Restoration of Degraded Peat Swamp Forest through Community Participation: The case of Raja Musa Forest Reserve, North Selangor, Malaysia

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Abstract

Peat swamp forest (PSF) is an ecosystem of global significance. It sequesters and stores atmospheric carbon, regulate hydrological system, provide habitat for many endemic wildlife, and deliver livelihoods support to thousands of local people. Despite these values, during the last several decades PSF have been subject to extensive deforestation and degradation globally. A significant portion (7%) of the Malaysia's total land mass is PSF that are traditionally managed with the state governance system. However, depletion of this PSF has been continued due to various anthropological causes including intensive logging, drainage, fire, conversion to agriculture, oil pam, settlement, industry etc. Continued depletion of PSF with the centralized governance system (in other ways, here, state forest management, SFM system), and the success of community-based forest management (CBFM) approach in many countries of the world motivated several South-East Asian (SEA) countries to impart changes in their governance system from traditional centralized/state governance approach to CBFM approach. Recently, in Malaysia, specifically State Government of Selangor introduced CBFM approach in the governance of depleted PSF at Raja Musa Forest Reserve (RMFR) in collaboration with Global Environment Centre (GEC, a national non-government organisation). However, the success and/or failure of the newly applied CBFM approach in terms of PSF restoration and community development has not been fully explored yet. The aim of this research was to understand the effectiveness of community participation toward restoration and sustainable conservation of degraded PSF of RMFR in Peninsular Malaysia, with the following objectives: (i) ascertain characteristics of peat, peatland and peat swamp forest, and activities involve in PSF restoration through literature review, (ii) examine the formation and functions of social capital, and the level of community participation in PSF restoration, (iii) analyse the impacts of institutional setting and governance on sustainable conservation and community-based PSF restoration, (iv) assess ecological outcomes of community-based PSF restoration programme, and (v) examine the effect of management regimes of the PSF on local peoples' socio-economic and environmental benefits. To attain these objectives, the study deployed a pluralistic research approach of social research and ecological (e. g. vegetation survey) study. For social research, both qualitative and quantitative data were collected through a stakeholders' workshop (with the presence of 49 participants from federal and state Forestry Department, other government agencies, NGOs, local government, academics, local community leaders), four focus group discussions, five key informant interviews and 200 household interviews in four adjacent

villages of RMFR. In addition, secondary data was collected from official documents of GEC local office.

Building on the concepts and theoretical framework of social capital and level of participation, this research found that some social capital has been developed through forming three local organizations viz. Friends of North Selangor Peat Swamp Forest (FNSPSF), Junior Peatland Forest Ranger (JPFR) and Peatland Forest Ranger (PFR), and integrating another existing organization (Homestay agro-tourism Sungai Sireh) in the restoration programme. In addition, some structural social capital (bonding, bridging and linking) among local community, other similar organizations, NGOs and SSFD have also been developed. But trust (cognitive social capital) among local community, and GEC and SSFD was in question and economic development activities were also very minimal, which demotivated local community and thus showed low level of their participation in the restoration programme. I concluded to reform the organizational structure of local community-based organizations (CBO) by forming two site specific CBOs on local environment namely Forest Conservation and Recreation Village (FCRV), and Forest Restoration Village (FRV), in addition to the current FNSPSF for improving local involvement in the PSF restoration and community development programme.

Based on Institutional Analysis and Development framework and concepts of forest property rights (specifically *de facto rights*), empirical qualitative and quantitative research was carried out on the effectiveness of the local community participation on PSF governance at RMFR; and the impacts of CBFM approach on the *de facto rights*. I found that CBFM regime had a significant impact on the reduction of exercising *de facto rights,* which might be related to improved monitoring and enforcement. Further, I identified seven major categories of actors who are actively involved in the PSF restoration programme; however, two actors such as GEC and SSFD play the key role in all governance functions and interact with most of the actors. FNSPSF (key local CBO), have very insignificant role and limited interaction with other actors in the current governance structure. The actors' participation was enabled by a number of regional, national and local level strategy, policy, and agreements. Although the emergence of the current CBFM showed its effectiveness in the PSF restoration programme; however, limited participation of local community (in particular FNSPSF) in PSF governance posed the major threat to the sustainability of this multi-stakeholder PSF restoration programme. I recommended to put FNSPSF at the centre of the collaborative organizational structure with policy, capacity building and funding

support to improve the efficacy and to sustain this newly emergent multi-stakeholder PSF governance.

The study on the ecological outcomes of the community-based restoration programme was assessed by collecting data through focus group discussions and key informant interviews (for data on restoration approach), official documents (for data on plantation establishment, water table monitoring and fire incidences) and vegetation survey (for data on planted tree growth and natural regeneration data). Results revealed that PSF rewetting (e.g. improvement of water table) can be achieved with canal blocking and clay dyke construction; further, fire incidences can be reduced through improving water table, providing training on fire drill, creating awareness, and involving local community in forest vigilance. However, annual rate of plantation (about 30 hectares (ha) per year) was found low compared to the total targeted plantation area (1,000 ha). The composition of planted species is limited to only *Euodia redlevi* with some few other species e.g. *Shorea leprosula*, *Myristica lowiana* and *M. pruinosa*. The average survival rate is 65% with a MAI (mean annual increment) of diameter and height of *E. redlevi* decreased from younger plantations (3-year) toward older (5-, 7-year). Sixteen regenerating species was identified with an average of 17,798 seedlings ha^{-1}. Natural regeneration was dominated by *E. redlevi* and only 10.6% of the regeneration could survived to the young tree stage. I recommend to expedite the plantation with diverse potential native species and giving emphasis on post-plantation maintenance.

The perceived environmental and socio-economic benefits derived from the community-based restoration programme and local community's willingness to participate revealed through four focus group discussions, five key-informant interviews and 200 household interviews. I found that CBFM approach has helped to improve some societal and economic benefits including introduction of nature-based recreation, increased income from eco-tourism and community nursery establishment, and nature education and research, and declined PSF conversion to other land uses. On the other hand, perceived environmental benefits including water storage and supply for irrigation, biodiversity and habitat conservation, carbon sequestration capacity of the community-based PSF restoration programme and the material benefits from timber and non-timber forest products (NTFP) supply has not showed any significant improvement yet.

This study provides a number of recommendations which highlights institutional such as local level CBOs and multi-stakeholder governance structure, and legal reform, and capacity building of the local community through training and fund streaming to strengthen

the community-based PSF governance in Malaysia. In addition, recommendations regarding ecological restoration points out to continue the canal blocking activities with proper maintenance and community patrolling, expedite the annual tree planting rate, increase the number of planted species, and enrichment plantation with diverse species in the planted and assisted natural regeneration forests. I highlight the potential of this study to influence policy space in Malaysia and other SEA countries, as they have similar socio-economic conditions, PSF degradation contexts, and community-based restoration possibilities.

Publications

Alam, M. J., Nath, T. K., Dahalam, M. P. B., Halim, S. A. & Rengasamy, N. (2021). Decentralization of forest governance in Peninsular Malaysia: The case of peatland swamp forest in North Selangor, Malaysia. In Natural Resource Governance in Asia. ELSEVIER | Global Book Production, International Tech Park, Taramani, Chennai 600 113

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Paper: An Institutional Analysis of Multi-stakeholders' Engagement in Peatland Forest Governance: The Case of Raja Musa Forest Reserve (RMFR) in Peninsular Malaysia.

Chapter 1 : Introduction

1.1 Context of the study

Globally, peat swamp forest (PSF) has been recognized as one of the highly significant natural ecosystems to occur in temperate, boreal, and tropical regions, where they are habitually grown on water-logged and nutrient poor peat soil (Dommain, Couwenberg, & Joosten, 2011; Page, Rieley, & Banks, 2011; Yule, 2010). These ecosystems play an important role in continuing global ecological stability and providing numerous socio-economic benefits (Kimmel & Mander, 2010). Their pivotal ecological roles are related to global climate regulation of carbon sequestration and storage (Kurnianto et al., 2015; Page et al., 2011); hydrological functions of flood prevention and water storage (Harrison, 2013; Lennartz & Liu, 2019); and critical habitat of a wide variety of rare, threatened, and declining endemic and unique flora and fauna such as Sumatran orangutan (*Pongo abelii*) and leopards (*Neofelis diardi*) (Giesen, Wijedasa, & Page, 2018; Tata et al., 2014; Yule, 2010). In addition to their functional values, PSF are valued worldwide for their key role in human livelihoods (Tata et al., 2014) because they offer a broad spectrum of goods and services, including highly valuable wood and non-wood forest produces, fish, food, medicine; and also appreciate as a unique location for culture and heritage (Harrison, 2013; Rieley & Page, 2008).

Despite their high ecological, socio-economic, and climatic significances, depletion of tropical PSF continues worldwide at an alarming rate. For example, a study in Southeast Asia (SEA) conducted by Miettinen, Shi, & Liew (2011) depicted that, over the period 2000 to 2010, the annual depletion of PSF was almost double (at 2.2% per year) than that of other regional lowland evergreen forests (at 1.2% per year) and also projected that PSF cover would be substantially decreased over the coming years. Under a business-as-usual scenario of deforestation and forest degradation, Southeast Asian forested peatlands may disappear by 2030 (Miettinen, Hooijer, et al., 2012a). Peatland forest coverage of Peninsular Malaysia, Sumatra, and Borneo has been declined from 77% to 36% in just two decades in between 1990 and 2010 (Miettinen, Shi, & Liew, 2012). Furthermore, a more recent study carried out by Miettinen, Shi, & Liew (2016) revealed that only about 4.60 million hectares (Mha) of PSF are believed to exist across Indonesia and Peninsular Malaysia as of 2015, reduced from 6.40Mha in 2007, which was 11.90Mha in 1990. In

Malaysia, it has been suggested that one-fifth (20%) of the existing peatlands (~2.46Mha) were covered with good vegetation (>70% forest cover) (Wetlands International, 2010); while, the others are severely degraded and/or degraded. Consequently, the socio-economic, environmental, and cultural benefits of the local people would become threatened (Kumaran, 2014; Nath et al., 2017).

For maintaining ecological and economical sustainability, many scholars (e.g., Miettinen, Shi, & Liew, 2017; Murdiyarso, Hergoualc'h, & Verchot, 2010; Page et al., 2009) highlighted the need for protecting and rehabilitating the degraded PSF in SEA (Erwin, 2009; Jaenicke et al., 2010). Although, numerous ecological restoration initiatives including tree planting had been undertaken in the last few decades; however, scholars (e.g. Ismail & Shamsudin, 2003; van Eijk et al., 2009) found that in many cases, survival rate was very low. Successful restoration of PSF not only depends on suitable ecological restoration techniques but it largely depends on appropriate conservation strategies (van Eijk et al., 2009; Graham & Page, 2014). Conservation strategies need to be based on local socio-economic condition as poverty and lack of alternative livelihood means may prompt local users to over-exploit, and/or conversion of forests to other land uses, which might impede rehabilitation initiatives (Silvius & Diemont, 2007; Suyanto et al., 2009).

For the last few decades, the experiences of the failure of halting resource over-exploitation and deforestation with central forest management system had driven many countries to take decentralise strategies of resource management, thus creating scope for wider engagement of local community and other relevant stakeholders in the management of natural resources (Dressler, McDermott, & Schusser, 2015; Nath, Jashimuddin, & Inoue, 2016). Further, globally, there is a growing body of studies documented community participation as a suitable solution in restoring degraded forest and local socio-economic development (Pokharel et al., 2007; Pokharel & Nurse, 2004; Chapagain & Banjade, 2009; Nath et al., 2013; Nath & Inoue, 2014). A number of African countries have obtained success in PSF conservation initiatives with the active community participation (Prospere, McLaren, & Wilson, 2016). Community participation encourages collective action, a form of social capital, which brings positive outcomes of natural resource conservation programmes (Nath, Inoue, & Pretty, 2010; Nath et al., 2016).

The Forestry Policy (National Forest Policy 1978, Amended 1992) of Malaysia emphasizes community participation in forest conservation and development projects, according to the principles of sustainable forest management (Nath et al., 2017). The United Nation Development Programme (UNDP), with its small grant programmes, has funded several community-based forests and biodiversity conservation programmes (GEF SGP Malaysia, 2016) for the last few years. Although this approach is still at an early stage in Malaysia; however, there is a growing consensus among the scientists for making appropriate institutional arrangement (both legal and organizational) to involve local community in forestry management that will benefit both local community and the forests (Nelson et al., 2014; Nelson, Muhammed, & Rashid, 2015). Recently, part of Raja Musa Forest Reserve (RMFR) located in North Selangor has been brought under community-based restoration programme. The RMFR is a part of North Selangor Peat Swamp Forests (NSPSF) which has been degraded severely due to increased economic activity and several anthropogenic disturbances including logging, drainage and recurrent fire, and land conversion to agriculture (e. g. oil palm, paddy, aquaculture), industry, and residential projects (UNDP, 2006; Nath et al., 2017).

In order to restore the degraded PSF and to improve the local socio-economic condition, the Selangor State Forestry Department (SSFD) in cooperation with Global Environment Centre (GEC, a national non-government organisation) has undertaken a PSF restoration programme at RMFR since 2008 with the participation of local people and other stakeholders. This was a pioneer attempt to restore degraded PSF with the participation of community people. Anecdotal information claimed that the programme has been successful in terms of creating awareness among wider community about the importance of PSF conservation, ensuring their participation in restoration activities and socio-economic development of local community. A comprehensive study is necessary to understand how and why local community were involved, and to assess the restoration outcomes in terms of ecological and socio-economic aspects of PSF restoration programme. The motivation for this study is that despite support from various stakeholders for PSF conservation; however, systemic academic research on the effectiveness of community participation in the restoration programme and its impacts on the forests and local community development has not yet been studied comprehensively.

1.2 Research problems

The community involvement in PSF restoration in Malaysia is not a much-talked topic and neither conducted substantial research. Previous research on NSPSF focused on its biological aspects including the variety and conservation status of black water fishes (Ng et al., 1994), impacts of logging, fire and PSF conversion to agriculture and oil palm on native mammal and avian species richness (Azhar et al., 2011; Ainuddin & Goh, 2010; Adila et al., 2017). These studies emphasize the immediate action to stop further deforestation and halt transformation of PSF to oil palm. Some recent studies have focused on forest policy and management issues. Pradhan, Suliman, & Awang (2007) detected the fire hotspots and produced a forest fire susceptibility map of RMFR. Charters et al. (2019) investigated the rate and extent of oil palm expansion in and around NSPSF over the last three decades, exploring how land conversion has affected the region's tropical forests, and assessing the relative success of PSF conservation measures. Evers et al. (2017) reviewed the appropriateness of the existing policy frameworks and their management implications in Malaysia and Indonesia and reported that policies are mainly driven by the economic benefit of the oil palm and other monocrops which are considered as factors of development and prosperity.

Several studies were also conducted on the socio-economic aspects of RMFR, for example, local communities' perception on the PSF values, their understanding of PSF degradation, and role in conservation and protection of PSF (Nath et al., 2017); farmers' perceptions, attitudes and willingness to contribute towards NSPSF's management and watershed conservation (Abdulkarim et al., 2016; 2017a; 2017b).

Even though local communities are involved in the restoration of RMFR for more than ten years started from 2008; however, to the best of author's knowledge, no comprehensive research so far been conducted to examine social capital that encourage effective community participation in PSF restoration, effectiveness of the current multi-stakeholder PFS governance, and ecological and socio-economic outcomes. Having said above, I identified following research problems that this study will focus on:

1. Characteristics of peat, peatland and peat swamp forest, and activities involve in PSF restoration,

2. Formation and functions of social capital, and the level of community participation in PSF restoration,
3. Impacts of institutional setting and governance on sustainable conservation and community-based PSF restoration, and
4. Ecological outcomes of community-based PSF restoration programme,
5. Effect of management regimes of the PSF on local peoples' socio-economic and environmental benefits.

1.3 Objectives of the study

The aim of this research is to understand the effectiveness of community participation toward restoration of degraded PSF at RMFR and associated ecological and socio-economic outcomes. In light of above research problems, following specific objectives are set for this study:

1. To ascertain characteristics of peat, peatland and peat swamp forest, and activities involve in PSF restoration. Through literature review this objective explored concepts of peat, peatland and peat swamp forest and their extent, conservation status and restoration initiatives taken worldwide in particular in Southeast Asia and Malaysia. This objective addresses the first research problem;
2. To examine the formation and functions of social capital, and the level of community participation in PSF restoration. This objective explored the social capital formation process and functions, and level of local community participation in the planning and implementation of restoration programme. This objective is related to second research problem;
3. To analyse the impacts of institutional setting and governance on sustainable conservation and community-based PSF restoration. Through institutional analysis of multi-stakeholder PSF governance, this objective reported *de facto* rights, rules-in-use, actors and their actions in restoration programme. This reflects third research problem above;
4. To assess ecological outcomes of community-based PSF restoration programme. These investigated strategies of restoration programme,

hydrological restoration, vegetation growth, and natural regeneration. This is related to fourth research problem (ecological aspects); and

5. To examine the effect of management regimes of the PSF on local peoples' socio-economics and environmental benefits, which is related to fifth research problem (socio-economy). This objective highlighted environmental and socio-economic benefits to local people due to their participation, and their contribution to PSF restoration programme.

1.4 Research methodology

The case study is a research strategy that investigates a contemporary phenomenon within its real-life context, especially when the relevant behaviours cannot be manipulated (Yin, 2014). One of the advantages of the case study method in this research is that it is able to explain the causal links in real-life interventions that might be too complex to investigate using other methods (Hancock & Algozzine, 2011; Yin, 2014).

The case for this study is the community-based restoration of PSF in Peninsular Malaysia. The study focused on the severely degraded part of RMFR (embedded units of analysis) to draw a historical description of RMFR degradation and restoration, analysis of important driving forces of community participation, and outcomes of restoration programme. As such it followed a pluralistic research method including social and ecological approach for collecting field data. Both qualitative and quantitative analysis of social research and the study of vegetation and hydrology were adopted. Table 1.1 shows the theoretical approaches, methods and level of analysis. Details of research methods are described in respective chapter.

