Lembeh Strait, Indonesia

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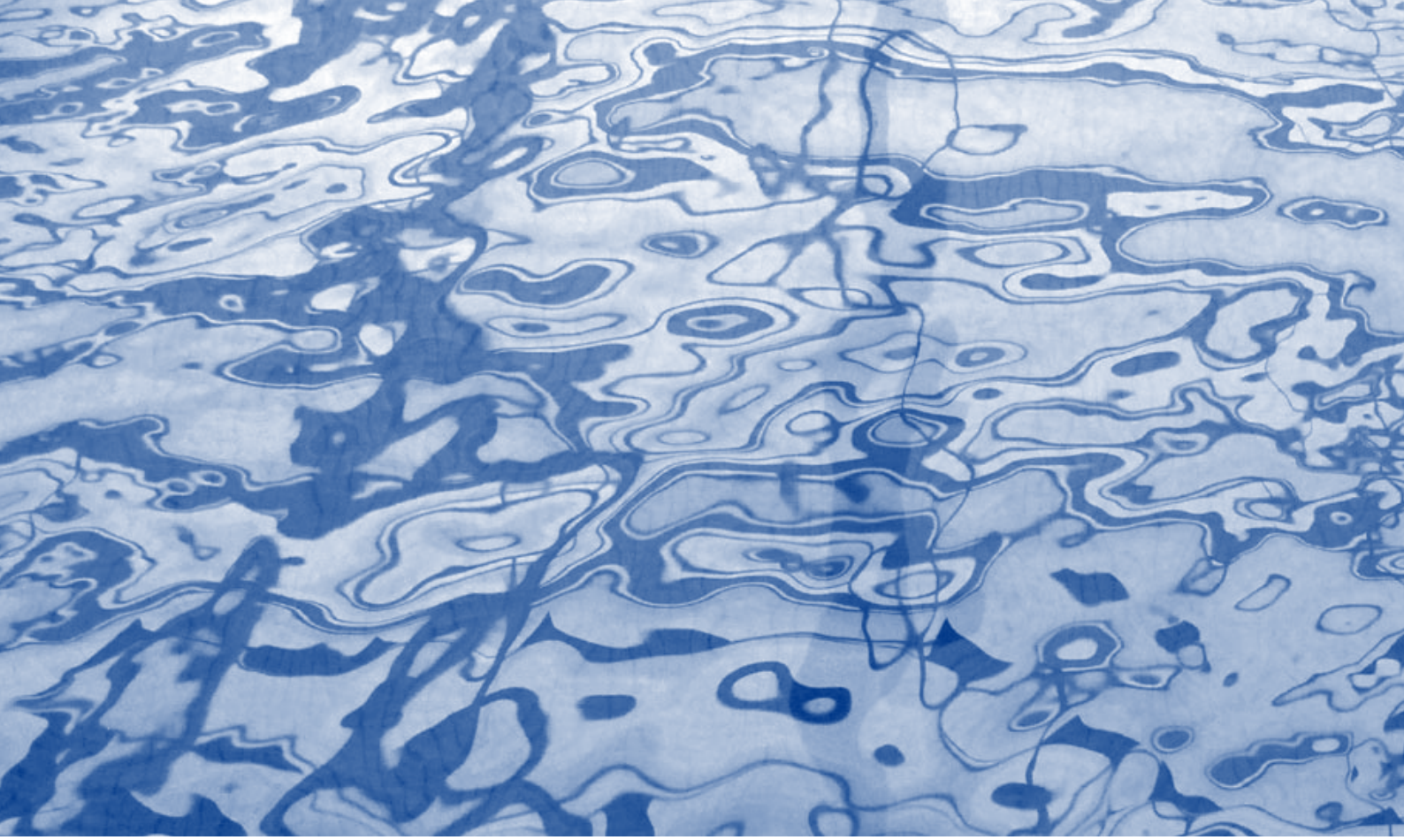

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Table of contents

Abstract	v
Introduction	1
Economic value of lembeh strait	5
Conflict resolution	9
Concluding remarks	13
References	15

Abstract

Lembeh Strait in north Sulawesi is not only home to thousands of traditional fishermen whose livelihood depends on fishing, but also has located within it the region's busiest seaport. The strait is also known for its high marine biodiversity and has been an alternative tourist destination to the famous Bunaken National Park. Determined to protect the marine habitat and high expectation of revenue generation from the tourist industry, the local government has decided to allocate part of the strait as a marine protected area, or no fishing zone. The decision has sparked controversy over use of and access to resources among user groups in the area. Using an economic valuation approach and simple modeling, this paper analyzes the economic impact of various resource allocation mechanisms as well as policy implications for the local government.

