated that reforested Rhizopora species planted in 2004 by the BAMARA were abundant in the area but oftentimes confused with the population of regenerations from the old mangrove stands.

Table 8. Changes in population and current agronomic parameters of reforested mangrove before and after typhoon.

	Before Typhoon	After Typhoon	% Change Increase (Decrease)
	2004 (Derived through extrapolation)	2010 This survey	2010 This survey
No. of stems /hectare	2,892	1,520	(47.44)
Mean Diameter (cm)		0.69 (upper part) 2.50 (lower part)	
Mean Height (cm)		109.64	

Secondary Effects of Typhoon on Mangrove Ecology

The changes in mangrove ecological resource productivity are presented in Table 9. A slight decline in the mangrove fishery productivity was reflected in catch per unit efforts (CPUE) with most of the common fishing gear used. Among the fishing gear, gill nets had the highest (39%) manifested decline followed by handline (28%). The decline in fish pots catch was presumably 100 percent but could be conclusively accounted for due to lack of post-typhoon data as the most of the gear was lost during the typhoon. Production of invertebrates gleaning and Nipa-shingle making also suffered losses. Gleaning posted a discrepancy of 33 percent from pre-typhoon invertebrate production composed of shrimps, mud crabs and small sea cucumbers. Nipa shingle-making registered a four percent loss from previous nipa leaves production.

Table 9. Changes in mangrove ecological resources.

Resources	Before Typhoon Production/day	After Typhoon Production/day	% Change in CPUE Increase (Decrease)
Fish production (gear fishery, kg)			
Gill nets	2.26 (19)*	1.38 (12)*	(39)
Handline	1.06 (24)	0.76 (19)	(28)
Pots	1.18 (24)	0.3 (24)	
Invertebrate production (gleaning, kg)	1.6**	1.33**	(17)
Nypa production (Nipa shingle-making, pcs)	56.52***	54***	(4)

* *Values in parenthesis are in catch per unit effort (CPUE), * *kg per operation*

Production losses from fishing in this analysis could not be attributed to the direct impact of typhoons on ecosystem per se; rather, the decline in fish yield on a household basis was more likely credited to the destruction and decrease of fishing gear which temporarily reduced fishing efficiency. It is not also clear whether the reduced average yield or reduction in leave production in nipa after the typhoon was more likely due to high local demand for roofing materials that increased the number of gatherers, or the destruction of nipa leaves from typhoon.

Effects of Typhoon on Project Sustainability Plans

Changes on NRM and Livelihood Components of PO Sustainability Plan

There were seven key result areas with a total of
the typhoon was more likely due to high local demand for roofing materials that increased the number of gatherers, or the destruction of nipa leaves from typhoon.

Effects of Typhoon on Project Sustainability Plans

Changes on NRM and Livelihood Components of PO Sustainability Plan

There were seven key result areas with a total of
17 indicators under the NRM component of the mangrove sustainability plan of the POs. Of these, five key result areas (KRA) and 11 indicators were considered for analysis. On the other hand, there were six KRA's and seven indicators under the livelihood component of the PO sustainability plan. Of these, four KRA's and four indicators were considered for analysis as presented in Table 10.

In the NRM component, most of the indicators under the KRAs on maintenance of NRM and continuous IEC increased after the typhoon, while the indicators under the KRA on Involvement of Community in Environmental Activities posted decreases. The KRA indicators under Provision of Ordinance for the protection of established NRM were ambiguous. On the other hand, there was no change in the indicator considered under KRA on regular monitoring and evaluation.

The increases in performance indicators under KRAs on maintenance of NRM and continuous IEC were a natural rehabilitative effort after an environmental calamity. Findings from KI showed that the replanting activities after the typhoon were conducted by NGOs in the province driven by the vigorous campaign for climate change adaptation by the provincial government of Albay.

The negative change incurred in most of the indicators considered under the KRA on Involvement of Community in Environmental Activities suggest that collective involvement and participation of members in community-based NRM activities was disproportionately impacted by typhoons. The decrease could be attributed to the members' preoccupation with both economic and physical restor-ative activities in their households.