Table 1.1 Theoretical concepts, methods and level of analysis

Objectives	Theoretical Concepts	Methods	Sampling Approach and Level(s) of Analysis
1	Peat, peatland and peat swamp forest, and activities involve in PSF restoration	Secondary data from literature review, official documents etc.	Relevant literature search through websites and personal communication at GEC and SSFD local office
2	Formation and function of social capital (Nath et al., 2010) and Typology of participation (Pretty, 1995)	Qualitative and quantitative analysis Focus group discussion (FGD), key-informant interview (KII), Workshop, Household survey (HHS) Semi-structured questionnaire personal observation, and informal talk with villagers and officials	Purposive and judgment; SSFD local staff, GEC local staff, local community, academics, NGOs, local leaders, other government officials, household, and local community
3	Forest property rights, rules-in-use and Institutional analysis and development framework (IAD) (Ostrom et al., 1994)	-do-	-do-
4	Plantation performance e.g. growth and survival percentage, and natural regeneration status, biodiversity and recruitment etc. (Roy, Ruel, & Plamondon, 2000; Uddin et al., 2014; Yang et al., 2014)	Establishment of 32 temporary 20m x 20m quadrats, randomly distributed in various year of plantations; establishment of four 2m x 2m plots at the center of 20m x 20m size plots, 20 plots at assisted natural regeneration and 8 plots at grassland	Stratified and systematic sampling; vegetation survey
5	Socio-economic and environmental benefits of PSF restoration Contingent valuation method (Mitchell & Carson, 1989; Nath et al., 2017)	Qualitative and quantitative analysis: FGD, KII, Workshop, Semi-structured questionnaire, personal observation, and informal talk with villagers and officials	Purposive and judgment; SSFD local staff, local community, GEC local staffs, local leaders, and household

1.4.1 Research site

Raja Musa Forest Reserve

The study will be carried out at the RMFR and inhabiting surrounding villages, situated in the north-west corner of the State of Selangor, Peninsular Malaysia (Figure 1.1).

The RMFR covers an area of 23,486 ha, which is a part of NSPSF (N 3°40′26.56″, E 101°4′29.52″) and is located at the North Western part of Selangor (Shuhada et al., 2017). Geographically this area is featured by flat coastal plain and having an elevation of 16 m above sea level (Shuhada et al., 2017). Its climate is characterized by high but uniform annual temperature, high humidity and abundant precipitation (Miyamoto et al., 2014).

This NSPSF is recognized as one of the biggest remaining tracts of PSF as it alone occupies about one fifth (73,592 ha) of the peatlands found on the western coast of Peninsular Malaysia (Wetlands International, 2010; Sasidhran et al., 2016). The forest is predominantly characterized by secondary mixed swamp forest with main tree species include: *Macaranga pruinosa, Shorea platycarpa, Campnosperma coriaceum, Ixora grandiflora, Pternandra galeata, Parartocarpus venenosus;* palms: *Crytostachys sp.; ferns: Stenochlaena palustris, Nephrolepsis biserrata, Asplenium longissimum*; sedges: *Cyperus rotundus* and ample stands of *Pandanus atrocarpus* (Yule & Gomez, 2009). Faunal diversity is also very high with more than 100 fish (Azmai, 2014), 173 avifauna, 16 mammal and 4 primate species (Prentice & Aikanathan, 1989) including leopard, tapir and Malaysian sun bear (Azmai, 2014). This forest is also featured by global significance of carbon storage (Parish et al., 2008; Davies, 2011) and important water reservoir (Parlan, 2001; Nath et al., 2017).

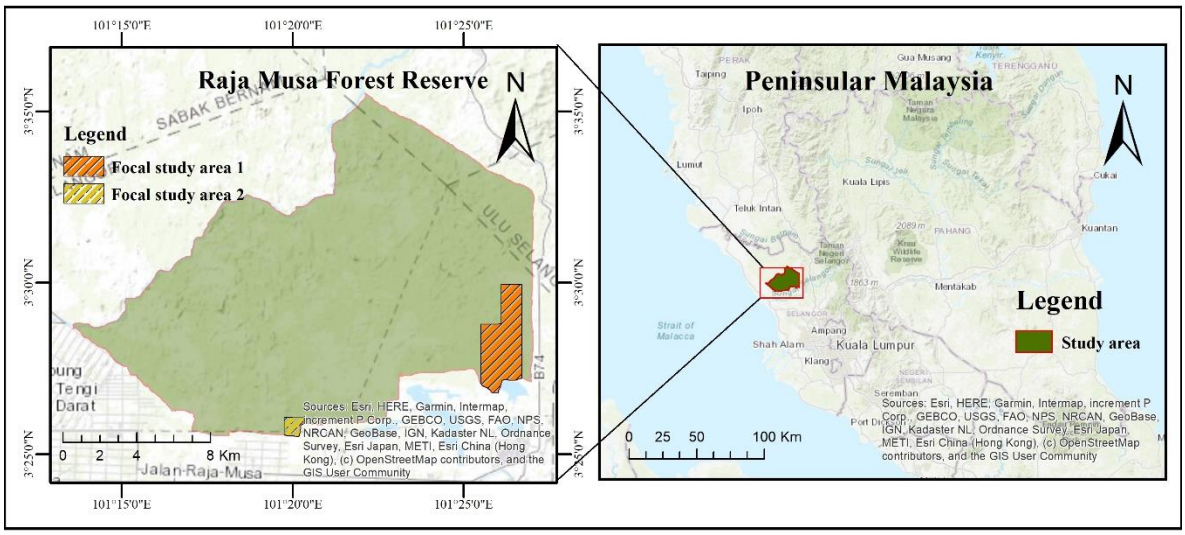

Figure 1.1 The study area map of Raja Musa Forest Reserve showing the focal study sites (Source: Google Earth and Esri ArcGIS 10.4)

However, this forest has been declining for the last few decades. Aisyah et al. (2015) found that PSF in Selangor state of Malaysia decreased by 12.7% (12,313 ha) in 2011 compared with 1989. Before declared a permanent forest reserve in 1990, NSPSF was classified as "state land forest (SLF)", and was subjected to active logging since 1950s (Kumari, 1996). Further degradation continues as intensive logging was associated with drainage canals, for easy transportation of log more than 500 km canals were constructed inside the forest reserve (SSFD, 2014). In the early 1980s, logging stopped but forest disturbances continued firstly, by draining water to the nearby Tanjung Karang paddy Irrigation project (Yule & Gomez, 2009). And secondly, logging was followed by fire, encroachment of logged-over land for oil palm plantation; cultivating perennial crops like pineapple, banana, tapioca, yam, and vegetables; cattle farming and dwelling huts in some parts of this RMFR (Nath et al., 2017).

Previous studies reported that till 2008, extensive fire events damaged a large portion of NSPSF, and being encouraged by global market demand about 1,231 ha of this forest has been transformed into oil palm plantation and other cash crops despite its designation of permanent forest reserve (Yule & Gomez, 2009; Sasidhran et al., 2016).

In 2008, the SSFD enforced stricter regulations at RMFR and halted all the illegal activities. At the southeast portion of RMFR, about 1,000 ha was identified as degraded PSF-practically devoid of any forest cover (SSFD, 2014). Although RMFR covers an area of 23,486 ha, principally, this study will be focused on this 1,000 ha area. This area was heavily degraded due to intensive logging followed by draining of peat water,

encroachment, unsustainable agricultural practices and recurrent fires. In the same year 2008, SSFD recovered this encroached area and initiated a restoration programme with collaboration of GEC and local community (Nath et al., 2017).

1.4.2 Socio-economy of the study population

Typically, the study site extends from north to south spreading over four nearby villages (locally called Kampung): Kampung Sungai Sireh, Sri Tiram Jaya, Raja Musa and Bestari Jaya located within 1–2 km of the RMFR. Admittedly, people living in the surrounding four villages have a close connection with the PSF and are directly or indirectly affect or affected by various activities like setting fire and subsequently encroaching the forests mainly for agricultural purposes. On the other hand, the people of these villages are also directly or indirectly involved in the restoration activities of the project. These study villages were established in 1930s and 1940s and currently contains 120–200 families each with a population of 3,172 (Bestari Jaya), 1625 (Ampangan also known as Sungai Sireh), 886 (Raja Musa), 2808 (Sri Tiram Jaya) respectably (SSFD, 2014; Nath et al., 2017).

The main economic activities include agriculture, mostly paddy, vegetables, and oil palm plantations (Nath et al., 2017). In addition, numerous smallholder farmers and villagers are largely engaged in cultivating cash crops (e.g. oil palm, vegetables, cassava, banana, coconut and fruits), aquaculture (e.g. cat fish and fresh water prawns) and to some extent rearing cattle, goats, poultry and burung walit as a subsidiary source of income. Besides agriculture, some other people are also engaged in services (e.g. teaching, government service, working at private companies etc.); business (e.g. food stall, retail shop, homestay agrotourism, and others); collecting NTFPs (e.g. fishing, harvesting of lotus flower and others) (SSFD, 2014).

1.4.3 Land uses of locality

The local land uses adjacent to the forest reserve are mainly paddy fields (Sg. Karang rice fields), large-scale and small holders (below 5 ha) oil palm plantation, and clay and sand mining (SSFD, 2014; Nath et al., 2017). Other land uses include fruits and vegetables cultivation (SSFD, 2014). A brief overview of the local land use types can be found in Table 1.2

Table 1.2 Land use category within one kilometre of the forest boundary (Source: SSFD, 2014)

Land use category	Area (ha)
Agriculture/Aquaculture	
Rice	2,132
Oil palm	9,655
Horticulture (mixed)	164
Coconut /banana/ orchard / vegetables	135
Aquaculture	24
Mining	
Mine and Ex-mining/sand and clay mine	396
Ponds and Lakes	311
Forested area	
Secondary forest (degraded)	161
Grasses/Shrubs/Ferns	134
Secondary forest (good condition)	951
Other	
Residential, Urban etc.	279
Recent open area	345
Total	14,687

1.4.4 Local administration

Administration and management responsibility of RMFR is locally entrusted to two District Forest Officers (DFO); namely DFO Rawang, Hulu Selangor, who manages the south part of RMFR (south side of river Tengi) and the DFO, Pantai Klang, Klang responsible for north part of RMFR (north side of the river Tengi). Each DFO is responsible for overall management of the forests including conservation, protection, restoration and other administration. They are also responsible for implementing approved Integrated Management Plan (2014-2023), the preparation of Annual Work Plans, executing all project activities and liaison with the Director of SSFD. Hierarchically, they are accountable to the Director of SSFD for the overall forest management operations.

In field level, overall conservation, management and development activities are performed by Forest Ranger, Rawang Batu Arang Range and Forest Ranger, Rawang who are supported by foresters, forest guards and workers under the administrative control of DFO.

1.5 Rationale for selecting research site

The PSF restoration programme that involved local communities are in the RMFR, North Selangor, Malaysia is the proposed study site (Figure 1.1). The reasons behind the selection of the study area are that: (1) this is the pioneer programme for conservation and restoration of PSF of Peninsular Malaysia due to the role of local communities in state forest management (SFM), (2) this is the prime remaining patch of PSF of Peninsular Malaysia, and is highly significant for water storage, carbon sink, biodiversity conservation (Parlan, 2001), and socio-cultural values to local people (Nath et al., 2017), (3) RMFR restoration project is considered as a suitable community forestry programme that attempted to improve forest condition and local community development but very little is known about the impacts of the project on the forest and communities, (4) this is the first of its kind in Malaysia to involve public/volunteers other than local community in the restoration activities in a forest reserve, and finally, (5) this area is highly vulnerable to recurrent fire, further encroachment and degradation, due to the high demand of land conversion for oil palm plantation.

1.6 Significance of this study

Only a decade ago, converting PSF to other land uses like agriculture and infrastructure has considered a key poverty reduction and income generating approach for the rural poor in Malaysia in the context of rising population and land scarcity for development (Paramananthan & Omar, 2008). Nonetheless, the depletion of these unique ecosystems distressed their ecological balance and generate a variety of environmental and socio-economic challenges (as discussed in section 1.1).

As such the study links the community participation and PSF restoration with the broader sustainable management of PSF and socio-economic development of local community. The novel approach of the study is to analyse the broader social ecological environments and various interaction of related stakeholders following social-ecological system (SES) framework (Ostrom, Gardner, & Walker, 1994; Ostrom, 2011; McGinnis & Ostrom, 2014).

The research represents the first attempt to systematically analyse the drivers that influence the effectiveness of community participation in degraded PSF restoration and determine

the factors that contribute in success/failure of the restoration efforts of PSF and community benefits due to their participation in restoration process.

It is anticipated that institutional analysis will provide a clear understanding about the current and past PSF governance, management and development efforts, their impacts on PSF conservation and/ or degradation and the influencing factor for their changes. This study would also recognize the current status of social capital, the approach of social capital formation and the factors which are best suited to increase the PSF conservation and community development outcomes. Exploration of the levels of community participation will help to understand the current contribution towards PSF conservation and the incentives local people are obtaining and how to improve their participation, if any. The study will evaluate PSF restoration outcomes in terms of growth, survival rate, density, natural regeneration, hydrology etc. which will help to understand the conservation outcomes of current efforts. Overall, it is hoped that the study will be able to find out the factors that make the interventions successful and sustainable or unsuccessful and non-sustainable.

These findings would aid the concerned authority of forestry department to make a proper PSF development and conservation policies and plan. This will also assist other authorities like agriculture, fisheries, water development, industrial, land and local government, NGOs, researchers, and academics by providing vital information during formulating their policies, planning and/or implementing any development, research activities in RMFR and for other PSF in SEA regions. The outcomes of this study are also helpful for the local community organizations and local community participants.

1.7 Structure of the thesis

This thesis consists of seven chapters (Figure 1.2).

Chapter one depicts the context of the study, previous studies on the study site and then identifies the research problem of the study. In light of research problem, this chapter then sets objectives of the study. Research methods and the theoretical concepts related to each objective are briefly described. It also depicts research sites and rationale for selecting the case study site. Finally, it elucidates about the significance of the study.

Chapter two is about a synthesis of literature on peat, peatland, and extent of peat swamp forest, their conservation status, ecological restoration techniques and community-based forest restoration. Next, it extensively reviewed the social capital and its important variables such as group formation, networks, trust, collective action, and participation. Then typology of participation was extensively reviewed. Finally, it elaborates conceptual framework to conduct the whole study in conjunction with the research problem.

Chapter three first, explains the social research method including qualitative and quantitative data collection technique. Next, illustrates the findings of social capital formation, status, functions and community participation in PSF management. Finally, this chapter assessed the level of community participation (based on Pretty, 1995), limitations and suggests possible intervention to improve the level of local participation in PSF management.

Chapter four reviewed the institutional factors such as forest property rights and rules-in-use, and then discussed the analytical frame work (Institutional Analysis and Development Framework) of this chapter; next describes the data collection method. After that demonstrates the findings of the influence of governance regime on exercising forest property rights, relevant rule-in-use that enables non-state actors to participate in PSF management, actors' roles and interactions and finally, evaluates the effectiveness of the existing community-based governance structure. Based on the findings, this chapter recommends to restructure the existing community-based governance structure by putting local community-based organizations in the core management structure.

Chapter five elaborates the sampling process and data collection method of vegetation survey and then describes the PSF restoration approaches and lastly, presents the findings

of the ecological restoration outcomes in terms of reforestation, natural regeneration status, hydrology and fire management. Then possible interventions are suggested to improve the ecological condition of the degraded PSF site.

Chapter six first extensively reviewed the data collection approach and variables and then analyses the findings of perceived environmental and socio-economic benefits of local community due to their engagement in PSF restoration programme as well as their willingness to contribute. On the basis of the findings, recommendations are made to increase the local benefits from PSF restoration.

Chapter seven, final chapter of the thesis, draws a comprehensive discussion and conclusions by answering the research problem identified in chapter one. The discussions elaborate the limitations; and finally, states some recommendations to enhance local community participation in PSF management that contributes the sustainable PSF management in the study site as well as other similar sites of Malaysia and elsewhere.