INTRODUCTION

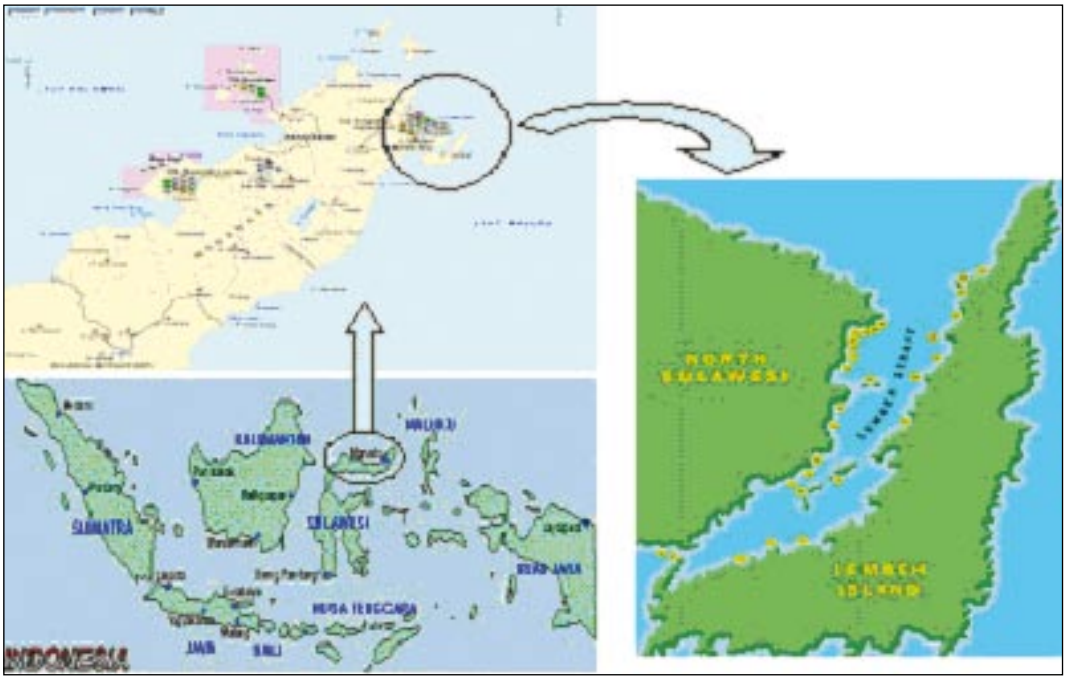
Coastal areas in developing countries are typically shared by many user groups or activities between which conflicts over access to the resource may occur. Such a conflicts may arise, for example, due to competing uses among beach recreationalists (Bower and Turner 1998), competing uses of fish stocks exploited by different user groups (Charles 1992, McKelvey 1983) or simply conflicts over a narrow area of the strait for different coastal activities such as commercial fishing and conservation or tourism. These phenomena, coupled with the lack of administrative resources, make the management of costal resources, especially fishery resources, where the livelihood of small-scale fishermen depends very much on fishing, a challenging task.

In Indonesia, this challenging task is amplified by the complexity, uncertainty and rent seeking behavior which arises in the era of decentralization. Since 2001, when the decentralization process took place in Indonesia, local governments have sought various ways to manage their own natural resources, including fisheries, to increase local government revenue (known as PAD, an abbreviation of Pendapatan Asli Daerah or original regional revenue). These include establishing stringent fiscal policies and, more importantly, maximizing all potential benefits that could be accrued from coastal resources (Fauzi & Anna 2003, Fauzi & Buchary 2002).

Lembeh Strait, located in the north Sulawesi city of Bitung is one of the busiest straits in the Indonesian island of Sulawesi (Figure 1). The strait is the only gate to Bitung Sea Port which is the hub of ocean transportation in the eastern part of Indonesia. The strait is also home to thousands of small-scale fishermen whose livelihood depends very much on fishing in the strait. The fishermen live along the narrow strip of the strait on the west and the east banks, with a density of 325 people/km^2. Their average income is low compared to other occupations in the area. It was estimated that average income of the fishermen in Lembeh Strait is around Rp 500,000 (approximately US$ 50) per month per household. This is an equivalent of US$ 10 per capita per month. This level of income is clearly below the

poverty line set out by the Government of Indonesia, which is approximately US$ 70 per capita per month. This state of poverty is in contrast with other activities currently taking place in Bitung. Besides being one of the busiest seaports in Eastern Indonesia, several industries and economic activities are located around Bitung. These include fish processing, ship building, sea transportation, and notably marine tourism. Lembeh Strait is endowed with a rich marine biodiversity which makes it one of the favorite diving spots beside the well-known Bunaken National Park.