The ambiguity of the indicators for the KRAs under Provision of Ordinance for the Protection of Established NRM characterized by declining participation of members in activities related to the KRA as well as in the conduct of organizational meetings can be explained by the PO officers' and members preoccupation with restorative efforts in their own households and in the NRM project.

In the Livelihood Component, except for the KRA on Regular Monitoring and Periodic Financial Statement, all of the KRAs posted a negative change after the typhoon. These KRAs and indicators were the following: the number of coordinated activities with LGU/line agencies done by PO per year (24%) under the KRA on close coordination with LGU/Line agencies; the number of benefici-aries that faltered in loan repayment (41%) under the KRA on Strict Imposition of Repayment Schedule; and the number of regular meetings and dialogues conducted (44%) under the Regular Meeting and Dialogue. These suggest that comm-unication and the capacity of the beneficiaries to pay livelihood loans suffered after the typhoon. The dominance of negative changes among the KRAs indicated the relative vulnerability of livel-ihood components of community-based mangrove rehabilitation projects to extreme events such as typhoons. Indicators that manifested constant performance and remained by the calamity were related to procedural rules in financial bookkeeping of livelihood funds and activities.

Table 10. Changes on KRA indicators on NRM and Livelihood Component of Project Sustainability Plan, PO Level.

KRA Indicators	Before Typhoon	After Typhoon	% Change Increase (Decrease)
NRM KRA			
Maintenance and protection of NRM			
No. of replanting activities	2,833	4,789	69
No. of propagules produced in nursery	1,250	2,125	70
No. of patrols conducted per month	21	23	8
Involvement of Community in Environmental Activities			
No. of community environment activities conducted/ month	2	1	(67)
No. of PO members that participated in environmental activities	46	40	(14)
No. of management committee meetings done per year	5	4	(14)
Continuous IEC in the community			
No. of IEC activities conducted per month	6	7	25
Provision of Ordinance for Protection of Established NRM			
No. of ordinances for the protection of environment enacted per year	2	2	0
No. of members participation in planning	33	29	(15)
No. of meetings conducted by PO officers	28	29	6
Regular Monitoring and Evaluation			
No. of monitoring and evaluation conducted per month	2	2	0
Livelihood KRA			
Close coordination with LGU/Line agencies			
No. of coordinat ed activities with LGU/line agencies done by PO per year	1.22	0.93	(24)
Strict imposition of repayment schedule			
No. of beneficiaries with regular loan repayment	9	5	(41)
Regular Monitoring and Periodic Evaluation of Financial Statement			
No. of monitoring activities on financial statements of livelihood projects	5.83	7.31	25.40
Regular Meeting and Dialogue			
No. of regular meetings and dialogues conducted per month	1.53	1	(43.60)
No. of beneficiaries with regular loan repayment	9	5	(41)

Changes in LGU Sustainability Plan

There were seven Key Result Areas (KRAs) under the NRM component of the LGU Mangrove Rehabilitation Project Sustainability Plan, each having an indicator. Of these, only five were considered in the analysis. On the other hand, there were five KRAs under the livelihood component of the LGU Mangrove Rehabilitation Project Sustainability Plan, each KRA having a single indicator. Of these, only four were considered for analysis. The changes in these KRAs are presented in Table 11.

Table 11. Changes in KRA indicators on NRM and Livelihood Component of Project Sustainability Plan, LGU Level.