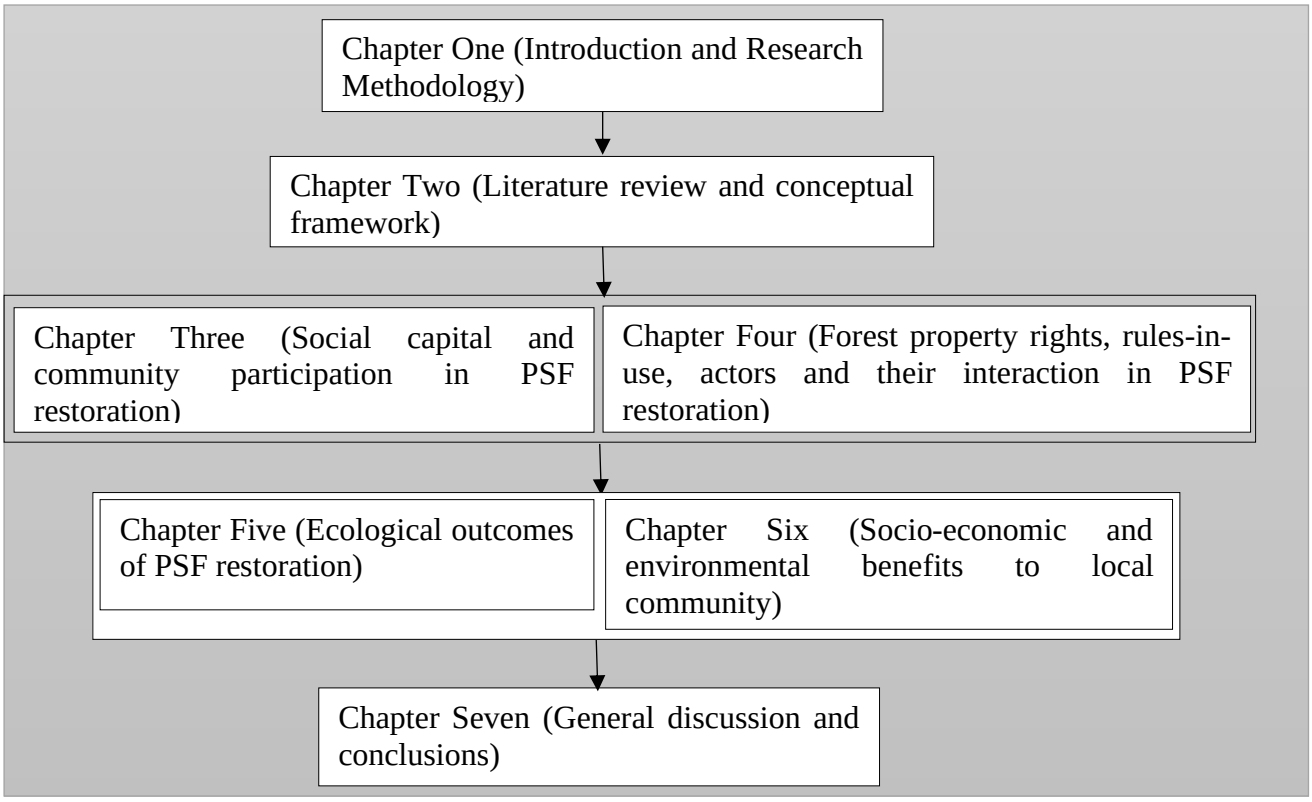

Figure 1.2 Structure of this thesis

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Chapter 2 : Literature Review and Conceptual Framework

2.1 Introduction

This chapter explores the current literature related to the PSF in global, regional and national context. Critical review of PSF in SEA and Malaysia has been done in order to understand their extent, conservation status and restoration efforts from various perspectives, and to construct the basis for further work that can be done on this field. This chapter organizes under three main different sections in order to fulfil this requirement. The first section reviews concepts around the issue on Peat, Peatland and Peat Swamp Forest. The second section addresses the extent and conservation status of PSF worldwide, SEA and Malaysia context. The third section reviews different approaches of PSF restoration that have been employed in different countries for the last few years and their limitations associated with these approaches. Finally, past literature concerning the concepts and adoption of community-based forest restoration in diverse forest ecosystems including PSF of different countries, in particular, SEA and Malaysia have been critically reviewed.

2.2 Concept of peat, peatland and peat swamp forest

Peat is typically termed as the long-term amassing (more than thousand years) of the plant remains develop under waterlogged, anaerobic, acidic, and nutrient deficit environments, where they decompose partially (Rieley et al., 2008; Yule, 2010; Rydin & Jeglum, 2013) to develop a heap which can be about 20 m thick (Rieley & Page, 2016). However, in literature, no universal definition of ‘peat’ and ‘peatland’ is found, that might be linked to the use variation of peat in different ages (Andriesse, 1988). For example, Joosten & Clarke (2002) depicted that peat is a sedentarily accrued matter comprising a minimum of 30% (dry mass) dead organic matter. On the other hand, the United States Department of Agriculture (USDA, 1975) Soil Taxonomy, terms peat as an organic matter that has a minimum of 65% organic matter (dry weight, maximum 35% mineral matter), with a minimum depth of 0.5 m and covers a minimum of 1.0 ha land. Natural peat contains water (90%) and decayed plant remaining 10% (Jaenicke, Englhart, & Siegert, 2011). Peat layers are formed when organic material production rate is more than its rate of decomposition (Hooijer, 2013).

Peatland is an area having vegetation or not, but the surface is covered with a layer of naturally aggregated peat (Joosten & Clarke, 2002). Peatland are wetland ecosystems whose surface is covered with a naturally accrued dead organic matter (peat) (Parish et al., 2008). A similar definition is given by Rieley et al. (2008) who termed peatland as a geographic extent covered with a peat layer. Rydin & Jeglum (2013) describes that the features of tropical peatland are not same as the boreal and temperate peatlands. Tropical peatland is developed at high rainfall and high temperature and derived primarily from partially decomposed remains of woody plants (e.g. branches, leaves, roots and trunks) and they are usually covered with tropical rainforests. On the other hand, boreal and temperate peatland is developed in cooler climatic zones, where peat is developed from herbs, shrubs, mosses and small trees and the land is covered with herbaceous plants. The average thickness of tropical peatland is about 5.5 to 7.0 m (Page, Rieley, & Banks, 2011).

Peat Swamp Forest is a waterlogged forest grows on nutrient poor peat soil accumulate in layer up to 20 m thick (Yule, 2010; Rydin & Jeglum, 2013; Rieley & Page, 2016). Parish et al. (2008) defined PSF as peatlands with dense tree canopy cover.

2.2.1 Tropical peat swamp forest: current extent

2.2.1.1 Tropical peat swamp forest: A global scenario

Peatland is distributed in temperate and boreal zones (88%) and in humid tropic zones (12%) (Rieley & Page, 2008; Hooijer, 2013). In a whole, PSF exist in about 180 countries covering one third of the world's wetlands (Parish et al., 2008). Over the past decades, a number of studies have assessed the extent and distribution of peatlands (e.g. Lehner & Döll, 2004; Joosten, 2010; FAO, 2012; Xu et al., 2018). A short overview of PSF based on different studies can be found in Table 2.1. In a recent study, Xu et al. (2018) reports that world's peatlands cover around 2.84% (423 Mha) of the global terrestrial area, where Asia represents 38.4%, North American contains 31.6%, and the others including Africa 4.4%, Australasia and Oceania 1.6%, Europe 12.5% and South America 11.5%

Although each of these studies has used different parameters and methods to investigate peatland area; however, variations in estimated areas are largely due to firstly, information inadequacy on tropical peatlands such as in Joosten (2010), some new area mapped recently in South America and Africa (Lähteenoja et al., 2012; Lawson et al., 2015); secondly, some countries updated their peatland inventories and variation in, definitions, methods and data

sources and finally, many PSF are no more existed and/or have already been degraded (Joosten, 2004).

Table 2.1 Estimates of global peatland areas from a variety of studies (Source: Xu et al., 2018)

Continent	Peatland area (Mha)			
	Joosten, 2010	Lehner & Döll, 2004	FAO, 2012	Xu et al., 2018
North America	136.88	20.76	132.74	133.93
Asia	154.57	52.70	117.41	162.32
Europe	50.46	1.79	63.43	52.83
South America	17.56	91.10	10.27	48.58
Africa	13.02	17.88	7.25	18.71
Oceania	7.28	0.03	0.67	6.76
Global	379.78	185.26	331.76	423.2

2.2.1.2 Peat swamp forest: Southeast Asia

In SEA, PSF occurs in Malaysia, Indonesia, Papua New Guinea, Thailand, Vietnam, Brunei, and Philippines (Page et al., 2011; Parish et al., 2014). Most of them are situated in the Indo-Malayan states where, Indonesia shares 84% (21 Mha) and Malaysia 13%, (2–2.5 Mha), with other countries containing the remaining 3% (Murdiyarso, Hergoualc'h, & Verchot, 2010; Chin & Parish, 2013; Lo & Parish, 2013). An overview of the extent of peatlands in SEA could be found in Table 2.2.

Table 2.2 Extent of peatlands in Southeast Asia (Source: Dohong, Aziz, & Dargusch, 2017)

Country	Total Area (Mha)		
	Joosten, 2010	Page et al., 2011	Lo & Parish, 2013
Brunei	0.09 (0.30%)	0.09 (0.38%)	0.09
Cambodia	-	-	0.004
Indonesia	26.50 (88.96%)	20.70 (87.45%)	20.70
Lao PDR	0.02 (0.07%)	–	0. 02
Malaysia	2.67 (8.96%)	2.59 (10.94%)	2.59
Myanmar	0.19 (0.64%)	0.12 (0.51%)	0.12
Philippines	0.01 (0.03%)	0.06 (0.25%)	0.06
Singapore	0.01 (0.03%)	–	0.00005
Thailand	0.06 (0.20%)	0.06 (0.25%)	0.06
Vietnam	0.24 (0.81%)	0.05 (0.21%)	0.05
Total Southeast Asia	29.79 (100%)	23.67 (100%)	23.67405
% of SE Asia Compared to Global Tropical Peatland	63.02%	53.67%	

2.2.1.3 Peat swamp forest: Malaysia

In Malaysia, PSF are principally seen on the coastal plains and extent approximately 7% (2.46Mha) of its total land surface area and approximately three fourths (75%) of the country's wetlands, of which more than one-quarter (26%) is occurred in Peninsular Malaysia and the remaining 74% is mostly distributed in western part of Malaysia-Sarawak and Sabah (Wetlands International, 2010). Further, Awang et al. (2019) reported that 30% (0.85Mha) of PSF in Malaysia can be found in Peninsular Malaysia. A large and growing body of literature has investigated the extent of peatlands in Malaysia, for instance, Rieley et al. (1996) estimated 2.25 - 2.73 Mha of pristine peatlands, Tie (1990) reported 2.56 Mha; Melling (2016) suggested about 2.6 Mha; Page et al. (2011) 2.59 Mha; Joosten (2010) 2.67 Mha; Lehner & Döll (2004) 2.10 Mha; FAO (2012) 2.15 Mha; Xu et al. (2018) 2.24 Mha.

In Peninsular Malaysia, Peatlands distribute in 7 states namely Selangor, Johor, Negeri Sembilan, Kelantan, Perak, Pahang, Terengganu. Following the USDA definition of peat (as being more than 65% organic) Wetlands International (2010) gave an estimate of PSF in Peninsular Malaysia (Table 2.3).

Table 2.3 State wise peatland area and their proportion in Peninsular Malaysia (Source: Adopted from Wetlands International, 2010)

State	Total Area (ha)	Peatlands	
		Area (ha)	Proportion (%)
Pahang	3584758	164113	4.6
Selangor	840315	164708	19.6
Johor	1909886	143974	7.5
Terengganu	1289944	84693	6.6
Perak	2090827	69597	3.3
Kelantan	1497351	9146	0.6
Negeri Sembilan	663730	6245	0.9
Federal Territory	29200	381	1.3
Total	11906011	642857	5.4

2.2.2 Tropical peat swamp forest: Conservation status

Posa, Wijedasa, & Corlett (2011) argued that PSF's protection and restoration are conservation priorities because they are more susceptible to anthropological disturbances compared with other forest ecosystems, hence they need immediate intervention. They added that the highest 36% (6.72Mha) of the historical PSF (18.25Mha) remains in SEA, of which only approximately 9% (1.70Mha) areas are currently designated as Protected

Area (PA) in the United Nations Environment Programme World Conservation Monitoring Centre (UNEP-WCC) and the International Union for Conservation of Nature (IUCN) World Database. While the estimated surviving PSF in Malaysia is approximately 0.88Mha, which is approximately 32.30% of the initial estimation (2.73Mha) and only a small portion 16.19% (0.14Mha) of the surviving PSF is designated as PA in the said World Database. On the other hand, in Peninsular Malaysia the current extent of PSF is approximately 0.25Mha, which is approximately 25.30% of the initial estimation (0.98Mha); and approximately 17.82% (44,400 ha) of the remaining area is designated as PA in the UNEP-WCC and IUCN World Database (Table 2.4).

Table 2.4 Estimates of designated protected areas in the peat swamp forest of Southeast Asia

Region	Initial area (Mha)	Remaining area (Mha) (%)	Protected area (Mha)(%)
Indonesia	15.35	5.72(37.29)	1.51(26.45)
Malaysia	2.73	0.88(32.30)	0.14(16.19)
Brunei	0.10	0.09(83.90)	0.02(21.00)
Thailand	0.07	0.03(44.70)	0.02(30.30)
Southeast Asia Total	18.25	6.72(36.80)	1.70(9.30)
Peninsular Malaysia	0.98	0.25(25.30)	0.04(17.82)

This study suggests that the conservation status of most of the PSF is not clear, as they are not assigned in IUCN's PA categories, and hence their prime management objectives are still unknown. Then again, designation of a natural ecosystem as PA does not always guarantee its sustainable conservation, as various human disturbances like forest conversion, timber harvesting, and hunting occur in numerous PA areas of SEA (Curran et al., 2004; Gaveau et al., 2009).

According to the National Forestry Act 1984, approximately 30% of the total PSF in Malaysia is declared as Permanent Forest Reserve; while, most of the remainder areas have already been converted for other land uses, although some are still classified as SLF. In a study conducted by UNDP (2006), it was shown that in Peninsular Malaysia about two-thirds (67%) of the remaining (0.30Mha) PSF are protected as permanent forest reserve and the rests are designated as SLF (UNDP, 2006; Arumugam et al., 2019). Approximately 87% of the NSPSF had been categorized as permanent forest reserve, and a small portion (4,330 ha) of this forest is officially designated as PA (Sasidhran et al., 2016). However,

Mohd Azmi et al., (2009) reported that most of the PSF within permanent forest reserve are categorized as production forests and are permitted for sustainable logging; in converse, those within the SLF are commonly used for the conversion of other uses. Although Selangor State Government declared a 25-year moratorium (started from 2010) on logging in the state's permanent forest reserve; however, such kind of moratorium is subjected to review in certain intervals (SSFD, 2014). It is apparent from these studies that the remaining PSF irrespective of designation are still at risk of logging and/or conversion to other land uses. Furthermore, to recognize the significance of RMFR, in 2017, this PSF was granted Queens Commonwealth Canopy accreditation by the Queen's Commonwealth Canopy (QCC) partnership with the Royal Commonwealth Society and Cool Earth and the Commonwealth Forestry Association (GEC personal communication, 23 June 2019). In addition, Selangor Forestry Management Plan 2011-2020 allocated 14,360 ha of peat swamp area in Sg Karang FR and RMFR as peat swamp conservation area to ensure the long-term stability of the PSF ecosystem (SSFD, 2014).

In summary, despite a number of legal and administrative conservation initiatives have been taken to protect the PSF from further conversion and degradation, and some global recognition has also been gained. However, in one hand, these legal arrangements are not adequate and not strong enough to protect the remaining PSF from further conversion and/or degradation and also subject to change at any time and on the other hand, it is necessary to restore the areas which has already been deforested and/or degraded.

2.2.3 Peat swamp forest restoration

2.2.3.1 Concepts of rehabilitation and restoration

Depending on the degradation level, expected outcome, and time frame and cost involved, varied restoration approaches are applied to uplift a degraded or damaged forest ecosystem to a higher level of restoration staircase (Figure 2.1). In the restoration staircase various restoration activities such as reclamation, rehabilitation, commercial reforestation/agro-forestry, reforestation, assisted natural regeneration and natural regeneration are arranged in a continuum in where the degree of distinction between one type of activity to another is quite minimal, but from the most basic action to the most advanced, the distinction is quite significant (Chazdon, 2008). However, based on the outcomes three most significant restoration approaches are reclamation, rehabilitation and restoration.

Reclamation is the process of making severely degraded land (e.g. former mine sites) fit for agriculture, forestry and/or some other human use. Main outcome of the reclamation is the restoration of soil fertility and hydrology. Rehabilitation is the reparation of ecosystem processes, productivity and services of a degraded site (SER, 2004; Gann et al., 2019); replacing ecosystem structure or function that may be diminished or lost (Field, 1999). The key aim of rehabilitation is to ensure the long-term stability of soils, landforms and hydrology required for the site to establish and sustain a natural ecosystem or vegetation that aligns with the agreed future land use. Production of timber, NTFPs and/or other ecosystem services are the outcomes of rehabilitation (Chazdon, 2008).

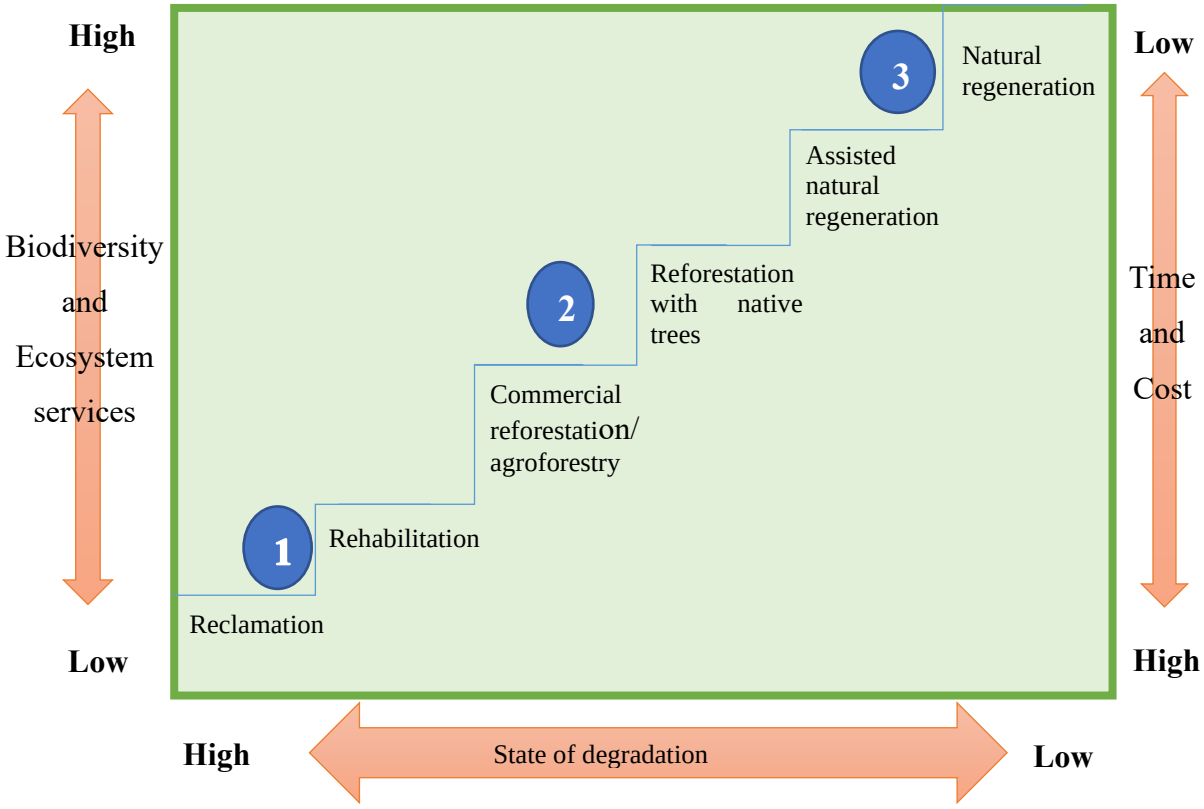

Figure 2.1 The restoration staircase. Depending on the state of degradation of an initially forested ecosystem, a range of management approaches can at least partially restore levels of biodiversity and ecosystem services given adequate time (years) and financial investment (capital, infrastructure, and labor) (Chazdon, 2008).