Figure 1. Map of Lembeh Strait in North Sulawesi, Indonesia.



In 2003, supported by donors and the Department of Fisheries and Oceans, the local government decided to establish marine protected areas (MPA) in some parts of the Lembeh Strait. To implement such a program, an economic valuation study was conducted to determine the economic value that could be generated if the strait is designated as marine protected area. The study also included the economic benefits derived from tourism (diving activity) around Lembeh Strait.

The decision to establish a marine protected area, however, was not automatically endorsed by the fishermen. Fishers feared that they might not be able to fish in the strait. In addition, they felt that as they have been fishing in the strait for quite long time, they should have prime access to the fishery resources. Given current economic situation, this could be translated into more economic hardships for the fishermen in the area.

This paper attempts to analyze allocation issue between conservation motives on one side with fishing activity on the other, relating to the economic activity of the seaport. The paper begins with an economic analysis of each activity followed by scenario analysis of conflicting user groups over access to resources as well as policy implication associated with the arrangements for assigning the use of the resource.

Economic value of Lembeh Strait

An analysis of economic value of Lembeh Strait was conducted to determine the economic values derived from fishing and marine recreation. The analysis also included calculating the ecosystem value of the resource. This analysis was conducted in part to justify the importance of Lembeh Strait, if it is designated as marine protected area (MPA).

To calculate the economic value of fishing, this paper followed the method developed by Withmarsh et al. (2001) by calculating economic surpluses accrued to the fishermen which include net revenue, boat income and value added. Net revenue is defined is the difference between total revenue and operating costs while value added is the difference between net revenue and fixed cost per vessel. Boat income, on the other hand, is the surplus after all labor costs are deducted from net income.

A survey of four major fishing villages with total of 156 vessels was conducted in the Lembeh Strait. The survey recorded the cost and revenue structure of fishing fleets as well as other socioeconomic indicators (Table 1).

Table 1. Economic value of fishing activity in Lembeh Strait (in millions of rupiah).

Indicator	Binuang	Makawide	Paudean	Aertembaga	Total Lembeh Stratit
Total revenue	32.038	207.718	184.142	24.012	447.910
Net revenue	21.917	197.494	108.328	20.700	348.438
Value added	20.682	171.694	86.578	20.561	299.515
Boat income	18.685	168.286	76.228	8.141	271.340

Fishing activity in the strait provides revenue to fisher labor of approximately Rp 271 million (around US$ 28562[1]) or US$ 183 per vessel per year. If one looks at the net revenue derived from fishing, Lembeh Strait fishermen

1 1 US$ = Rp 9500

received on average of Rp 2.2 million per vessel per year (around US$ 235) or approximately US$ 78 per capita per year. This labor income is relatively small compared to minimum wages received from other industries.

As mentioned above, besides fishing activity, Lembeh Strait has also been used for marine tourism such as diving as well as local sea transportation from mainland Bitung and Lembeh Island. To determine the economic value generated by this non-extractive activity, data from various surveys (Tyler 2005, Pratasik 2001) were used and a back of the envelope technique was used to calculate the total economic value from this activity (Table 2).

Table 2 reveals that diving activity generates roughly Rp 225 million per year (US$ 23684), while charter boats and sea taxis generate revenue of Rp 25.2 million (US$ 2600) and Rp 54 million (US$ 5684) per year respectively. In total, the non-extractive activity from Lembeh Strait contributes around US$ 32000 per year. These economic surpluses are mostly distributed to the local people living around the strait such as boat owners (non-fishermen), tour guides, and local government in form of fees and taxes.

Table 2. Economic value of non-extractive activities in Lembeh Strait.

Acitivity	Unit	Rate	Usage rate/ month	Economic Value (Millions of rupiah)
Diving	Rp/person	750,000	25	225.0
Chartered boat	Rp/boat/day	175,000	12	25.2
Sea Taxi	Rp/person	3,000	1500	54.0

To determine the ecosystem value a technique called benefit transfer was used to calculate the value of mangroves, coral reefs and sea grass in the Lembeh Strait. The dollar value per hectare for those ecosystems was available from a previous study by Hansen et al. (2003). This value was then extrapolated for the area of Lembeh Strait, yielding a total ecosystem value of US$ 134,230 (Table 3).