KRA Indicators	Before Typhoon	After Typhoon	% Change
NRM KRA			
Continuous Technical Assistance of Line Agencies (DA,DENR, BFAR)			
☐ Number of technical assistance received by LGU	2-3	2-3	0
Pro vision of legislative support to NRM			
☐ Number of resolutions/ordinances/policies enacted by the LGU for the project	6-8	6-8	0
Provision of NRM protection and maintenance activities			
☐ Number of maintenance activities conducted by LGU	3	3	0
Provision of social and environmental and safeguards			
☐ No. of social and environmental safeguards	3	3	0
Regular Monitoring and Evaluation			
☐ Number of monitoring and evaluation conducted per month	1	1	0
Livelihood KRA			
Provision of 10% retention of from livelihood fund and forced saving			
☐ Amount saved from 10% retention livelihood fund and mandatory PO service force savings	17,143	8,548	(50)
Provision of technical assistance from line agencies			
☐ Number of technical assistance extended by line agencies per year	3	3	0
Close coordination of PO to LGU livelihood specialists			
☐ Number of coordination of PO to LGU livelihood specialist	5	5	0
Fund sourcing and accessing to lending institution			
☐ Number of instances of fund sourcing and accessing to lending institutions	2	3	50

All of the KRA indicators under the NRM component did not post any change after the pre- and post- typhoon scenario indicating the LGU NRM Plan's resiliency. The same was almost true with KRAs for the livelihood component except for the KRA on provision of 10% retention from the livelihood fund and forced saving from PO which suffered a 50 percent reduction. The setback on the achievement of retention of 10% of funds from livelihood project beneficiaries was credited to the heavy damage inflicted by the typhoon on the livelihood assets which prevented them from remitting the forced savings. The KRA on 'Fund Sourcing and Accessing to Lending Institution' increased by 50 percent after the typhoon The financial assistance for calamity stricken communities by both government agencies and non-government entities provided opportunities for the LGU to access available funds for rehabilitation purposes thereby posting a 50 percent accomplishment from its target. These results indicated that the availability of funds contributed by beneficiaries to sustain the livelihood project was constrained by the extreme event, while such an event was also be used as an opportunity to resuscitate bad loans and lost financial capital through calamity assistance from well-meaning institutions.

Changes in Revenue, Operating Expenses and Net Income of CBRM Livelihood Projects

All livelihood activities established under the Mangrove Rehabilitation Project sub-component; both agricultural production and fishery resource-based activities posted drastic reduction in production assets, revenues and net income after the t yphoon (Table 12).

The native chicken-raising and swine production livelihood projects which were unprofitable even before the typhoons were rendered completely un-operational and bankrupt due to mortality and absolute loss of production assets after the typhoon. Bangus production, although not suffering profit loss after the typhoon, has completely stopped operation. The relatively resilient ducks as production assets also suffered heavy casualties resulting in a lower income than its pre-typhoon records. The industry oriented livelihood project connected with weaving posted positive profits even after the typhoon. The positive performance of this project can be attributed to their flexibility and absence of risks from mortality of production assets.

Impact of Typhoon on Community - based Mangrove Rehabilitation and Coastal Resource Management Project Outcomes

Results showed that beneficiaries respondents perceived positive and statistically significant changes in four performance indicators of CBCRMP due to the effect of the typhoon ($p<0.01$), using a paired comparison t-test. Very minimal positive changes were perceived in influence over NRM, and control over resources under equity; collective decision-making under efficiency; and knowledge on mangroves after the typhoon (Table 13). The typhoon altered the normal trajectory of the expected outcomes in the CBCRMP, resulting in minimal gains in the achievement of CBCRMP goals. The lack of statistically significant improvement in the overall well-being of the households and mangrove resources could be explained by the fact that the socioeconomic and ecological impacts of a rapid onset natural hazard like a typhoon is relatively short on a "meso-scale" basis in creating a huge impact on both socioeconomic and ecological goals which takes a longer gestation period, at the

Table 12. Changes in revenue, operating expenses and profit of CBRM livelihood projects before and after the typhoon.