Restoration is one of the common use words in the field of ecological restoration that typically involves recovering the damaged or degraded ecosystems to its pre-undisturbed natural state (SER, 2004; Erwin, 2009; Jaenicke et al., 2010). Kaly & Jones (1998) defined restoration as the return from a deteriorated condition to a state similar to a preserved reference site that represents the structural and functional variability within habitats before a devastating natural or human-induced disturbance. The main aim of ecological restoration

is to regain degraded ecosystem structure and function to its original features by employing a number of restoration measures and techniques (Hobbs & Cramer, 2008; Aronson et al., 2010) and natural recovery of vegetation to achieving the same plant species and diversity as found in the remaining forest ecosystems (Mansourian, Vallauri, & Dudley, 2005; Baur, 2014). Main outcomes of restoration are the recovery of biodiversity and ecosystem services (Chazdon, 2008). There is some distinction between restoration and rehabilitation in where, restoration emphasises recovering of ecosystem structure and composition, whilst rehabilitation stresses ecosystem processes and functions (SER, 2004). However, Aronson et al. (2007) suggested that rehabilitation is aligned with restoration as both management strategies generally take a historic ecosystem/landscape as a reference for planned initiatives to halt degradation and initiate more sustainable ecosystem trajectories. Scholars (e.g. Osuji et al., 2007; Hashim et al., 2010; Salmo et al., 2013) described the terms rehabilitation as process and restoration as goal. Restoration is often used as a catch-all for both of these actions, without indication of end-point or temporal scale. Over time, the rehabilitation of ecosystem processes can lead to the restoration of ecosystem structure and composition (Page & Graham, 2008). It may be possible to rehabilitate the functions of an ecosystem, but to achieve the original ecosystem structure will be more difficult and require a much longer time-scale (Wösten, Rieley, & Page, 2008).

2.2.3.2 Concepts of restoration in PSF management

Understanding and implementation of tropical PSF restoration is relatively new (started only in the early 2000s) compared to the temperate regions (Jaenicke et al., 2010; Graham, 2013; Ritzema et al., 2014). However, the concept of PSF restoration and rehabilitation is largely derived from ecological restoration and rehabilitation. Peatland restoration is the process of assisting the recovery of peatland that has been degraded or damaged to its original natural condition. On the other hand, peatland rehabilitation is the repairing of ecosystem processes, productivity and services, but does not imply the re-establishment of the pre-existing biotic integrity in terms of species composition, community structure and ecosystem functions (Clarke & Rieley, 2010).

In PSF management, many scholars (e.g. Yuwati et al., 2021; Musri et al., 2020; Graham & Page, 2012; Page et al., 2009) used these terms restoration and rehabilitation broadly and do not clearly distinguish between them. Although, Blackham, Webb, & Corlett (2014)

used the term restoration solely when studied natural regeneration as a PSF restoration approach.

Appropriate water management is the key to PSF restoration as improved hydrology could be an important factor for reducing fire hazard and creating conditions for forest vegetation to regrow (Jauhiainen et al., 2008; Page et al., 2009). The key aim of the PSF restoration and/rehabilitation is to improve hydrological condition, prevent fire and revegetation of the deforested peatland (Yuwati et al., 2021).

2.2.3.3 PSF restoration/rehabilitation initiatives in Southeast Asia

Among Southeast Asian countries, Indonesia first introduced peatland restoration activities principally by peatland rewetting through canals blocking only in the early 2000s (Wosten & Ritzema, 2006; Wosten et al., 2010; Ritzema et al., 2014). Since then, many such restoration initiatives have been undertaken, among others, the main ecological restoration activities involved, firstly, (a) drainage canal blocking to rewet peatland (Dohong & Lilia, 2008; Jaenicke et al., 2011; Ritzema et al., 2014). And secondly, (b) reforestation of denuded peatland through producing seedlings and transplanting (van Eijk et al., 2009; Graham & Page, 2014); promoting seed dispersal means (Graham & Page, 2012) and third, gaining knowledge about the prospects of natural regeneration (Gunawan et al., 2012; Blackham et al., 2014). A brief description of several restoration methods that are used in Indonesia are given in Table 2.5

Table 2.5 Summary description of PSF restoration techniques applied in Indonesia (Dohong, Aziz, & Dargusch, 2018)

Management scheme	Method	Details	References
1. Water management			
Peatland rewetting and re-flooding	Canal and ditch blocking	Construction of dam or bund on canal or ditches to decrease run-off and improve water reserve	Dohong & Lilia, 2008; Panda et al., 2012; Ritzema et al., 2014
	Canal and ditch infilling	Canal or ditch filling with peat soils, plant remains (e.g. leaves, twigs, branches, and trunks) etc.	Applegate et al., 2012
2. Restoration of forest cover			
2.1 Natural regeneration	Re-sprouting from scatter trees and/or from seed germination	Left over trees of the degraded PSF are managed for re-sprouting and used as a seed source for germination	van Eijk et al., 2009; Gunawan et al., 2012
	Seed rain	Adjacent pristine forests would be a good seed source of endemic plant species to regenerate naturally	Blackham et al., 2014
2.2 Raising plantation in the bare peat area	Tree nursery raising	Nursery raising with seeds or wildings collected from the forest floors	Page et al., 2009 Turjaman et al., 2008; Graham, Turjaman, & Page, 2013.
	Seedlings transplanting	Seedling from nursery or from wildings are used for plantation and proper silvicultural operations applied	van Eijk et al., 2009; Page et al., 2008; Page et al., 2009

On the other hand, in Malaysia PSF restoration activities are still infancy, and so far, SSFD and Forest Research Institute Malaysia (FRIM) carried out some small-scale activities and piloted a few field trials only (Van Eijk et al., 2009). For example, baseline studies on ecology, silviculture, growth and yield, hydrology, socio-economics and forest management were conducted in the harvested PSF of NSPSF and primary PSF of Pahang during the period of 1996-2000; and about 1.55 ha replanting trials were conducted, and guidelines were created for integrated and sustainable management (Parlan et al., 2001).

Previous studies also examined the PSF restoration barriers; for instance, Dohong et al. (2018) identified peatland drainage, repeated fires, invasive ferns and shrubs, inconsistency in land-use policy and lack of alternative livelihoods are the main hindrances to peatland

restoration in Indonesia. In a more comprehensive study, Graham, Giesen, & Page (2016) reported that even though several thousand hectares of denuded tropical PSF have been planted until now; however, a significant portion of these planted areas have been damaged due to fire, flood, drought and/or suppressed by ferns and sedges. However, Higgs (2005) argues that technically sound ecological restoration will be successful and sustainable only with an active engagement of the local community. Further, an effective community engagement depends on the participating communities' cultural dimension including appropriate policies and legislations as well as long term funding.

In sum, the success of PSF restoration not only depends on appropriate and effective ecological restoration. Nevertheless, a number of other factors in particular socio-economic and cultural factors of local community and their participation is also important.

2.2.4 Community-based forest restoration

2.2.4.1 Concepts of community participation in forestry activities

Community participation in forestry activities is built on the effort to make active engagement of local community in forest management, in where, others can engage to support them instead of getting involved in direct management (Arnold, 1991). While others viewed it as an internal representation between the forest communities and the external institutions such as the Non-Governmental Organizations (NGOs), private sectors, academic institutions and political parties (Chapagain & Banjade, 2009; Paudel, Khatri, & Paudel, 2010), whether it may be community initiated or developed through outside intervention like governments or other development partners (Fisher, 2014). Evidence (e.g. FAO, 1991) suggests that this approach was first commenced in the 1970s with a dual goal to meet fuelwood crisis and local community development. However, in the mid-1980s, decentralization and devolution of forestry policies began (McDermott & Schreckenberg, 2009; Devkota, 2010) and subsequently had become a prominent feature of global forest governance by the mid-1990s (Ribot, Agrawal, & Larson, 2006). As stated by Fisher, Prabhu & McDougall (2007), at the beginning community participation in forestry was focused on engaging local people in government projects for replantation and forest protection; and then progressively developed theories related to the devolution of decision-making power as well as optimizing use of forest resources by the local people. Furthermore, scholars (e.g. Kalonga, Kulindwa, & Mshale, 2015; Moktan, Norbu, & Choden, 2016; Rahut, Ali, & Behera, 2015) stated that it is a strategy of combining state

and local community in forest management with a view to improve community livelihoods, sustain natural resources, stimulate decentralization and good governance. The main idea of decentralization is to transfer power and forest management responsibilities from central government to local communities through which participation, efficiency, democracy and fairness in decision making can be achieved (Tacconi, 2007; Prassad, 2013). Further, authors (Ostrom, 1999; Nygren, 2005; Maryudi et al., 2012) elaborated it as a forestry practice where forest users directly take part in the process of decision making as well as forestry activities implementation aiming to improve the user's livelihood and forest conditions. Likewise, others (Agrawal, 2010; Pokharel, Rayamajhi, & Tiwari, 2012; Pokharel & Tiwari, 2013) depicted it is as a forest-centered activity where protection and management of forests are entrusted to the local community either directly or through any other form of management arrangements and those are answerable to the local people through their nominated representatives.

According to Agrawal (2002) community forestry is the capacity of a small cluster of community people who can formulate institutional provisions that facilitate management of forest resources sustainably. A similar definition proposed by McDermott & Schreckenberg (2009) which stated that it can be defined as the local people's decision-making power or influence about forest management, including making rules regarding access to forest and resource withdrawal from the forests.

2.2.4.2 Adoption of community participation in forest management

In the past few decades, decentralization and people's participation have been adopted as a principal approach for sustainable and equitable forest management (Kumar, Singh, & Kerr, 2015) all over the world, in particular, Africa, Asia, and, in recent times, Latin America (Cronkleton et al., 2013; Schusser et al., 2015). Based on the local socio-economic, political, cultural, historical and bureaucratic settings numerous forms of community participation with varied range of activities have been developed in different names, for example, community forestry in Nepal (Maharjan et al., 2009), community-based forest management (CBFM) in the Philippines (Braganza & Erdmann, 2012), joint forest management in India (Balooni & Inoue, 2009), village forestry in Laos (Inoue, 2003), community and participatory forestry in African countries (Potters, Reeb, & Crollius, 2003) and co-management in Bangladesh (Nath, Jashimuddin, & Inoue, 2016).

Estimate suggests that more than one tenth forests of the world are managed according to the community forestry model (e.g. Casse & Milhoj, 2011). Likewise, in a recent review study, Gilmour (2016) stated that around one fifth (18%) of world's forests are managed with local community involvement. Further, White & Martin (2002) reported that in developing countries, about one quarter of the forests are under the management of local community. A region wise community participated forest areas could be found in Table 2.6

Table 2.6 Region wise community participated forest areas (Source: Gilmour, 2016)

Region	Total forest area (Mha)	Community managed forest areas (Mha)	% of forest are under community participation
Africa	396.34	24.03	6.1
Asia and Pacific	548.03	184.87	34
Latin America	841.1	272.0	32.3
Europe	222	89	40
North America (Canada and USA)	614	124	20

Gilmour (2016) stated that to facilitate community participation in forestry activities some governments of Asia and Pacific regions, have been taken specific initiatives. In addition, in the early 1990s, many South and Southeast Asian countries incorporated decentralization and empowerment of local communities as an essential forest conservation and management tool in their policies, after that a clear change in forest management occurred (Balooni & Inoue, 2007). A brief summary of the extent of community participation in Southeast Asian countries can be found in Table 2.7

Table 2.7 Extent of community forestry in Southeast Asian countries (Source: Gilmour, 2016)

Country	Total forest area (Mha)	Community managed forest areas (Mha)	% of forest are under community participation
Cambodia	11.12	0.25	2
Indonesia	131.2	0.84	1
Lao People's Democratic Republic	18.68	5.90	32
Malaysia	18.48	na	na
Myanmar	20.41	0.05	0
Papua New Guinea	25.33	25.08	99
Philippines	18.08	10.96	61
Thailand	17.22	0.54	3
Viet Nam	13.52	3.81	28

2.2.4.3 Community participation in peat swamp forest conservation

Community participation in PSF restoration is recent and not as widespread compared to other types of forests (e.g., hill forests, plain land forests and mangroves etc.) in SEA. However, a number of previous studies reported the involvement of local communities in PSF restoration since early 2000s. Noor, Heyde, & Suryadiputra (2005) reported that a four-year (2001-2005) community-based peatland protection and rehabilitation programme has been implemented at Sumatra and Central Kalimantan, Indonesia aiming to improve local livelihood, reducing PSF deforestation and degradation, biodiversity conservation and maintaining carbon stock. Ansori & Dohong (2005) depicted that a peatland restoration project named one Mha ex-peatland project (2001-2005) at Central Kalimantan, Indonesia has been implemented with the active involvement of local people; the main activities includes canal blocking, nursery raising, fisheries, and hydrology monitoring and training. The study concluded the outcomes are mixed with both success and failure. Yuliani (2018) suggested that a pilot peatland restoration project (part of approximately two Mha peat ecosystem restoration initiative for five years, 2016-2020) has been implemented with the involvement of local community at Riau Province Sumatra Indonesia. The study concluded that through raising community awareness and building capacity, the Tohor River becomes a success area for PSF restoration. In contrast, Tata & Tampubolon (2016) studied community participation in PSF management in two locations namely Kalawa Village Forest (KVF) and Sebangau National Park (SNP) of Central Kalimantan, Indonesia and found that even though three local community based organizations have been developed well in these sites; however, due to lack of awareness the community participation in the PSF management is low, which can be characterised as functional participatory at KVF and consultative participation at SNP. Furthermore, in 2017, a 3 years PSF rehabilitation project has been initiated at two sites of NSPSF e.g. Bukit Belata (Extension) and Sungai Karang Forest Reserves aiming to rehabilitate 2,000 ha degraded peatlands with the active engagement of local community. However, no published literature is available about the success and/ failure or the current status of the project.

In summary, a significant number of previous studies and forestry policy of Malaysia highlighted the need for community participation in PSF conservation activities. However, there is no consensus among the scholars about the success and/or failure of such initiatives. Factors influencing the success and/or failure is also a matter of controversy. Although there has some policy support to the involvement of local community in PSF conservation

activities; however, the process of community involvement and to what extent they are empowered to take decision are not clearly defined. As reflected in the cited literatures before the role of community participation for successful and sustainable PSF restoration are well recognized and is significant but weaknesses exist in the community participation process and its broader environment. However, commitments and initiatives of the Southeast Asian countries including Malaysia to include community in the PSF restoration activities can be considered as an emerging trend to restore the degraded PSF.

2.3 Theoretical framework: social capital, collective action and participation

2.3.1 Social capital

For the past few decades, social capital concept has been emerged as a framework to understand and analyse the links between different actors engaged in collective action for the management of common pool resources to achieve sustainable development goal (Górriz-mifsud, Secco, & Pisani, 2016; Roslinda, 2018; Yoder & Roy, 2018). Theories such as social support, social networks, people participation and governance are the root of this concept (Grant, 2001). Bourdieu (1986) termed social capital as "the collection of actual or potential resources acquired by a single person or a group for maintaining a long-term network with more or less some form of institutionalized connections of mutual familiarity and recognition—or otherwise stated, to a membership in a group". Putnam (1993) stated that social capital is comprised of characteristics of social organizations viz. trust, norms, and networks that can augment the shared interest of individuals as well as the entire society by facilitating communication, co-operation, co-ordination and reciprocal support.

Based on the compositions of the groups and the extent of relations, social capital is classified into cognitive (normative) and structural components (Uphoff, 2000; Grootaert et al., 2004; Jones, 2005). Cognitive social capital consists of norms, trust, trustworthiness, shared values, attitudes and beliefs that contribute to cooperative behavior and mutually beneficial collective action (Uphoff, 2000). In converse, structural social capital refers to the degree of societal connections, interactions, networks, and practices within and among various community members that helps lowering transaction costs and accumulating social learning (Uphoff & Wijayaratna, 2000; Jones, 2005; Brunie, 2009). Cognitive social capital

drives people to undertake reciprocally beneficial collective action; while, structural social capital enables above-mentioned action and both components should be integrated together to obtain the cumulative potential for mutually beneficial collective action (Krishna & Shrader, 2000).

Social capital is multi-dimensional (Grootaert et al., 2004; Pretty & Smith, 2004; Ohno et al., 2010), and there is no consensus on appropriate measures (Kramer, 2007). However, the most common dimensions include: group characteristics, groups and networks, norms, togetherness, sociability, trust and solidarity, collective action and co-operation, social cohesion and inclusion, information and communication, participation, values and benefits, civic engagement and democratic functioning (Narayan & Cassidy, 2001; Nath, Inoue & Pretty, 2010; Baynes et al., 2015; Musavengane & Simatele, 2017; Marbuah, 2019). In this study, we explore social capital, operationalized through five major social capital dimensions: (a) *group formation, status and function* (b) *groups and networks* (c) *trust* (d) *collective action* and (e) *participation* as proxies for assessing the state of social capital among the actors. In addition, benefits and/or incentives were also included as a dimension since income, business opportunity and training have a positive correlation with participation in community-based resource management (Musavengane & Simateleb, 2017).