Table 3. Ecosystem value of Lembeh Strait.

Ecosystem	Coverage	US$/ha	Total Value
Coral reef	90 ha	1060.57	US$ 95451
Mangrove	8.9 ha	828	US$ 7369
Sea grass	90 ha	349	US$ 31410
Total			US$ 134230

Combining all those values, within a given year, the Lembeh Strait generates more than US$ 200,000. The largest share of this value derived from ecosystem value (62%) while fisheries contribute around 22% and the rest

is from non-extractive use (Figure 2). It is this disproportionate share of the biodiversity value which made the local government decide to establish MPAs, combined with marine tourism, in Lembeh Strait. This decision, however, has created tension among fishermen since it is considered detrimental to their livelihood. Fauzi and Anna (2005) have calculated various scenarios of positive and negative consequences of establishing such a no take zone in the fisheries area. By reconstructing their scenarios, the possibilities of economic gains and losses to the fishermen if some portion of the strait is designated as no take zones are described in Table 4 and Figure 3.

Figure 2. Distribution of economic value among various components in Lembeh Strait.

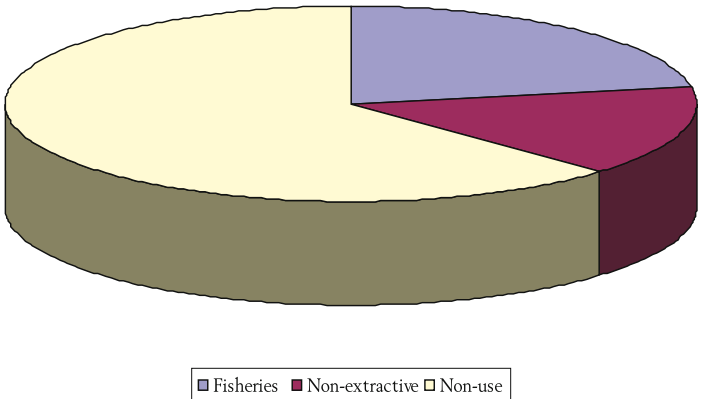


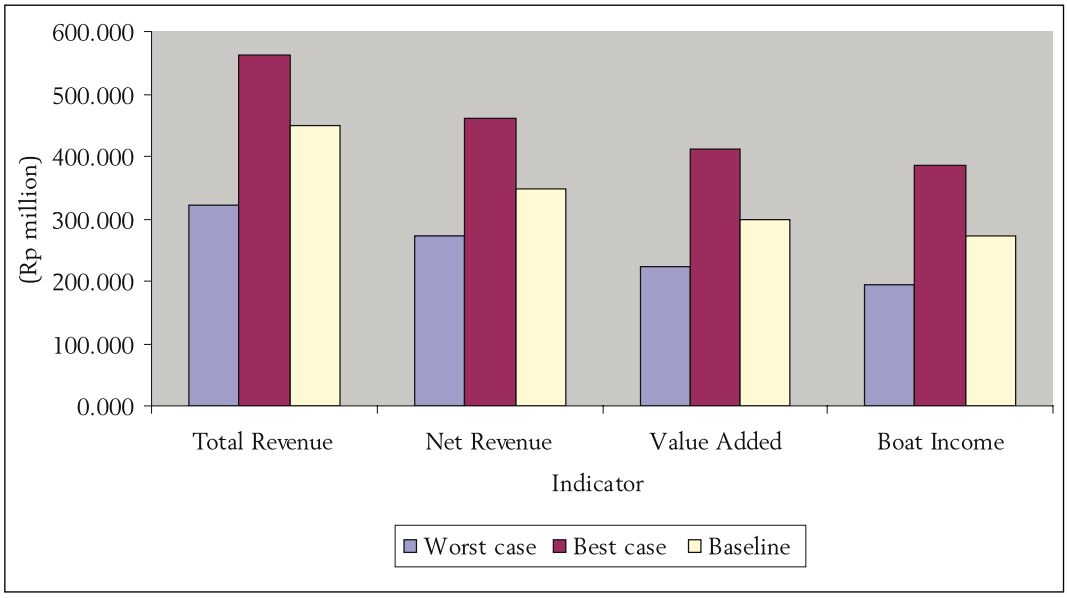
Table 4. Gains and loses to the fisheries due to no take zones (in millions of rupiah).