Livelihood Project	Before Typhoon	After Typhoon
Duck Raising		
No. of heads	334	33
Revenue per cropping	1,583	250
Operating Expenses per cropping	5,000	833
Net Income	(3,417)	(583)
ROI	(0.68)	(0.70)
Native Chicken-Raising		
No. of heads	37	1
Revenue per cropping	1,883	-
Operating Cost per cropping	2,917	-
Net Income	(1,033)	-
ROI	(0.35)	-
Bangus gathering		
Average catch/operation	50,000	0
Revenue per operation	2,500	
Operating Cost per operation	50	
Net Income	2,450	
ROI	49.00	
Swine Raising		
No. of heads	8	0
Revenue per cropping	3,500	-
Operating Cost per cropping	5,000	-
Net Income	(1,500)	-
ROI	(0.30)	
Weaving		
Average production per operation	468	498
Revenue per operation	1,833	1,958
Operating Cost per Operation	442	450
Net Income	1,392	1,508
ROI	3.15	3.35

very least, 14 years in community-based coastal resource management projects. The very small impact value generated in this study at less than one in a scale of one to 10 supports this observation.

Coping Strategies of Households

Household Coping Strategies

During the typhoon, most of the respondents assisted in the evacuation (34%). This coping mechanism was followed by sharing of foods to house evacuees (19%) and participating in the rescue and collective efforts in the barangay (18%).

Table 13. Perceived changes in outcome indicators of CBCRM by respondent beneficiaries: before the typhoon (2004) and now (2010).

CBCRM Performance Indicators	After Typhoon	Before Typhoon			
	T_2	T_1	T_1-T_2	t-value	p
Equity					
A. Participation in resource management	4.46	3.91	0.55	0.906	>0.01
B. Influence over NRM	4.66	3.98	0.67	0.007	<0.01
C. Control over resources	4.72	4.11	0.61	0.001	<0.01
D. Fair allocation of harvesting rights	4.39	4.06	0.34	0.541	>0.01
E. Satisfaction with mangrove management	4.59	4.22	0.40	0.026	>0.01
F. Benefits from mangrove areas	4.34	3.94	0.40	0.296	>0.01
G. Household well-being	4.40	4.15	0.25	0.837	>0.01
H. Household Income	4.32	4.01	0.32	0.382	>0.01
Efficiency					
A. Collective decision-making	4.49	4.08	0.40	0.011	<0.05
B. Quickness of resolving conflicts	4.59	4.22	0.37	0.153	>0.01
Sustainability					
A. Overall well-being of mangrove resources	4.98	4.57	0.41	0.146	>0.01
B. Compliance-mangrove rules	4.95	4.39	0.56	0.056	>0.01
C. Knowledge of mangroves	4.79	4.22	0.57	0.004	<0.01
D. Information exchange: Mangrove management	4.735	4.176	0.56	0.018	>0.01

After the typhoon, the most common coping mechanism (Table 14) among households was emergency borrowing (33%) and reduction of food consumption (28%). The dominant form of emergency borrowing was to lend from sari-sari stores (24%), borrow from relatives (20%) and lend money (17%). Only a few went to banks (7%) and pawnshops (5%). Almost one half (46%) chose reduction in rice intake as a strategy to reduce food consumption.

Switching to one's own produce and reducing child schooling were other relevant forms of coping mechanisms of the households in project sites and adopted by 14 percent and six percent of the respondents respectively.

The agri-based livelihood projects that lost productive capital such as ducks,and native chicken and swine raising, coped by shifting to alternative livelihood projects such as vegetable farming, while those industry-oriented livelihood projects that experienced production decline and typhoon-induced market constraints sought assistance from NGOs and government agencies such as the DTI and DA for production and marketing support

4. Conclusion and policy recommendations

The total direct cost of damages to crops, livestock and properties was estimated at more than PhP 24 million. The huge amount of losses justifies public higher investments for disaster risk, reduction and management (DRRM) as well as for generating environmentally sustainable technologies in AFNR for LGU's to achieve social and ecological resiliency against typhoon-induced impacts.