Group formation, characteristics and functions

Social capital can be formed or developed in a society through creating organizations (Nath et al., 2010). Organizations or groups provide the entry point for efforts to work with community members (Schneider, 2004). Donor agencies seek to enhance the effectiveness and efficiency of their aided projects through forming groups (Carney, 1996; Upton, 2008). Civic participation in organizations is a pathway to build social capital which helps to enrich their social and economic prospects (Kaufman, 1999; Stoll, 2001). Furthermore, the effectiveness of a group depends upon the group characteristics including number of groups formed and their diversity and the way they function. On the other hand, group membership status such as group density membership (number of memberships of each household in existing groups) has an influence on the networking of members where it can either positively or negatively affect group collective action (Snyman, 2012; Musavengane & Simatele, 2017). Moreover, democracy within an organization in terms voting rights and

leadership selection procedure, motivates people to engage in community forestry group activities (Baynes et al., 2015).

Groups and Network

Formal and informal organizations relevant to a development intervention may exist in a community and these organizations facilitate information diffusion, reduces opportunistic behavior and aid collective decision-making (Grootaert et al., 2004) and can bridge to social development, and sometimes create barriers (World Bank, 2003). Hence, it is necessary to incorporate existing appropriate formal and informal organizations which improves beneficiary targeting, reduce project costs and enhance the sustainability of projects (Grootaert, 1998). Three kinds of connectedness have been recognized as significant for the networks within, between, and beyond groups. These are bonding, bridging and linking social capital (Woolcock, 2001). Connections amongst peoples of homogenous demographic features, such as family members, close friends, neighbours, and colleagues are bonding social capital (Putnam, 2000; Grootaert et al., 2004). Bridging social capital is the relations among individuals of heterogeneous demographic characteristics but live in vicinity to each other (Gittell & Vidal, 1998; Grootaert et al., 2004). Linking social capital is the relations among individuals of different power, and which involves vertical connection between local actors and the people who are in high power (Woolcock, 2001; Grootaert et al., 2004; Schneider, 2004). Dense networks among active local groups indicate high level of social capital which suggests the greater potential for collective action (Bodin & Crona, 2009). However, Schneider (2004) argued that the quality of relationships is often more important than the quantity.

Trust and solidarity

Scholars argue that trust and solidarity are the significant ingredients in the success of community based natural resource management schemes (Musavengane & Simatele., 2016) Further, Nardone, Sisto, & Lopolito, (2010) identified trust as the most essential element of the relational dimension of social capital. Trust is defined as “socially learned and socially confirmed expectations that people have of each other, of the organizations and institutions in which they live, and of the natural and moral social orders, that set the fundamental understandings for their lives” (Paxton, 1999). It functions as a lubricant for interactions and co-operation between the members within a group, and among groups,

reduces transaction costs, save time and liberates resources (Pretty & Ward, 2001; Teilmann, 2012; Yohan, Rianti, & Park, 2017). It takes time to build, but can be broken easily. Clear dispute resolution policies impart trust among stakeholders (Frost et al., 2007; Snyman, 2012). Higher levels of trust positively affect community member's willingness to participate in community-based resource management (Dyer et al., 2014; Pienaar, Jarvis, & Larson, 2013; Snyman, 2012). However, when there is lack of trust in the common pool resource management schemes, there is a higher likelihood that community solidarity will be compromised (Meer & Schnurr., 2013; Katikiro et al., 2015). The level of trust of various stakeholders including local community (oil palm and agricultural cultivators), SSFD, and GEC was measured.

Economic and social incentives

Economic benefits gained from community forest management has a positive relationship with social capital (Lee, Rianti, & Park., 2017). Economic motivators act as drivers of the cognitive and structural social capital in Sub-Saharan Africa (Musavengane & Simatele, 2016). Lack of understanding on the importance of social capital among community members can be offset by the derived economic benefits (Musavengane & Simatele, 2017). Other findings by Snyman (2012), Pienaar et al. (2013) and Mabuza, Ortmann, & Wale (2015), suggest that if people receive the right training, they can start their projects.

2.3.2 Collective action

Collective action could be broadly defined as an "action taken by a group […] in pursuit of members' perceived shared interests" (Scott & Marshall, 2009). It refers to the shared benefits and costs of the activities undertaken for conserving and managing natural resources (Ostrom, 1994). It is recognized as an important component of rural development and local-level natural resource management (NRM) (McCarthy, Dutilly-Diané & Drabo, 2004). Through collective action, the flow of benefits from natural resources can be conserved and more equitably distributed among participants (Jagger & Luckert, 2008).

2.3.3 Participation

Participation can be defined as a communicating and collective learning process that change the way of thinking and acting together with diverse actors to attain common objectives (Pretty, 1995; Isager, Theilade, & Thomson, 2002). Some scholars view

participation as a way to improve efficiency, the main idea is that, if community are engaged in activities, chances are more for getting support and acceptance of the service and/or new development; while, the others view it as a basic right of people, and the primary goal of it to begin mobilization for collective action, empowerment and institution development (Pretty, 1995). World Bank (2003) denoted participation as the involvement of beneficiaries in project design, implementation and/or any other project generated opportunities.

Local participation is an indispensable component of sustainable NRM (Macura et al., 2011; Nath et al., 2016; Newton et al., 2016). At the Rio Conference in 1992, local participation was documented as a key element of NRM; and gained legal recognition as an orthodox environmental management approach of sustainable development (Bixler et al., 2015). Social capital is positively correlated with the people's participation in the natural resource management (Marín et al., 2012; Nenadovic & Epstein, 2016).

Typology of participation

Based on the extent to which actors are engaged in development programmes, researchers categorized level of participation in many different ways having similarities and dissimilarities among them. Scholars (e. g. Arnstein, 1969; Biggs, 1989; Pretty, 1995) proposed approaches containing diverse stairs with numerous terms of rungs for describing their 'ladder of participation'. According to Arnstein (1969) at the lowest level of the 'ladder of participation' is the passive information dissemination (named 'manipulation'), to the highest level as active involvement (named 'citizen control') where the actors possess actual power required to influence the outcome of the process. On the other hand, Biggs (1989) classify the level of participation as "contractual", "consultative", "collaborative" and "collegiate." However, Pretty (1995) proposed a typology of participation with seven clear types namely manipulative participation, passive participation, participation by consultation, participation for material incentives, functional participation, interactive participation and self-mobilization ranging from a clear shift from passive type of participation to a more interactive type. However, to avoid conflicting interpretation, it is important to define participation by making reference to a particular typology (Pimbert & Pretty, 1995). Hence, this study used typology of participation (Table 2.8) suggested by Jules Pretty (1995) which is aimed at empowering individual or local communities.

Table 2.8 Typology of participation describing the ways local community involve in development projects and programmes (Source: adapted from Pretty, 1995)

Typology	Features
Manipulative Participation	Participation is merely an appearance, in where, representatives of people have official recognition only but they are not elected and have no authority.
Passive participation	People involve by being informed after decision is taken or activities happened. Here, project management or administration give unilateral declarations without considering the local communities' feedback.
Participation by Consultation	People merely involve in the process through consultation or by responding queries conducted by outside agents. Outside representatives identify problems and information collecting procedure and have full control over analysis. People have no stake in decision-making and it is not mandatory to consider people's views in time of decision making.
Participation for material incentives	Community involves by offering resources in exchange of something, such as, they received cash, food or other kind of material incentives in return for labour. However, they do not have any long-term stake in technologies or the project activities and hence, partnership stopped when the incentives finish.
Functional participation	People engage by creating groups and allowed to take minor decisions to attain the project goals specifically to lessen costs. Here, engagement is sometimes interactive and involve collective decision making; however, in most of the time people know after main decisions are taken by external agencies.
Interactive Participation	Various responsibilities are shared, communities engage in communal activities and decision-making processes. People jointly involve in analysing and developing activity plans; local institutions construction and/or strengthening. Here, participation is viewed as a right of the people and not a way to obtain project objectives only. Participants have the power to take decisions about the use of the existing resources.
Self-mobilization	External agents act as facilitators and community independently take initiatives to alter systems, and they make liaisons with outside agencies for technical support and resources if needed, but they have full power to take decision about the resource use. Self-mobilization can expand, if NGOs and governments create a supporting environment.

2.4 Criteria for measuring restoration success

The Ecological Restoration International (SER) (2004) have listed nine ecosystem attributes such as (1) similar diversity and community structure in comparison with reference sites; (2) presence of indigenous species; (3) presence of functional groups necessary for long-term stability; (4) capacity of the physical environment to sustain reproducing populations; (5) normal functioning; (6) integration with the landscape; (7) elimination of potential threats; (8) resilience to natural disturbances; and (9) self-sustainability to measure restoration success. However, in practice, most studies assessed three major categories of ecosystem attributes such as (1) diversity; (2) vegetation structure; and (3) ecological processes. Most of the scholars suggested a number of (i) ecological attributes: vegetation characteristics (vegetation structure, forest dynamics) (Walters 2000; Wilkins et al. 2003; Page et al., 2009; Parish et al., 2014), species diversity (Gann & Lamb; 2008; Parish et al., 2014), ecosystem processes (e.g. water/hydrological cycle; fire incidence) (Gann & Lamb; 2008; Page et al., 2009; Parish et al., 2014), and (ii) socio-

economic attributes: improve human livelihoods; empower local people; employment, business opportunity, social cohesion and community participation (Gann & Lamb; 2008; Page et al., 2009; Parish et al., 2014) for measuring restoration success.

2.5 Conceptual framework

The basic conceptual framework for effectiveness of community participation in PSF restoration and community development can be constructed by analysing the work that has been done and reviewing the literature mentioned before. As such a conceptual framework of this research is shown in Figure 2.2. The framework incorporated the concepts, for examples, characteristics of peat, peatland and peat swamp forest (described earlier), drivers of PSF degradation, enabling environment including institutional arrangement, formation of social capital and increased community participation in PSF management that drives community based PSF restoration efforts including hydrology maintenance, fire control and revegetation etc. Eventually these factors contribute to improve the socio-economic condition of local community and to sustainable management and restoration of PSF resources.

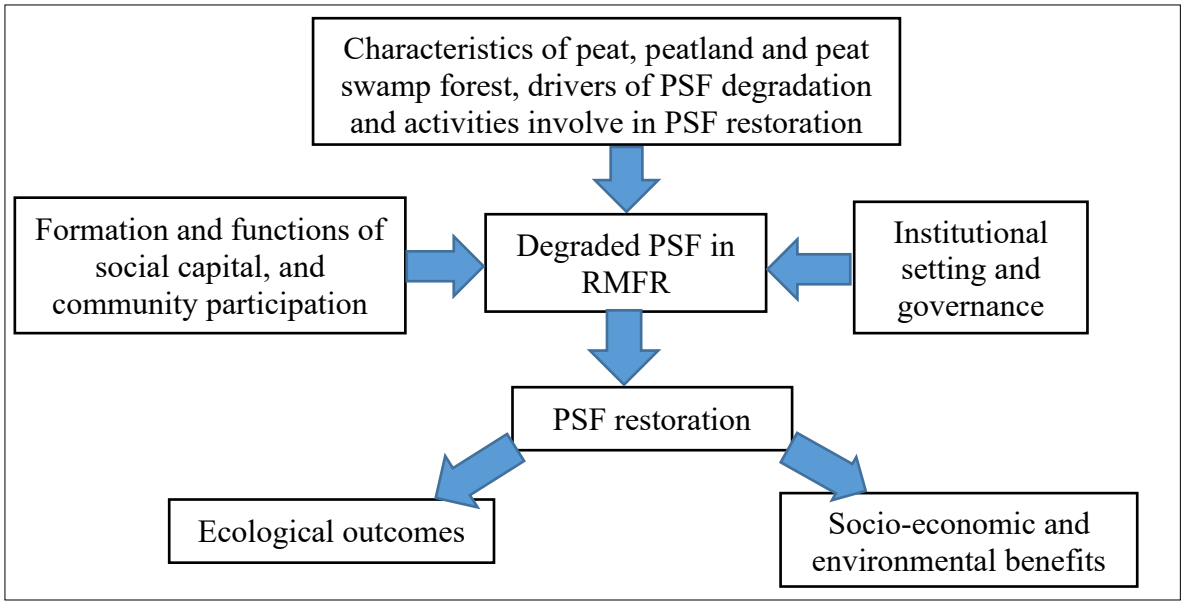

Figure 2.2 A conceptual framework for evaluating community participation in PSF restoration in RMFR, North Selangor, Malaysia

Degradation of tropical PSF in SEA are strongly connected with the economic and social demand of peatland (Koh, Butler, & Bradshaw, 2009). Scholars (e. g. Miettinen, Hooijer, et al., 2012b; Hirano et al., 2014; Margono et al., 2014) summarized that a vast area of

tropical PSF has already been deforested and the remaining areas are degrading rapidly mainly due to extensive timber extraction, drainage, indiscriminate fires and land use conversion, like agriculture, oil palm plantations and industry. In a study, Joosten and Clarke (2002) reported that agriculture was responsible for 50 % of natural peatland loss while the other 30% for forestry and 10% for peat extraction. During the last 25 years, Peninsular Malaysia, Sumatra, and Borneo have been lost around two-thirds of their PSF due to clear-felling, drainage and land transformation into agriculture, pulp and oil palm plantations (Lampela et al., 2017), unsustainable logging, road construction, and fuel-wood gathering (Miyamoto, 2007).

Yule & Gomez (2009) reported that tropical PSF in the Malaysian region are quickly disappearing as a result of logging, agriculture (mainly oil palm), drainage and fire. Likewise, Yule (2010) reported that Southeast Asian PSF are in danger for legal or illegal logging in particular, ramin (*Gonystylus bancanus*), drainage, transformation to agriculture e. g. oil palm, rubber, coconut, pineapple and paddy, residents and industries, fire, habitat fragmentation, hunting, tin mining etc. Schrier-Uijl et al. (2013) stated that approximately 14% oil palm plantations are raised on peatland. Further prediction revealed that, by 2020, 42 % of the total peatland (2.46 Mha) of Malaysia would be occupied by oil palm plantations (Miettinen, Hooijer, et al., 2012a).

To restore degraded forests and to improve socio economic condition of the local community, many countries of the world including SEA introduced community participation as a forest restoration and development intervention (Noor et al., 2005; Schusser et al., 2015). Studies (e. g. Pokharel et al., 2007; Chapagain & Banjade, 2009; Chen et al., 2013; Cheng et al., 2017) suggest that community participation in forest management can contribute to both degraded forest restoration and community development. The PSF restoration comprises of improving hydrological and forest condition by employing a number of activities including hydrological management, fire control, replanting, and encouraging natural regeneration, etc. (Dohong, Aziz, & Dargusch, 2018). For example, Lampela et al. (2018) identified some indigenous tree species e.g., *Shorea balangeran*, *Alstonia pneumatophora* and *Dacryodes rostrate,* those are suitable for revegetating the degraded PSF restoration of SEA. Blackham, et al. (2014) reported a continuous but low diversity woody vegetation cover with unassisted natural regeneration in degraded PSF in Indonesia. Ritzema et al. (2014) states that degraded PSF restoration

begins with rewetting the forest floor through water table management and he suggested to improve canal blocking strategies and dam design for proper hydrological management with a view to prevent fire and initiate revegetation. On the other hand, community development includes improving the local socio-economic condition, empowerment and capacity building of local community etc. However, community participation in forest management can contribute to improve local livelihood when there exists an encouraging condition and similarly, for local communities to be able to improve forest conditions through better management and protection, a conducive and enabling environment is also essential (Castren, 2005). The enabling environment largely includes policy, institutions, local level governance, community participation, capacity building, funding and technology etc.

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Chapter 3 : Social Capital and Community Participation in Peat Swamp Forest Restoration in North Selangor, Malaysia

Abstract

Local people's participation in the restoration and conservation of degraded forest has been regarded as an essential approach in many parts of the world including Malaysia. Social capital is an important factor that drive local people to participate in the collective actions of forest restoration and community development. An empirical investigation was conducted to examine the status and formation of social capital, and its contribution to the local communities' participation in forest restoration and community development activities at and around RMFR. Both quantitative and qualitative data were collected by 200 households survey from four adjacent villages, and by interviewing local community leaders, members of FNSPSF and officials of SSFD and NGO. Results revealed that some social capital in the form of local organization has been developed. Further, some encouraging structural social capital (bonding, bridging and linking) have been manifested; however, deficit in cognitive social capital (trust between local community, SSFD, and NGO) was noticed considerably. Moreover, paucity of economic development activities, demonstration of low level of community participation in forest restoration, and community development activities warranted to strengthen the current social capital. Recommendations are made to reform the local community-based environmental organizations (CBO) for greater participation of the local community in PSF restoration and community development.

Keywords: Social capital, participation, community-based environmental organizations, forest restoration, community development

3.1 Introduction

In recent years, many countries imparted remarkable changes in their state policy regarding forest and other resource management with an emphasis on collective approaches; in where, local people's participation is broadly viewed as crucial for sustainable forest management (Musavengane & Simateleb, 2017). Local user groups can skilfully manage common resources through collective action (Varughese & Ostrom, 2001; Pretty, 2003). Therefore, understanding the social processes behind collective action is essential to sustain ecosystems (Ban et al., 2013). A key component of these social processes is the social capital of individuals and communities (Auer et al., 2020). Social capital "refers to connections among individuals—social networks and the norms of reciprocity and trustworthiness that arise from them" (Putnam, 2000). The efficiency of social capital in devolution programmes based on participatory governance and collective action of local populations have made it a keystone for sustainable development policy (Ballet, Sliven, & Requiers-Desjardins, 2007). Further, social capital is the primary mechanism for facilitating collective action towards natural capital conservation and management, and sustainable rural development (Ostrom, 1994; Uphoff, 2000; Pretty & Ward, 2001; Ostrom & Ahn, 2009; Bizikova, Nijnik, & Kluvankova-Oravska, 2012; Liu et al., 2014). The enhancement of social capital in the villages and in the groups can be prompted to work together for mutual benefit on environmental initiatives and for meeting conservation objectives (Miller & Buys, 2008; Bisung et al., 2014) and is expected to help resolve problems in the collective governance systems (Putnam, 1993). Further, it empowers people in meaningful ways to pursue conservation objectives (Dale & Sparkes, 2007).

On the other hand, significance of social capital in driving local participation in biodiversity conservation (Pretty & Smith, 2004) and the sustainable management of natural resources has been well established (Gilmour, Dwyer, & Day, 2011; Marín et al., 2012). Scholars (e.g. Putnam, 1993, 2000; Uphoff & Wijayaratna, 2000; Ohno, Tanaka, & Sakagami, 2010) employed social capital as a predictor of civic participation in collective action.