Indicator	Worst case	Best case	Baseline	%change Worst Case	%change Best Case
Total revenue	321.3	562.5	447.9	-0.28	0.26
Net revenue	272.4	461.9	348.4	-0.22	0.32
Value added	223.4	413.0	299.5	-0.25	0.38
Boat income	195.3	384.8	271.3	-0.28	0.42

In Table 4, the worst-case scenario is assumed to reduce the catch rate and utilization rate of 10% to 15% while the best-case scenario is based on the opposite assumption, supported by empirical studies of the effect of MPA to fisheries (Gell & Robert 2004).

As can be seen from Table 4, although other indicators are in favour of best-case scenario, the total gain from fishery as measured by total revenue is less under the best scenario. In other words, the total value of the fishery will be reduced substantially under the MPA scenario. This is due to the fact that given a narrow strip of the strait, the establishment of a designated "no take zone" will substantially limit the fishing ground and consequently fishermen's catch.

Figure 3. Economic gains and loses of no take zone to fisheries.



Conflict resolution

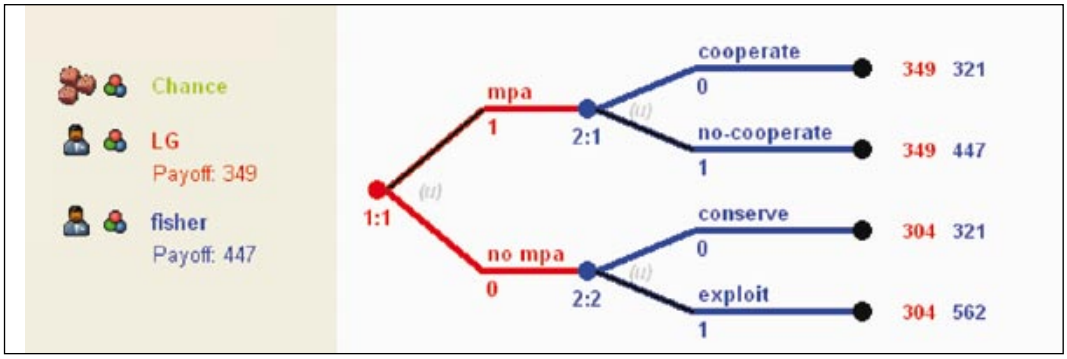
Conflict of access to fishery resources in Lembeh Strait can be categorized as sectoral conflict whereby fishermen who have traditional access to the resource now have to compete with conservation and marine tourism, supported by the local government by establishing a marine protected area. The fishermen have rejected the idea but they are voiceless since most decisions are made entirely at the local government level. To channel their concern, the fishermen began working with local nongovernmental organizations (NGOs), who negotiated with the local government in the drafting of the zonation of the Lembeh Strait. A series of dialogues and workshops was held to resolve the conflicting issues and to convince stakeholders about the importance of strait for tourism and conservation, as well as protecting the strait from over fishing.

After several group meetings, backed by experts from universities as well as expatriates working with the donor agency, it was finally agreed that the zonation of the strait for the MPA and tourism is not based on spatial division, but rather based on "spot areas". It means that the MPAS will be scattered around the strait and will be designed in such a way that they will not disturb and interfere with transportation activities and fishing activities. Most the protected zones will be in the area around 5–10 m from the edge of the west and east banks. Nevertheless, fishermen are not really convinced that their rights to the fishery resources will not be violated. Their skepticism and hesitation arise due to lack of their direct involvement in drafting and negotiating the boundary. Even though the NGOs spoke on their behalf, the fishermen thought that even the NGOs did not fully understand their needs and their dependence on fishing around the strait.

Given such a reluctance of the fishermen to share the area, the local government then used a media campaign to spread the information to the public about the economic benefits of establishing an MPA in the Lembeh Strait. This media campaign included special radio interviews with experts as well as publishing articles in the local newspaper. Even though this lengthy

process was costly and exhausting, the public acceptance slowly emerged and fishermen, even though they did not say no to the MPA, at least they did not protest the issue anymore. This implies that they actually have not fully endorsed the plan. Their reasons can be understood by using a game theoretical approach as follows: Assume there are two players, fishermen and local government. The government plays first and the fishermen take their action given the information provided by the local government in the first stage of the game. The payoff received for each strategy is described by the economic values as calculated previously. Using the GAMBIT software (McKelvey et al. 2005), the structure of the game can be seen in Figure 4.