The per capita cost of the direct effect of the typhoon was estimated at PhP12,581 per household which was equivalent to two months lost income for an average household making them 'two months poorer' than before. This suggested that relief assistance and support should cover at least two months at the minimum to offset the impact and prevent people from sinking into deeper poverty. The cost of the immediate and direct impact of the typhoon was highest in damage to house dwellings, exceeding damage to crops and livelihood, and reflective of the strength and the fury of Typhoon Reming compared with other typhoons. The magnitude of economic losses in mangrove fisheries is a priori expectation in calculating direct impacts from rapid-onset hazards like typhoon. Comparatively, the cost of damages to agriculture and mangrove fisheries was slow and unseen, but in the late phase of post typhoon events the secondary and indirect impacts of the typhoon were difficult to quantify.

Table 14. Coping strategies of households after the typhoon.

Coping Mechanisms	No of response	%	No. of response	%
During Typhoon				
Stay inside house and evacuation centers			16	7.02
Share house/Accept evacuees			16	7.02
Assist in evacuation			79	34.65
Share food			45	19.74
Give information and warning			1	0.44
Evacuate Family			7	3.07
Pray			2	0.88
Fix house			10	4.39
Enlist in Disaster Mgt Council			10	4.39
Participate in rescue and collective efforts in the Barangay			42	18.42
Total			228	100
After Typhoon				
Reduce Food Consumption			250	27.8
Rice	115	46		
Protein	77	31		
Food taken outside	58	23		
	250	100		
Switch to own produce			124	13.8
Reduce Child schooling			54	6.0
Reduce Medical Expenses			48	5.3
Sale of valuable Items			25	2.8
Emergency Borrowing			302	33.6
Friend	32	10.60		
Bank	22	7.28		
Relatives	61	20.20		
Neighbors	48	15.89		
Money Lenders	52	17.22		
Pawnshop	17	5.63		
Sari-sari store	70	23.18		
	302	100		
Emigration			7	0.8
Aid from GO/NGO			27	3.0
Seek Non-Farm Employment			42	4.7

Tall growing agricultural crop swere more vulnerable to the typhoon resulting to higher yield reduction from fruit trees and bananas due to wind stress. Higher mortalities for smaller livestock animal ssuch as chickens and pigs than large animals were noted during the typhoon. A similar observation was reported by Huigen and Jens (2006) on the impact of Typhoon Harurot in Isabela where more small animals were lost or killed than large animals. The number of lost physical assets was highest for sustenance fishers, considered as the poorest of the sectors. This demonstrated that the main assets of the poor are more likely to be affected during extreme hydro-meteorological events.

The slight increases in access to, social networks, relief and rehabilitation services and credit by households were "windows of opportunities" brought by the calamity. These positive changes in the social services landscape that thrived under the spirit of volunteerism and humanitarian relief works provided "safety nets" to cushion the adverse impact of the economic shock. However, these sources of financial relief were merely ad hoc government assistance and emergency aid during disaster events. The inability to raise formal loans among households is attributable to lack of collateral and assets lost during the event, restrained the most affected people from accessing credit services (Badject, et al, 2010).The disadvantageous financial terms commonly associated with informal sources of credits commonly accessed by the poor and capital-deficient households undermined the 'cushioning effect' of these safety nets in the long term.

The negligible impact of the typhoon on the density of old mangrove stands reflected its resiliency to short-term perturbation. The fast recovery of the old mangroves in terms of the number of added tree stems could be directly credited to the mangrove rehabilitation and protection efforts.

The high colonization and regeneration rate in old mangrove trees patched up those that were felled by typhoon and offset the mortality in four years after Reming's devastation of 2006. This was in accord with Bosire et al (2003) who observed that bare sites within the mangal did not have re-colonization, except in reforested and natural stands with tree cover. According to Ellison (1994) mangrove reforestation facilitated natural colonization of sites, most likely by altering local hydrodynamics and other physico-chemical factors. The aerial roots of established trees helped in breaking waves, slowing tidal currents and trapping floating mangrove propagules.