The use of social capital in natural resources management evolved in the early 1980s when collaborative natural resources management in many developing countries had emerged. In 2008, a participatory forest management programme was started at RMFR by involving local people through forming social capital in terms of local community-based environmental organizations (CBO) e. g. FNSPSF, Junior Peatland Forest Ranger (JPFR) and Peatland Forest

Ranger (PFR). Nath et al. (2017) appreciated the local involvement in the restoration of degraded RMFR; however, to our knowledge, there is no empirically tested research relevant to formation and status of social capital among local community and other stakeholders, and its influence on the participation of collective actions (e. g. forest restoration and community development) at RMFR. Based on empirical research carried out in adjacent four villages, this paper aims to contribute to a better understanding of i) the formation and status of social capital among different actors; ii) the contribution of social capital in engaging community in collective action such as PSF restoration and community development activities; iii) levels of community participation in those activities; and iv) the sustainability of the main CBO (e.g. FNSPSF) based on the functions of social capital variables that influenced people's participation in PSF restoration and local socio-economic development at RMFR

We hypothesized that formation of the social capital among local community and other actors would facilitate higher level of local peoples' participation in the PSF restoration and conservation as well community development and which in turn helps the sustainability of the CBOs.

3.2 Methods

3.2.1 Data collection approach

I adopted a sociological survey to collect primary data from multiple sources applying both qualitative and quantitative approaches. Quibria (2003) highlights the need to integrate qualitative and qualitative data in order for studies to be rigorous. For qualitative data, I conducted four focus group discussions (FGD) with FNSPSF members, local level GEC staff members, village leaders, and elderly people from two adjacent villages during August–November, 2018. In each FGD, 4-8 participants were attended and each session took about two hours. To manage and minimise 'power dynamics' and 'group think' in the sessions, I acted as the facilitators (Bloomberg & Volpe, 2016). Similarly, five key-informant interviews (KII) were conducted with two SSFD officials, a homestay agro-tourism manager, FNSPSF chairperson, and a school teacher from JPFR in between August 2018 to October 2019. Sessions were audio-recorded with the consent of the respondents, and transcribed. Separate check-lists were prepared following Nath et al. (2010) and Pretty (1995) to explore the following topics: (i) identify the local CBOs involved in the PSF restoration programme, (ii) explore the CBOs emerging process, (iii) activities of the CBOs, (iv) relations with other

concerned organizations, (v) their participation process and (vi) extent of participation in the PSF restoration programme and community development activities (Appendix 1 for FGD & Appendix 2 for KII).

In order to collect quantitative data, I conducted household surveys in four villages (e.g., Sungai Sireh, Sri Tiram Jaya, Raja Musa and Bestari Jaya) surrounding RMFR. This was part of a broader socio-economic study. These villages were selected based on villagers' connectedness with the PSF and involvement in the PSF restoration programme (details of study villages illustrated in Chapter 1). Two hundred households, 50 from each village were selected randomly, and interviewed (Figure 3.1). A pre-tested structured questionnaire was prepared following Nath et al. (2010) and Pretty (1995), and outputs of FGD and KII to collect data on peoples' perception on social capital formation and dimensions, and participation in PSF restoration programme (Appendix 3). Taken together, these qualitative and quantitative data provided a holistic picture of the formation and functions of social capital, and the level of community participation in the PSF restoration programme.

I prepared questionnaire in English and translated into *Bahasa Melayu*, native language of the respondents. Interviews were conducted in *Bahasa Melayu* and each interview took about 40-50 minutes. Four women research assistants helped to conduct interviews, and they were provided training on interview process beforehand. Data collection was carried out through a series of field visits from August to December 2019. Ethical committee of Faculty of Science and Engineering, University of Nottingham Malaysia approved this research (approval no. MJA090819) (Appendix 4). Participation in the survey was voluntary and respondents' verbal consent was taken before each interview.

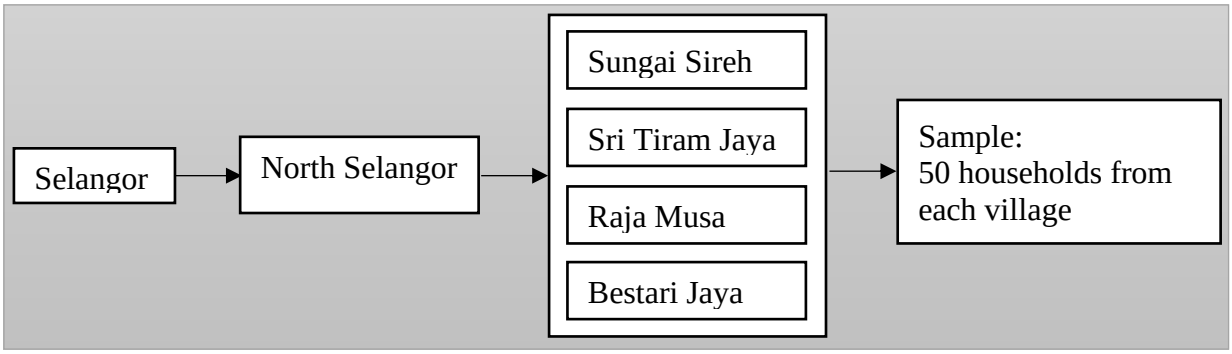

Figure 3.1 Flow diagram of population and sampling design

The mobilisation of mixed methods (qualitative and quantitative) allowed for triangulation of data to verify the validity and credibility of the information obtained (Harwell, 2011; Bryman, 2012).

3.2.2 Data analysis

Qualitative data were classified and coded according to the themes and issues, and then narrative description was followed to interpret the findings of FGD and KII. Quantitative data were classified according to the themes and coded first, and then transferred to Microsoft Excel data sheets to develop raw data tables. Descriptive statistics (e. g. frequency, percentage, and mean) of the variables such as socio-demographic attributes, social capital, level of participation was calculated.

3.3 Results

3.3.1 Social capital

Group formation, status and functions

Participants of FGD and KII commented that as an entry point for social capital formation, one village level CBO viz. FNSPSF was formed in 2012 with direct support from GEC. Then in 2014, two school level nature clubs namely PFR in five local high schools and JPFR in 13 local primary schools (near to the RMFR) were formed with the direct inducement of GEC. They said that FNSPSF was the prime local CBO involved in PSF restoration programme.

Discussion with FGD participants and key-informants revealed that GEC initiated the formation of FNSPSF in early 2012 by conducting a series of meetings with local forestry staff, community leaders, and villagers. In August 2012, FNSPSF was formed with the presence of about 100 villagers from four villages (e. g. Sungai Sireh, Sri Tiram Jaya, Raja Musa and Bestari Jaya). Initially 97 members from all four villages joined while majority from Sungai Sireh and Raja Musa. Membership eligibility criteria was open irrespective of village, gender, occupation, education, income and age. However, the current active member is around 30-40; with 2 members from each Bestari Jaya and Sri Tiram Jaya, around 5 and 20 from Raja Musa and Sungai Sireh respectively.

Results of household surveys indicate that currently a very small portion (16%) of sample respondents has a membership with FNSPSF (Table 3.1). Most of them are from Raja Musa (45%) and Sungai Sireh (36%). Members are mainly composed of male (77%); older 48% and middle-aged 45%; secondary education 65%; agriculture 32%; service and wage labour 9% and low income 55% (Figure 3.2).

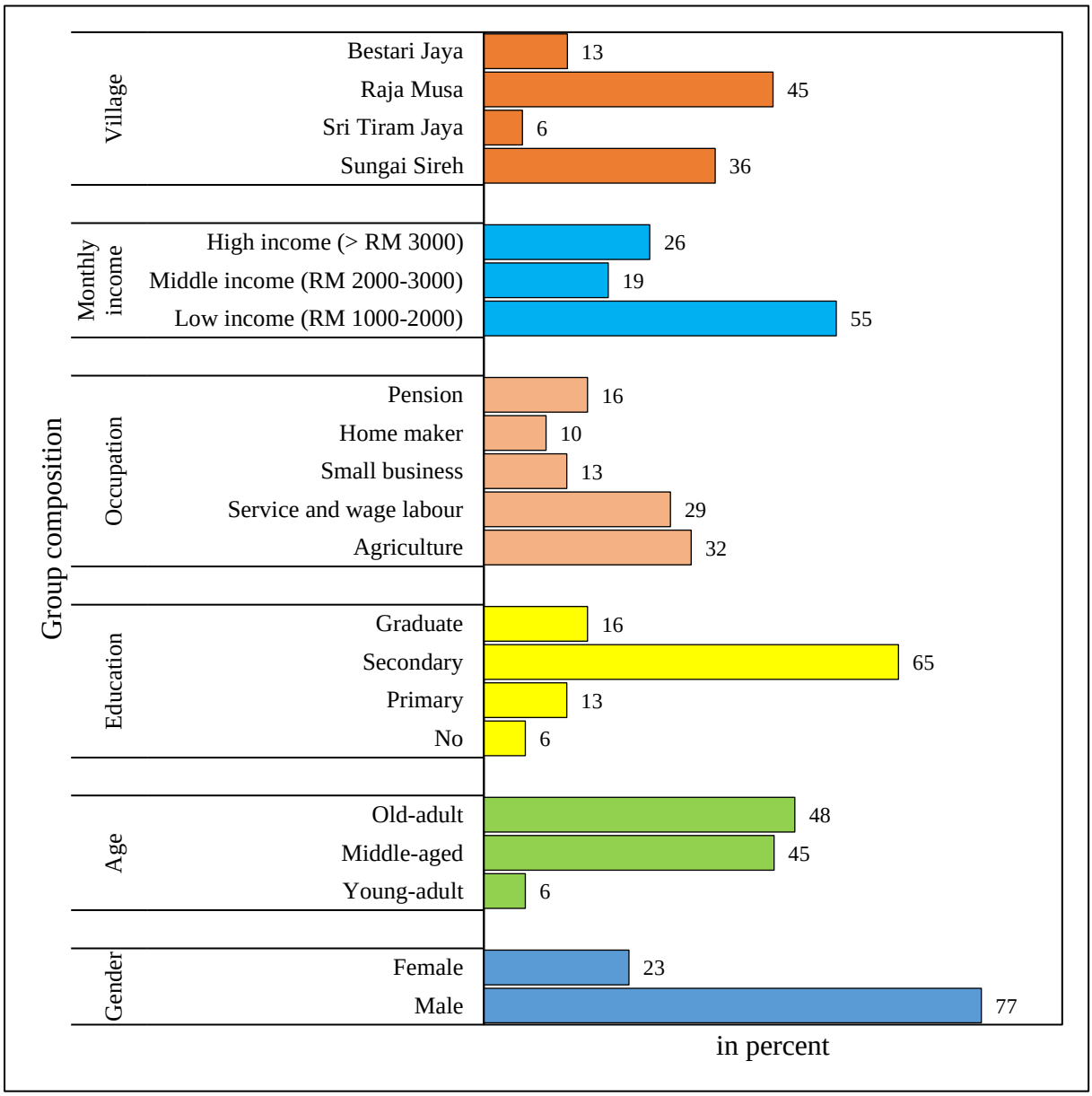

Figure 3.2 FNSPSF membership composition (n=31)

A 13-member executive committee was formed involving representatives from all four villages (Figure 3.3) and registered with Register of Society (ROS), Malaysia in August 2012. Annual general meeting (AGM) holds almost in every year with the support of GEC. Committee was formed through consensus and most of the committee members are inactive now.

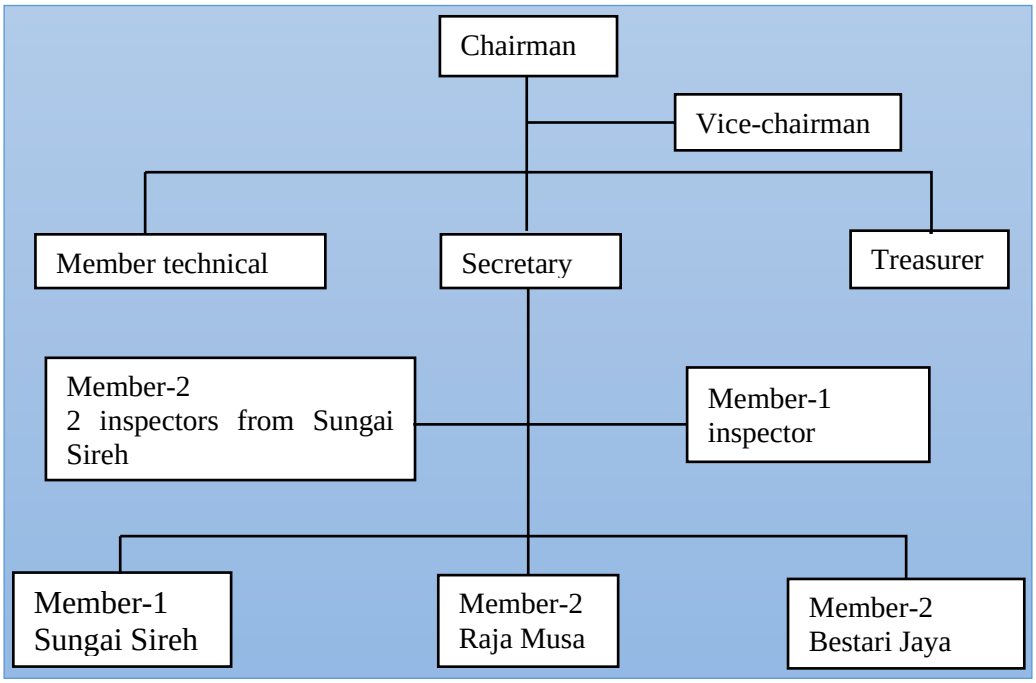

Figure 3.3 Organizational structure of FNSPSF

About one third (35%) of the current members participated in group meetings and among them only 36% took part in the decision-making process (Table 3.1).

Table 3.1 Household membership status of FNSPSF

Variables	n(%)
FNSPSF membership from households (N=200)	
Yes	31(16)
No	169(84)
General awareness about FNSPSF (N=200)	
Know	92(46)
Don't know	108(54)
Participation in group meetings * (n=31)	
Yes	11(35)
No	20(65)
Take part in decision making ** (n=11)	
Yes	4 (36)
No	7(64)
Want to continue membership with FNSPSF †(n=31)	
Yes	18(58)
No	13(42)
Village-wise willingness to continue membership with FNSPSF ††(n=18)	
Sungai Sireh	6(33)
Sri Tiram Jaya	1(6)
Raja Musa	9(50)
Bestari Jaya	2(11)
Non-member respondents' interest to join FNSPSF (n=169)	
Yes	15(9)
No	154(91)
Share of village non-member respondents' interest to join FNSPSF ¥ (n=15)	
Sungai Sireh	2 (13)
Sri Tiram Jaya	6(40)
Raja Musa	5(33)
Bestari Jaya	2(13)
Reasons to join	
Help to rehabilitate the forest	7(47)
Job and income opportunity	8(53)

Note: values calculated from the respondents: *who have a membership of FNSPSF. ** who participates in group meetings. † who wants to continue and not continue. †† Village-wise willingness to continue membership. ¥ who would like to join.

Groups and Networks

Participants of FGD and key-informants revealed that apart from the FNSPSF, local level social development organizations such as 'village committee' in all studied villages and 'homestay agro-tourism' in Sungai Sireh have been operating for the last few years. Some of the FNSPSF members and/or their families have a membership with those organizations. As homestay agro-tourism manager explained that "*although homestay agro-tourism and FNSPSF are two different establishments; however, most of the homestay operators and/or their families are also the members of FNSPSF*". This bonding helped to promote communication between

FNSPSF members and local community and hence, about half (46%) of the household respondents know about the FNSPSF and their activities (Table 3.1).

Further, FNSPSF have built a linking network with SSFD and GEC through partnership with different PSF restoration and conservation activities. This working partnership facilitated to develop a congenial relation with SSFD officials. As one FNSPSF member stated that "*SSFD director is a very good man and always embrace me when we meet; and also we have a good relation and communication with local forest officers*". Bridging network with other similar CBOs in Malaysia and abroad have also been developed through study visits, attending seminars and sharing knowledge. For example, current chairperson of FNSPSF explained that

> "we attended an environmental event organized by Friends of Kuala Langat North Peat Swamp Forest to learn their activities and set out a booth to display our activities. Likewise, me and secretary of FNSPSF participated in the inaugural ceremony of Friends of Mangrove Forest at Johor".

Further, one senior member of FNSPSF stated that

> "when I was the secretary, I attended many meetings in different places of Malaysia, Indonesia and Thailand".

Current chairperson of FNSPSF stated that

> "our previous secretary Mr. Jainun, has a good connection with a local CBO for PSF management in Rio, Indonesia. This connectivity helped us to arrange a study tour for some of our members".

Trust and solidarity

Discussion with FNSPSF members identified a number of trust related issues among local community and project authority (SSFD and GEC). For instance, in the initial stage project authority did not buy seedlings from the community nurseries as committed verbally to FNSPSF. Second, some FNSPSF members of Bestari Jaya had oil palm plantations inside the PSF and their plantations were destroyed without allocating any alternate land to them. Third, canal blockings make risk (in particular Raja Musa) on their economy by hindering irrigation water supply to their oil palm plantations in dry season and increasing flood risk during heavy monsoons. As one of the members of FNSPF stated that they arranged meetings between village committee and GEC to resolve the irrigation and flood problems; however, the villagers did not get any solution despite their repeated appeal to GEC and SSFD. All these events caused to develop a mistrusting relationship and eventually some quit FNSPSF membership. In

addition, following statement of a key-informant of Raja Musa is the example of low level of trust toward GEC:

> "Although GEC has an office here and we know each other but we don't know about their activities. They stay here and make programmes for the outsiders; outsiders come and plant the trees".