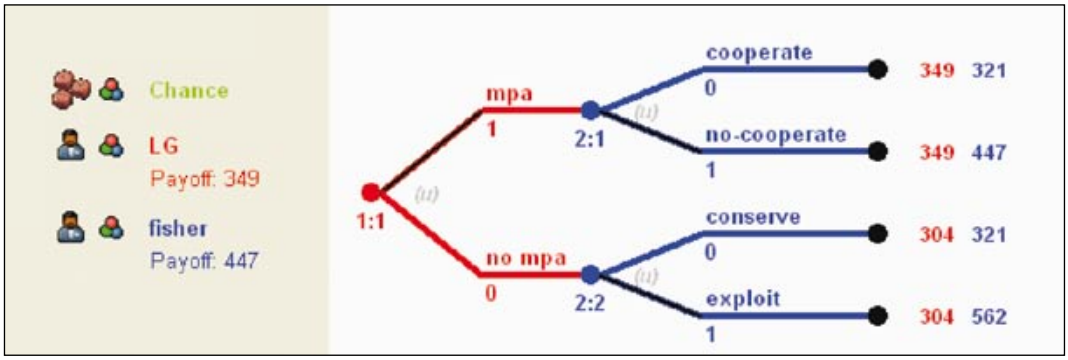
Figure 4. Extensive game of conflict resolution in Lembeh Strait.



Once the local government decided to establish an MPA, the decision faced by fishermen was either to cooperate or not to cooperate. If they cooperated, the short-term revenue will decrease to Rp 321 million. The government is assumed to receive benefits from tourism of 15 % of the baseline i.e., increasing the total to Rp 349 million. If they decided not to cooperate, then the net revenue received is equivalent to current net revenue, which is Rp 447 million rupiah. The second strategy concerns when the government decided not to establish an MPA, then the fishermen were asked to conserve voluntarily or be left alone to exploit the fishery resource using their full capacity. The payoff to the government is equal to current revenue from non-extractive use while the payoff to fishermen when they were left to fish freely is approximately 15% from the current revenue, or Rp 562 million.

GAMBIT software can then be used to find Nash Equilibria associated with such a game. Figure 5 below describes graphical view of the solution to the game.

Figure 5. Nash equilibria of the extensive game for the Lembeh Strait



As can be seen from the solution above, there are two Nash Equilibria. One is MPA-noncooperative with pay off (349,447) or no MPA-exploit with pay off (304,562). These equilibria are in favor of business as usual if the economic benefits derived from establishing MPA cannot be secured by the fishermen. This outcome would be different if such a benefit could have been received by the fishermen. Using a similar iteration and changing the payoff of Rp 562 million to the cooperate strategy, provides a unique equilibrium to this game which calls for cooperation from the fishermen in establishing an MPA. It means that co-management of the strait between fishermen and local government would result in win-win solution for both sides. It is worth noting that this type of solution would emerge if the game is played repeatedly. Falk et al. (2002) note that many real life common-pool resource or public goods problems are often played repeatedly. In such a play, players usually can condition their behavior based on past behavior of other players. The repetition will allow players to build trust and ensure cooperative outcomes. This could be done by continuous dialogue among players, in this case, fishermen and local government as well as other industries involved in the management of the Lembeh Strait.

Concluding remarks

Lembeh Strait fishery plays an important role for the livelihood of small-scale fishermen whose livelihood is dependent upon fishing and marine related activities around the strait. However, given a high potential economic value that could have been generated from other activities, and the need to protect the strait from overexploitation, there should be a trade off between protecting the right of the fishermen to fish in the strait and allowing the government to establish a conservation area for eco-tourism industries as well as preserving current use of the strait for transportation to and from the sea port. Several fiscal policies such as "shifting taxation" could be used to ease the problem. Such taxes could be levied on large-scale operation such as fishing port or tourism and use a cross subsidy mechanism to offset the loss to the fishery. Other mechanism such as involving fishermen in eco-tourism industries by employing fishermen in jobs related to their skills would also reduce the conflict. It is lack of employment opportunities for the fishermen that escalates the conflict. It is also worth mentioning that continuing dialogue with all stakeholders of the Lembeh Strait would improve the outcomes. This dialogue, however, should be facilitated by a third party since a lack of trust in the local government would not ensure smooth dialogue to solve the conflict in the strait.

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