Reforested mangrove areas, however, appeared vulnerable and less able to recuperate from the stress. The massive mortality of the replanted mangrove trees in Malinao resulted from the cumulative impacts of several stressors in the past that culminated in its almost complete decimation by Typhoon Reming. Although the typhoon could have been the key stressor that caused the massive deaths, it was difficult to pinpoint the single cause or the sequence of multiple causes in cumulative effects. According to Finn et al, (undated) the death of the mangrove trees from a series of stressors follows a spiral that leads from healthy saplings to death. Firstly, in the initial years of the reforestation, only an average of 65 to 58 percent of the saplings survived. One of the causes of these low survival rate was the planting density adopted. Secondly, the surviving trees were further reduced by human and natural stressors before the typhoon. Two die-off types were directly attributed by the key informants to boating and improved access. Boating activity knocked down saplings in different directions while access die-off waste deliberate removal of saplings by fishers for blocking their fishing gear. Thirdly, the impact of Typhoon Dindo in 2005 diminished the shrinking population of replanted mangroves by more than one half. Ultimately, the final stressors that provided lethal damage was Typhoon Reming, leaving less than 50 percent of surviving stands of reforested mangrove. Be that as it may, the current performance of mangrove rehabilitation in Malinao is comparable with most of the mangrove rehabilitation projects in the Philippines with survival rates generally low at 10-20% (Primavera and Esteban, 2008)). Sans the Typhoon Reming induced mortality in the calculation, the mangrove rehabilitation in Malinao fared comparatively better off than the national average and is comparable with the performance of most CBMRP-based rehabilitation as reported by Primavera and Esteban (2008) between 20-98 percent, and an average of 35.2 percent.

The secondary effects of the typhoon on mangrove ecological resource productivity reflected its impact on the asset base of the poor, particularly the mangrove resource dependent livelihood in Malinao which led to the temporary decline of fish population in mangroves as indicated by reduced fish catch from gill nets and hand lines. Similar observation was reported by Pinto (1988)that a typhoon changes the community structure of fish population in the mangrove ecosystem for a short time and then returns to the earlier pattern. The mortality in aquatic fauna is usually caused by flood-induced siltation which hampers the fauna's he ability to carry out sufficient gaseous exchange, and leads to problems in ionic regulation, toxic chemicals, lack of food and predation (Choy and Booth, 1994). Mangrove associations are adapted to events of natural mortality, and recovery after disturbances in mangrove areas is faster (Upadhyay and Mishra, 2008). Higher incidence of destruction of livelihood assets such as fishing boat owing to direct exposure to typhoon, limits fishermen's ability to fish offshore. As such, a shift of fishing pressure from offshore fishing grounds to the mangrove area puts more pressure on the already weakened productivity resulting ina decline in catch rates.

The direct effect of the typhoon on the CBCRM livelihood project demonstrated that the production capitals of agri-based livelihood projects utilizing live production assets were more vulnerable than non-agri-based ones such as commodity vending (aka sari-sari store). Agri-based production assets may have a high-return but appeared to be high-risk in typhoon-prone areas. As a coping strategy, the beneficiaries shifted to low-risk alternatives such as vending and gardening. People with remunerative livelihoods will choose low-risk and commonly low return alternatives in order to survive but at a permanently lower welfare level (Pomeroy et al, 2006).With the destruction of physical and capital assets in both the fishing and farming households compounded by the disadvantageous financial terms of non-formal credit institutions, the consequences of the shock will most likely endure. With most of the beneficiaries' livelihood falling below the profitable thresholds and diversifying towards lower return activities, the possibilities for asset recovery become very few (van den Berg, 2010) and the potential to be enmeshed deeper into the poverty trap becomes higher.

While the typhoon opened windows of superficial opportunities, it produced serious threats to CBCRM project on NRM sustainability plan by diminishing members' involvement, organizational communication and beneficiaries' capacity to generate enough to pay for livelihood loans. The effect of vulnerability of the institutional KRAs on members' involvement in NRM after typhoon impact confirmed the voluminous literature citing the critical role of the human dimension in determining the capability of the natural resources and the ecosystem to survive shocks from extreme events. The extreme sensitivity of institutional KRAs to organizational communication and the beneficiaries' capacity for repayment of loans after a typhoon can potentially constrain the CBRM livelihood project's long term viability. In the context of adaptation, the livelihood security of households and the community determines the social-ecological resilience (Calatharan, 2007).