Respondents' opinion on the economic and social incentives that form social capital

Participants in FGD from villagers and FNSPSF explained that initially many people joined with a hope to get some additional income. But paucity of direct benefit provisions demotivates them to continue their membership. Household surveys reveal that about three fifths (58%) of the current members want to continue and most of them are from Raja Musa (50%), followed by Sungai Sireh (33%), Bestari Jaya (11%) and Sri Tiram Jaya (6%) (Table 3.1). Further, a very small portion (9%) of non-members showed interest to join; most of them are from Sri Tiram Jaya (40%) and Raja Musa (33%); while, an equal 13% from each Sungai Sireh and Bestari Jaya. Again, with a hope to increase income (53%) (Table 3.1). Similarly, the present chairperson of FNSPSF stated that villagers are interested in to join but they want some direct benefits.

One of the pioneer organizers of FNSPSF explained that

> "general motivation of local people is that if I don't get anything, why should I join? But I believe if we can conserve the forests, we will get benefit; however, most don't believe that, and they want immediate benefit."

In converse, homestay operators get permit from SSFD to operate eco-tourism in the PSF and access to other project benefits like training on handicraft making.

Further, one GEC staff stated that:

> "FNSPSF formation created a channel with the FD and now local community got a space to speak up and say their opinion and demands to the government. So indirectly given them access because FNSPSF is already known to everyone. When FNSPSF come to SSFD to say something it gets acknowledged easily rather than you stand alone and say something".

3.3.2 Collective actions

Participants of FGD and KII identified a number of collective actions including nursery raising, tree planting and maintenance, canal blocking, forest patrolling, and participation in training. FNSPSF sometimes employs local community for canal blocking and their maintenance. Four community people was recruited as temporary staff by GEC (not FNSPSF affiliated) for forest patrolling (to report encroachment, water table reading, fire incidences, etc.). By dividing into two groups they patrol the boundary areas of RMFR. On every Wednesdays JPFR students (at one school) work (including cleaning, watering, manuring, etc.) two hours (from 9.0 am to 5.0 pm) in the community nursery. In addition, representatives of FNSPF (at least one member), JPFR and PFR members, and local communities of all demographic profile participate in the restoration events (e. g. tree planting, canal blocking, etc.) including observance of various environmental and nature conservation days organized by GEC and/or SSFD. However, we did not find any evidence of community organized collective action for community development in any of the four studied villages.

3.3.3 Participation

Participation was assessed from project design and activity planning to implementation, benefit sharing and information flow. Discussion with participants at FGD and key-informants indicated that GEC conducted a baseline socio-economic survey and consulted with local people prior to designing PSF restoration plan (by GEC and SSFD) and peoples' opinions were considered while developing the plan. Similarly, household interviews reveal that local people were consulted in identifying their needs and priorities and developing project restoration plan as stated by 40% and 41% of the informed participants (61%, 121 out of 200 respondents) respectively. Further, more than two thirds (71%) of the informed respondents believe that local needs and priorities were properly integrated (93%) (Figure 3.4).

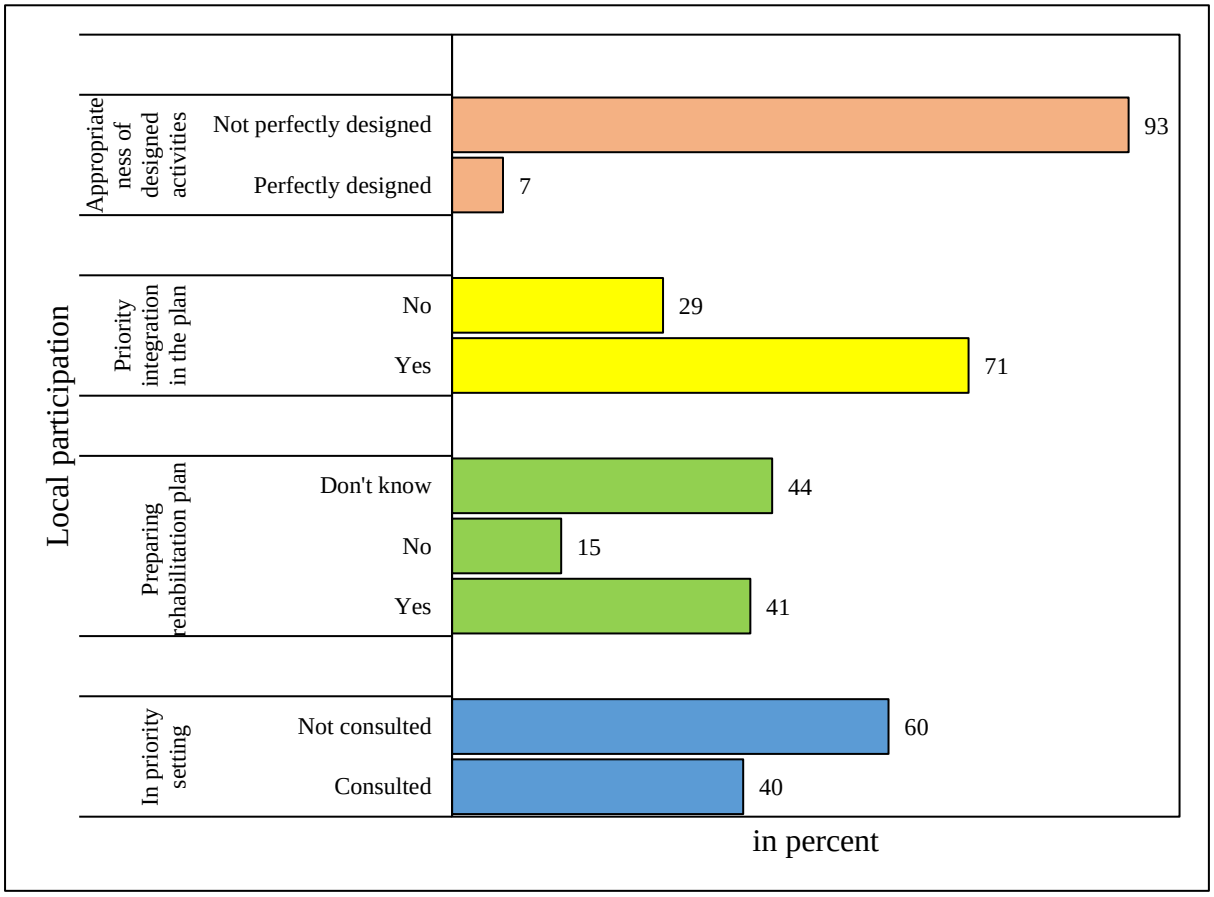

Figure 3.4 Local people's participation in the design and planning stage of the RMFR restoration programme (N=200 & n=121) (Data source: Field survey, 2019).

Restoration activity plan decisions are mainly taken by SSFD and GEC and local people were never invited to get involved in this process. As one elderly village leader argued that

> "we live here for generations, so we know the local situation better but they do not consult with us, they first take decision and then they inform us".

Similarly, only 17% of household respondents were attended in activity plan meetings 2.44 times in a year. Attendees stated that meetings were held once (42%) or twice (47%) in a year which were arranged by GEC. Over two thirds (71%) of the attendees got a chance to participate in the discussion and about one third (29 %) of the discussants' opinions were accepted frequently (Table 3.2). However, one GEC staff stated that they conduct regular meeting with the FNSPSF members in every two months to discuss about community development programmes and their involvement process in the project activities and forest conservation.

Table 3.2 Local people's participation in the project activity plan, implementation and benefit sharing of the RMFR restoration programme (Data source: Field survey, 2019).

Activities	
Attending project activity plan meetings (% of households) (N=200)	
Yes	17
No	83
Times/year †	2.44
Frequency of project development discussion meeting (% of households) *(n=34)	
1-3 months	15
Half yearly	47
Yearly	42
Had a say (% of households) * (n=34)	
Yes	71
No	29
Frequency of acceptance of people's opinions (% of households)** (n=24)	
Frequently	29
Sometimes	71
Implementation stage	
Participation in activities (% of households) (N=200)	
Yes	19
No	81
Frequency of participation (% of households) [a] (n=38)	
Every month	3
1-3 times	89
4-6 times	8
Times/year †	2.21
Obtain benefits from participation (N=200)	
Yes	22
No	78
Participation was [b](n=44)	
Voluntarily	86
With cash or other material benefits	14
Access to benefits for attending activities (% of households† (n=7)	
Patrolling activities	25
Nursery raising	21
Permission to ecotourism activities	46
Training allowance	8
Willingness to continue in restoration activities after the project benefit is withdrawn (% of households) † (n=7)	
Yes	62
No	38

Note: * values calculated from the participants: who joined the meetings, ** who had a say in the meeting, † total number of times attended meeting/activities in a year divided by number of participants attended, [a] who attend the activities, [b] values calculated from the participants only who get the benefits and [c] who obtain cash benefits.

Again, in the implementation stage only one fifth (19%) of the sample respondents participated in the forest restoration and training activities. Majority (89 %) of the attendees joined 2.21 times (average) in a year. A very small portion (14%) of the attendees received a very minimum amount of cash and/or other direct benefits for joining project activities such as forest

patrolling (25%), nursery establishment (21%), creating ecotourism opportunities (46%) and training allowance (8%). Further, GEC participants explained that community nursery, canal blocking projects, patrollers recruitment and eco-tourism provided some livelihood options for the local community. In contrast, one key informant from Raja Musa stated that "*villagers do not get any benefit from the project. The only benefit you might say, the establishment of a nice office in our village*". Majority (62%) of the benefited participants are willingness to continue even though the project benefit is withdrawn (Table 3.2).

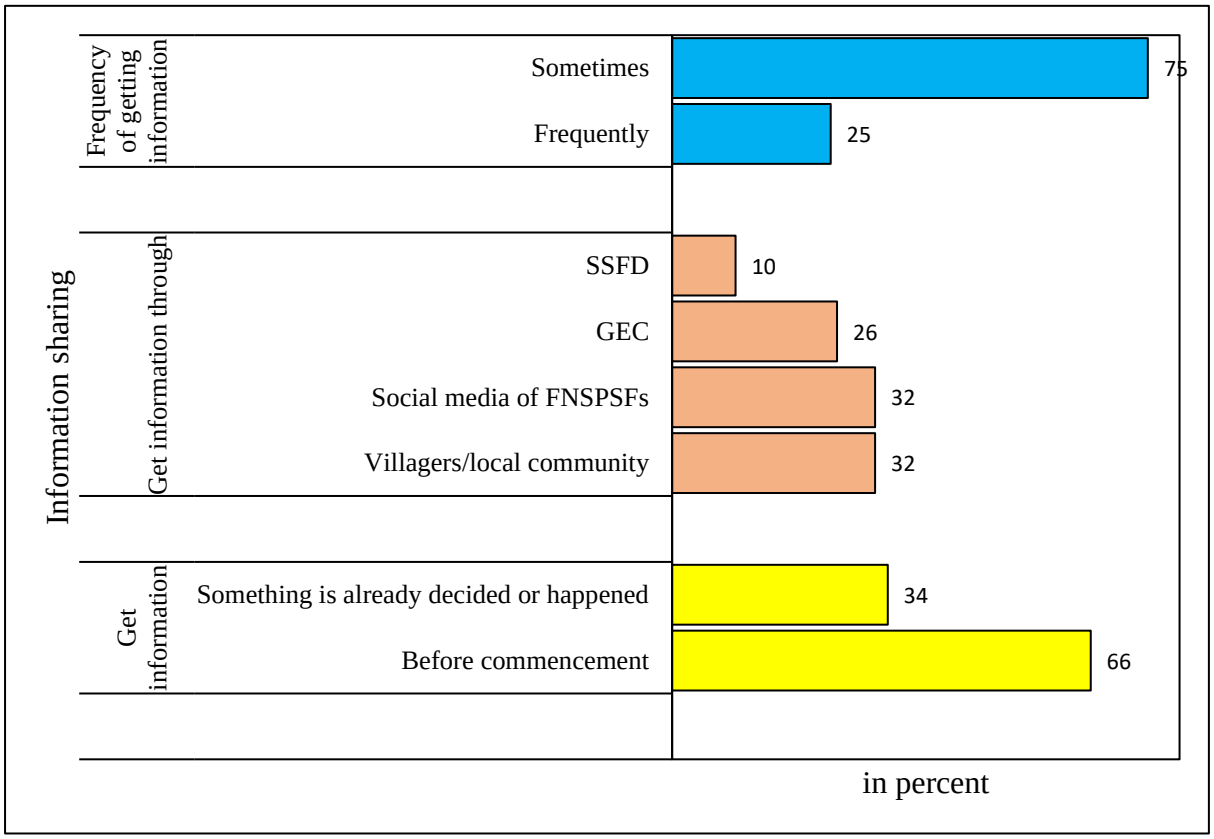

Figure 3.5 Information sharing of the local people about the RMFR restoration programme (N=200 & n=87, who get information) (Data source: Field survey, 2019).

Less than half (44%, 87 out of 200) of the participants has an access to project related information. Of them, only one quarter (25%) get information frequently mainly through villagers (32%), social media of FNSPSF (32%), and GEC (26%). Approximately two thirds (66%) of the informed respondents get the information before commencement of the activity (Figure 3.5.). One GEC participant stated that they have a WhatsApp group through which they disseminate project information to the FNSPF members.

3.4 Discussion

3.4.1 Social capital

Group formation, status and functions

Findings indicate that GEC with the support of SSFD facilitated to form one village level CBO (FNSPSF) and two school nature clubs namely JPFR in 13 primary schools and PFR in five secondary schools. The formation of these three diversified groups (FNSPSF, JPFR & PFR) encouraged different categories of people (e.g. local community and students) to participate in various activities of the PSF restoration programme. Groups with high diversity tend to share more experiences which in turn motivate many people to join and participate (Pienaar et al., 2013; Musavengane & Simatele, 2017). Further, FNSPSF was the main CBO aimed to involve local community in PSF management functions. Although, the initial formation of FNSPSF was found robust with a remarkable number of members (about 100) from all four bordered villages with varied demographic profiles (such as such as gender, age, occupation, education and income). Groups with a considerable number of people tend to have a wide pool of information to use in decision-making (Snyman, 2012) and groups with high diversity tend to share more experiences which in turn motivate many people to join and participate (Pienaar et al., 2013; Musavengane & Simatele, 2017). However, over the period, both composition (village-wise number of members) and overall number of members reduced drastically in three villages and a slight decrease was also found in one village. This organizational deterioration might be weakened the functional capacity (i.e. effectiveness and efficacy) of FNSPSF. Nevertheless, FNSPSF obtained government registration at the early stage of the PSF restoration programme. This legal recognition of FNSPSF would help its long-term sustainability. Another important finding was that AGM was held in almost every year with the support of GEC. AGMs have selected executed committees based on consensus rather than election and only a few numbers of members participated in the community development meetings. However, almost all of the cases GEC dominated the decision-making process. All of these features indicate a low level of democratic functioning within FNSPSF. Hove, Ngwerume, & Muchemwa (2013) stressed on to the greater civic participation in all levels including decision-making to improve democratic and development discourses.

Groups and Network

Results show that members of FNSPSF and/or their families have a membership with two other existing local CBOs (e.g. village committee and homestay agro-tourism). Our qualitative and quantitative analysis suggests that this network facilitated to increase communication and improve environmental awareness within and among families, friends and group members. Further, FNSPSF possessed linking social capital with SSFD through which they obtain various benefits ranging from social recognition and empowerment to raise voice, opportunities for small business, ecotourism, and training. Social capital can improve one's social status through providing improved recognition and increased assets (Valenzuela et al., 2020). Although very limited, FNSPSF had a meaningful sharing of learnings among the CBO networks (bridging social capital) in country and abroad. In some occasions, leaders of FNSPSF communicated with those institutions. In many societies, community leaders maintain bridging and linking social capital by voluntarily establishing linkages with external agents through their own efforts and personal networks (e.g., governmental officials, political groups and credit sources) on behalf of potential user groups (Bodin & Crona, 2009; Krishna, 2011).

Trust and solidarity

Trust (a cognitive social capital) is more important than the structural (such as groups and network) social capital (Yu, 2013). The finding of the study provides evidence that a mistrust was developed between the local community (local people and FNSPSF) and the project authority (GEC and SSFD) particularly with the issues such as not buying back of community nursery seedlings, irrigation water supply hindrance, and eviction of illegal occupats (e.g. settler, oil palm planters and other cultivators) from the PSF. While at the same time, no proper official initiative has been taken to resolved these disputes; although, FNSPSF and village committee raised the water issue to GEC and SSFD at several times. Results also show that only half of the members want to continue with the FNSPSF and on the other hand, only a negligible portion of the non-members willing to join. Reduction of the number of members and non interest to register as a member were linked to the mistrust developed between the local community and the project authority. Similarly, unclear dispute resolution processes increase the marginal probability of non-participation in community-based resource management (CBRM) (Zulu, 2008). Therefore, clear dispute resolution policies would be beneficial, as it instils trust among stakeholders (Frost et al., 2007; Snyman, 2012). Further, local community showed a low level of trust in GEC and their activities. Higher levels of trust

in fishing communities reduces the costs of monitoring and enforcement (Grafton, 2005) and bridging organizations serve the linking function between government and local communities through which processes of trust building, learning, information sharing, and others occur (Berkes, 2009). Hence, it is important to improve the trust of GEC to local community.

Respondents' opinion on the economic and social incentives that form social capital

Findings indicate that people initially joined FNSPSF with a hope to get some direct benefit but insufficient community development activities demotivated them to continue membership. Community members tend to positively participate if they perceive the accruement economic benefits (Suich, 2013), which also helps to build cognitive social capital (Liu et al., 2014). In contrast, homestay agro-tourism operators have gotten permission to use the PSF as an eco-tourism destination through FNSPSF and which motivated them to continue membership. In addition, local community obtained some other benefits including training on handicraft making and compost preparation etc. Fair distribution and accessibility of natural resources as well as income, business and training opportunities are positively correlated with the participation in CBRM schemes (Fritz-Vietta, Rottger, & Stoll-Kleemann, 2009; Musavengane & Simatele, 2017).