This study demonstrated thata typhoon can have a large impact on the goals of a well-structured mangrove rehabilitation-focused resource management and alter the expected socio-ecological outcomes commonly observed in community development and environmental conservation initiatives. This is reflected in the slight positive changes observed in key CBCMP goals in Malinao showing minimal positive and significant changes in people's influence on NRM and control over resources under equity; efficient decision-making; and knowledge of mangroves.The impact can be attributed to the buildup and erosion of resilience in the socio-ecological systems in the coastal barangays under the mangrove rehabilitation focused CRM project. In the ecological system, the erosion in resilience of reforested mangroves can be traced to the stress inflicted by Typhoon Dindo, while the build-up of resilience can be gleaned from the regeneration in old mangal species that were afforded protection under the CRM initiatives. In the social and livelihood systems, the build-up of resilience is evident in the increasing access to social networks and institutional support. On the other hand, the erosion of resiliency was reflected in the dissipation of the productive assets and capital from community livelihood projects that further exerted pressure on the mangrove ecosystem.

The stress induced by Typhoon Reming compounded the erosion of resiliency in social and ecological systems. As a result, the trajectory of outcomes had been altered resulting in minimal gains in selected CBCRM project goals. Studies conducted in the Philippines showed that co-managed and community-based initiatives lead to achievement of positive outcomes. For instance, in a similar mangrove rehabilitation-focused CRM in Cogtong Bay, positive and statistically significant changes in all indicators of CRM success were achieved, except in the overall well-being of coastal resources. Larger improvements were perceived in areas of knowledge, information exchange, conflict resolution, resource control and influence. Also in San Salvador, similar results were obtained highlighting relatively larger perceived positive changes in knowledge of fisheries and information exchange on fisheries management, satisfaction with fishery arrangements, such as mangrove management and sanctuary management, benefits from the marine reserve, and quickness in resolving community conflicts (Katon et al, 1997). This study presupposed that had it not been for the temporary shock from Typhoon Reming which impacted the socioecological landscapes of the community-based mangrove rehabilitation focused CRM in Malinao, that the same co-management outcomes could have been more or less achieved. The lack of statistically significant change on the overall well-being of the households and mangrove resources could be explained by the socioeconomic and ecological effect of rapid-onset calamities such as typhoon which is relatively short on a "meso-scale" basis in impacting both socioeconomic and ecological goals. According to CRM practioners, the generation of project impacts in CBCRM takes a longer gestation period.

There is an apparent natural evolving pattern in hydro-meteorological disaster adaptation and risk mitigation in Malinao. In local agriculture, this is demonstrated by a small number of households that grew typhoon-sensitive fruit trees and banana crops and harmonized their rice farming system in such a manner that the crop's vulnerable stage would less likely coincide with the typhoon months. In household dwellings, the relatively higher number of semi-concrete dwelling structures is an indication of adaptation to make abodes resilient to the increasing magnitude of typhoons. As this study has shown, semi-concrete dwelling structures have a relatively lower cost of repair and replacement when comparedwith native and concrete ones.

The coping mechanisms by the various entities are varied and reflective of the significant role of positive community values of sharing and caring, and the dynamics of social institutions: the spirit of "bayanihan" as a coping strategy demonstrated community strength and contributed greatly to the reduction of disaster risks. The poorer households decreased their food consumption and depended on borrowed money from relatives and informal lenders to cope with the damages brought by the typhoon. The beneficiaries of the livelihood project coped by shifting to low-risk-low return alternatives that underminedefforts for faster recovery. Generally, the coping strategies suggested by POs appeared to be more comprehensive and flexible. While the coping strategies suggested by the LGU to improve the asset base were dominantly controlled in nature, the coping strategies adopted and intended for adaption were geared to build-up and increase socioecological resiliency in the Malinao area. In the light of these findings and conclusions, the following recommendations are put forward to mitigate future impacts, strengthen vulnerabilities and develop socioecological resiliency in the mangrove-rehabilitation-focused community-based CRM Project in Malinao coastal communities: Distribute typhoon resilient seedlings and inputs to farming households and members of the PO's that manage the mangrove rehabilitation project. Available typhoon-adapted technologies for farming and mangrove replantation should be transferred to farmers and PO members.Provide microfinance to restore people's productive capacity, kick-start livelihood, and prevent debtors defaulting on loans. Develop and adopt typhoon resilient and environment-friendly livelihood technologies such as mangrove-based aqua-silviculture and food processing.Support livelihood strategies that have proved to be typhoon resilient, such as handicraft making and commodity vending, complemented with enhanced support for marketing.

Provide skills training to upgrade the quality of social capital of the households. Employable skills such as computer literacy, welding, automotive mechanics, and dress making should be provided to give household members a wider range of future employment opportunities. Young men and women should be taught new skills that match the immediate needs of rebuilding, such as carpentry, masonry, plumbing, but that can also be used after rebuilding is completed.

Conduct on information and education campaign to increase community awareness for typhoon disaster preparedness. Training in disaster preparedness and management should be linked with environmental education to complement the goals of mangrove-focused coastal resource management.

Implement solid waste management in the coastal barangays and integrate them with the coastal resource management to address flooding and siltation.

Institute early warning systems in the coastal barangays to increase access to climate information and forecasting and utilize traditional knowledge as an anticipatory adaptive measure.

Capacitate community and PO officials and members on DRRM. The key to effective disaster response is community-based preparedness so that communities can learn to help themselves.

Develop a Disaster Risk Reduction Management Plan (DRRMP) for coastal communities of Malinao. Integrate adaptation and coping strategies as part of the PO and LGU sustainability plan. The following adaptation strategies can be integrated by PO along NRM: a) Sustaining money current post-typhoon rehabilitation initiatives on NRM such as replanting; advocacy on mangrove conservation and protection, and credit-support; b) Encouragement of participation in NRM-related activities by providing logistical support, and link them with rehabilitation and relief assistance initiatives; c) Strict implementation of NRM protection laws and regulation after a typhoon;

The following adaptation strategies can be integrated by PO in regard to livelihood: a) Restructure payment of loans, institute insurance of crops and productive assets, provide support for enhanced coordination, b) LGU-NGA-PO interactions such as forum, meetings and intra-consultations; c) Integrated proactive mechanism in DRRP for livelihood rehabilitation, enhanced credit support and facilities.

The following adaptation strategies can be integrated by the LGU with regard to livelihood: a) Institute a disaster rehabilitation fund as a buffer fund for calamity-induced payment defaults; b) Allocation of part of income into a privatized social security system as a safety net or establishment of analogous schemes as tools to reduce the vulnerability.

The following strategies can be integrated in the sustainability plans of both LGU and PO to address the low achievement of CBCRM outcome: a) enhancement of community-based use rights, tenure instruments to promote greater stakeholders' influence and control over resources, participation in collective decision-making and increasing awareness; an increase in technical and logistical assistance for livelihood alternatives to reinvigorate local participation and promote sustainable use practices; b) the establishment of effective institutional arrangements by strictly setting, monitoring and enforcing rules; and c) reinvigoration of the people's organization by networking the people's organizations in the five coastal barangays.

Institutionalization of disaster risk reduction management (DRRM) in the municipal and barangay LGU levels through enactment of relevant ordinances. The institutional framework should include allocation of regular funds for DRRM, creation of a DRRM structure or DRRM Council in municipal and barangay levels and a comprehensive DRRM Plan.

The conduction of studies on typhoon-resilient farming system, livestock management, livelihood strategies and issues among resource users in terms of access to mangrove resources, benefit and sharing mechanisms. We must strengthen the spirit of "damayan" to increase the adaptive capacity of households.

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