3.4.2 Participation

Results indicate that GEC conducted a baseline survey to gather information on local problems, needs, priorities, environmental and socio-economic impacts of RMFR. Local people participated this process by providing information through discussions and answering survey questionnaires which was designed, conducted and analysed by GEC. Success in collaborative management is linked to the processes of pre-negotiation and meetings among relevant stakeholders (Husseini, Kendie, & Agbesinyale, 2016). When local communities, their goals, and needs are disregarded in project planning and implementation stage, there is a risk of forest landscape restoration project failure (Höhl et al., 2020). Most believed that the peoples' responses were reflected in the PSF restoration strategies (e. g. collective action) taken and local concerns and problems were incorporated in the project plan; although, a different view about the negative impact of canal blocking was reported. A minimum to moderate level of local participation in the planning stage of a participatory forest and watershed management programme was reported by Tadesse, Woldetsadik, & Senbeta (2017) and Mengistu & Assefa (2021) respectively; while, Akello et al. (2017) found community participation was excluded

at a community-based watershed management programme in Uganda. In general, therefore, it seems that local community's participation was limited to consultation during planning stage. On the other hand, GEC and SSFD in together took restoration activity plan decisions in where local people and/or FNSPSF have no involvement. However, occasionally FNSPSF and GEC meet together to take some minor decisions regarding community development issues like nursery establishment, eco-tourism enrichment and forest patrolling etc. In Bangladesh, local people were less involved with forestry project planning, as forest department officers had always played the dominant role and controlled the whole decision-making process (Islam et al., 2013). In contrast, high level of community involvement in development programme decision-making in Kainji lake national park (KLNP) in Nigeria was observed (Ayodeji, Ayodele, & Reuben, 2016). Overall, these results suggest that local community exhibited a very minimal to no participation during the activity planning stage of the programme.

Further, a notable portion of villagers and FNSPSF members participated in quite a few numbers of collective actions related to PSF restoration such as plantation establishment, canal blocking, fire control and training more than two times in a year. Researcher (e. g. Maraga et al., 2011; Husseini et al., 2016) found that local communities only participate at the implementation stage especially during the nursery and plantation development activities. Further, a very negligible portion of local people get some cash and/or other material benefits for participating project activities.

About one quarter of the informed respondents get project information frequently after decision was taken. Informing community members from the onset of CBRM project encourages participation (Pienaar et al., 2013; Dyer et al., 2014).

3.4.2.1 Assessment of level of participation

FNSPSP is an officially recognized local CBO having a selected executive committee but they have no apparent authority in the PSF restoration project (participation level 1 as suggested by Pretty, 1995). FNSPSF was usually informed before the commencement of the activities; however, SSFD and GEC undertake activity plan decision without getting local communities' consent. Hence, people participation is limited to be told what is going to be happened (level 2). Local people were consulted by GEC in identifying their needs and priorities. GEC identified the problems and collected information and had full control over analysis. Very limited to no local participation in project meeting and local community have no stake in decision-making which is mostly entrusted to GEC and FD (level3). People participate in the

activities mostly voluntarily; although, a negligible portion get cash and other benefits. FNSPSF and JPFR have a very limited long-term stake in the restoration programme. Majority of the benefited members are interested to continue their participation even though the incentive stops (level 4). Three local groups such as FNSPSF, JPFR and PFR were formed to meet project objectives; however, they are highly dependent on GEC and SSFD for operation. They usually informed major decisions after taken by GEC and FD; whereas, with the help of GEC, they can take some minor decisions on community development programme. No evidence was found to be self-dependent (level 5). Local CBOs participate in various restoration activities and some responsibilities (such as forest patrolling and seedling raising) are also shared but not involved in analysing and developing activity plans. Some evidence of the efforts to strengthen the CBOs were observed with the help of GEC (level 6) (Table 3.3).

Table 3.3 Typology of community participation in the PSF restoration, conservation and community development at RMFR (according to Pretty, 1995)

Level	Typology	Features of participation
1	Manipulative participation	FNSPSF is a government registered CBO and it has a selected executive committee are being selected in the annual general meetings (AGM); however, they have no apparent authority in the restoration project.
2	Passive participation	FNSPSF usually informed prior to the start of the activities. However, GEC and FD in together take activity plan decision without having local communities' opinion.
3	Participation by consultation	Local people were consulted by GEC in identifying their needs and priorities at the beginning of the restoration project. GEC collected and analysed the information. In project meetings, local community have very limited to no involvement and they have no role in decision making which is mainly entrusted to GEC and FD.
4	Participation for material incentives	Generally, people participate the activities voluntarily; however, an insignificant portion get some benefits like employment, training and small business opportunity etc. Local CBOs e.g. (FNSPSF and JPFR) have a very limited long-term stake in the restoration programme. Most of the benefited members are interested to continue their participation in the restoration activities even though the incentive stops.
5	Functional participation	Three local groups such as FNSPSF, JPFR and PFR were formed aiming at to meet project objectives; however, they are highly dependent on GEC and SSFD for operation. After taking major decisions by GEC and FD about forest restoration activities they are usually informed. However, with the help of GEC, they can take some minor decisions on community development programme.
6	Interactive participation	Local CBOs participate in various restoration activities and some responsibilities such as forest patrolling and seedling raising for monthly tree plantation are also shared but not involved in analysing and developing activity plans. Some evidence of the efforts to strengthen the CBOs were observed with the help of GEC
7	Self-mobilization	Features are not available

Taken together, the result shows that based on the features of Jules Pretty's (1995) typology the local participation in RMFR restoration and management can be ranked between levels 1-5 as most of the features of those levels are available; although some of the features of level 6 are also very hardly available. Local communities' participation in resource management at Borgu sector of KLNP ranked between levels 3 to 5 (Ayodeji et al., 2016) and at Kakum National Park in Ghana between levels 2 to 3 (Enuameh-Agbolosoo, 2016)

3.5 Conclusions

The main aim of this chapter was to determine the influence of social capital on communities' level of participation in collective action. By evaluating the formation of the FNSPSF and its functions related to different social capital variables/attributes and assessing level of participation in collective action, this study found that FNSPSF is mostly function with the assistance of GEC (external agency). FNSPSF developed some (bonding, bridging and linking) social capital with others (e. g. local community, authority and other CBOs in country and abroad) but mistrust to the authority (GEC and SSFD), lack of democratic functioning and paucity of economic activities caused drastic reduction of number and composition of FNSPSF members and thus the organization functioned poorly. Moreover, most of the claims about participatory approach tested deficient in this study. No self-initiated PSF restoration and/or community development activities were found, which are the main threats to the sustainability of FNSPSF. Level of participation is mostly featured by manipulative to functional (1-5) which undermines the FNSPSF's effectivity. Interactive participation (level 6) can be achieved through forming new local institutions or the strengthening the existing ones with an ultimate aim of a self-mobilized (level 7) local organization (Pretty, 1995).

Hence, in order to foster social capital and increase local participation in PSF restoration and community development activities, this study proposes to form two new village level institutions (grass root) in addition to this current FNSPSF (canopy level). A brief description of the proposed institutions and their structure are described below.

Formation of village level local community based organization

Depending on the distance and context, the adjacent villages can be divided into two categories namely 1) Forest Conservation and Recreation Village (FCRV), and 2) Forest Restoration Village (FRV). (Figure 3.7)

1) Forest Conservation and Recreation Villages (FCRV) (Sungai Sireh and nearby villages)

Adjacent to these villages the PSF condition is good and have ample eco-tourism opportunity. Here the following activities are proposed: i) Awareness creation about the importance of PSF; ii) Community based PSF conservation; and iii) Development of recreational facilities in and around the PSF iv) Training on handicraft making v) funding support

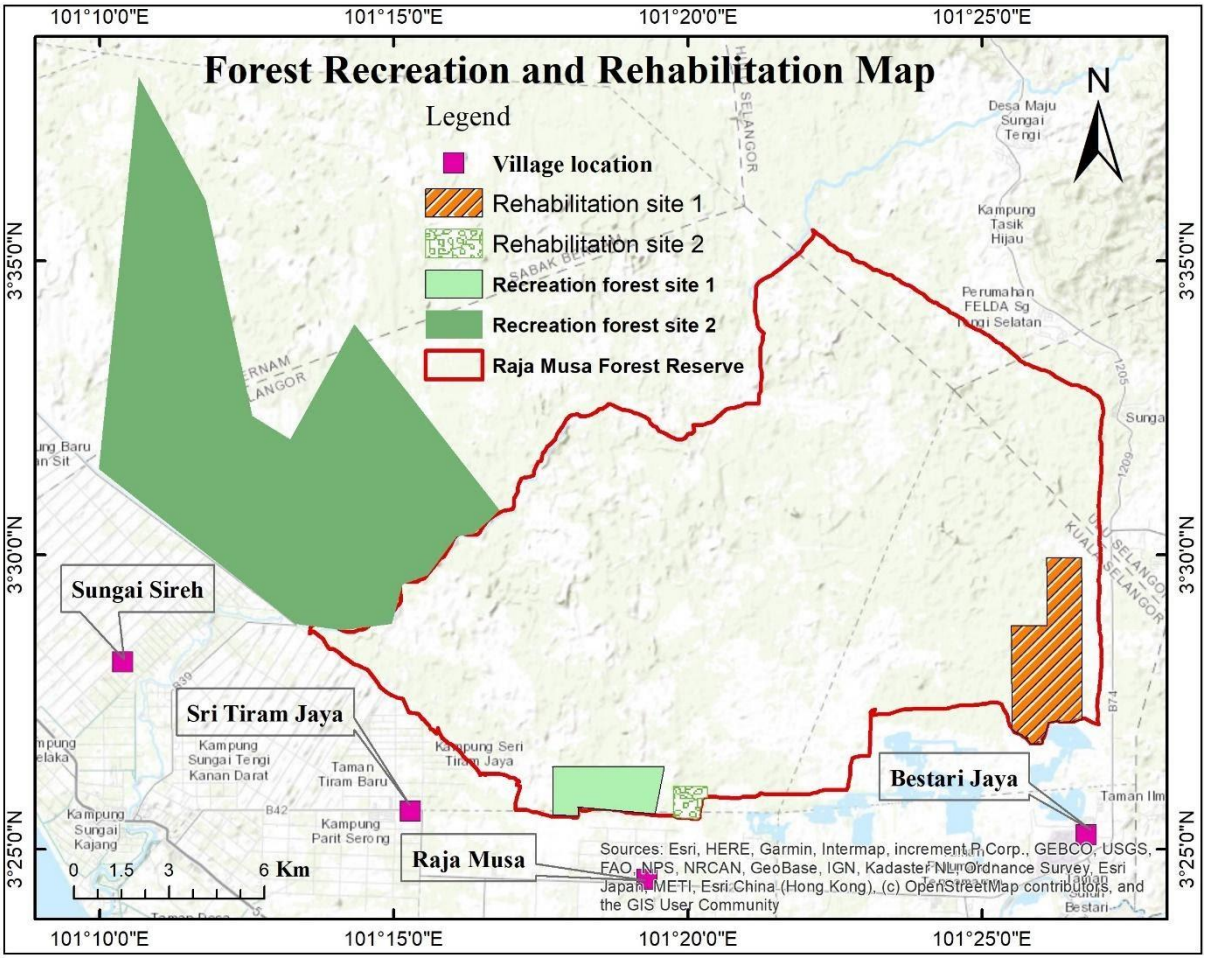

Figure 3.6 The recreation and rehabilitation management map of Raja Musa Forest Reserve showing the location of the forest recreational and rehabilitation site in respect to the village location (Source: Google Earth and Esri ArcGIS 10.4 was used to create this figure) (SSFD, 2014)

2) Forest Restoration Villages (FRV) (Raja Musa, Bestari Jaya and nearby villages)

Forests adjacent to these villages are damaged and/or degraded. The following activities are proposed here:

i) PSF restoration through replanting, and canal blocking, fire prevention, patrolling and monitoring; ii) awareness creation about the importance of forests; iii) reintroduction of community nursery; iv) increase employment opportunity through recruiting local people as a patroller and engaged them in infrastructure development. On the other hand, for local community well-being nursery development; iv) provide training and fund; and v) development of a long-term benefit sharing mechanism for example, share from planted trees and revenue from irrigation water, carbon trading, etc. A general organizational framework for village level FNSPSF is illustrated below (Figure 3.7)

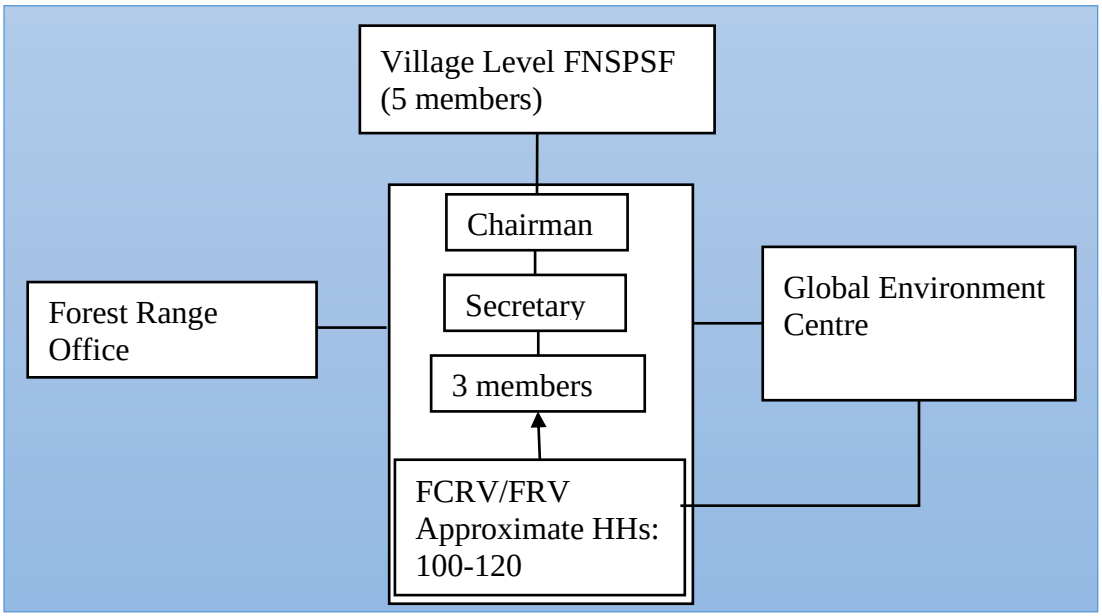

Figure 3.7 Organizational structure of proposed Friends of Peatlands Forest Conservation and Recreation Village/ Friends of Peatlands Forest Restoration Village

In addition, leaders of all committees should be democratically elected, and need to be involved in all governance functions including planning and implementation. This will create a sense of ownership among villagers, which in turn will motivate them to participate in the restoration programme.

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Chapter 4 : Institutional Analysis of PSF Governance: Actors and their Interactions towards Sustainable Conservation and Restoration

Abstract

Peat swamp forest in Malaysia have been highly degraded due to various anthropogenic disturbances. A community-based restoration programme had been initiated in the degraded PSF of Raja Muja Forest Reserve (RMFR) in 2008, which allowed multiple actors to collaborate. This study aimed to explore peoples' perception on changes of *de facto rights* due to changes in governance regimes (SFM to CBFM) and institutional arrangement that influence interaction among actors towards sustainable conservation and restoration of PSF in RMFR. We followed Ostrom's institutional analysis and development framework, and collected both qualitative and quantitative data through organizing a stakeholders' workshop, 200 structured interviews, four focus group discussions and five key informants' interviews. Exercising of *de facto rights* was significantly reduced due to improved monitoring, and enforcement in CBFM regime. This study identified seven major categories of actors namely forestry department (FD), other administrative departments, GEC, community-based organizations (CBOs), international and private/corporate agencies, environmental volunteers, and research institutions/universities in the governance structure. The GEC played significant role followed by the FD. The role of CBOs was limited only in programme implementation, had no part in programme planning, had no financial and technical capacity to plan and implement any restoration or community development activity. Reduction of *de facto rights* validated the efficacy of CMFM. Findings suggest the reformation of the multi-stakeholder governance structure by actively engaging CBOs to boost and sustain this collaborative forest governance.

Keywords: Peat swamp forest; restoration; multi-stakeholder governance; institutional analysis; sustainability

4.1 Introduction

Over the past few decades, there has been an increasing interest in the concepts and measures to improve the forest governance in the context of the global experience of the failure of declining environmental resources with centralized government management approach (De Zoysa & Inoue, 2008; Hayes & Persha, 2010). Such interest has led to the evolution of an array of decentralized governance regimes and new institutional arrangements, aiming to better conservation of forest resources as well as improving socio-economic condition of local community (Balooni & Inoue, 2007; Moktan, Norbu, & Choden, 2016). Institutional arrangements are the policies, rules, laws and organizations that form governance structure and process for natural resources management (Mokhtar et al., 2011). Institutions (policies, rules, laws, norms etc.) influence positively on the conditions of the local forests (Ostrom & Nagendra, 2006; Coleman & Steed, 2009) and higher rule-making autonomy in governing forests are linked with greater livelihood outcomes (Chhatre & Agrawal, 2009; Newton et al., 2016). In the past few decades, many countries have adopted decentralization policies, which facilitated to involve local community and other relevant non-state actors in forest management (Kumar, Singh, & Kerr, 2015).

Since 2008, SSFD in collaboration with GEC, local communities and other non-state actors has been implementing a community-based peatland restoration programme (CBPRP) in the heavily degraded PSF area [1,000 hectare (ha)] of RMFR (SSFD, 2014). Introduction of community-based forest management (CBFM) in PFR was an initiative toward governance regime change that facilitate different actors to participate in the forest management. On the other hand, rules-in-use (policy, strategy, norms etc.) at the study site allow different actors to interact to address inevitably complex social and ecological issues associated with forest conservation, which are less addressed in study or practice (Bell & Morrison, 2015; Friedmana et al., 2020; Gilmour, 2016; Aryal, Laudari, & Ojha, 2020; Ludvig et al., 2021). Empirical research is required to improve the knowledge of the effects of institutions in the management of community forests and to test the strengths and weaknesses of this type of forest governance (Skulska et al., 2021). Increased interaction among actors improves forest governance, expand forest areas and benefit the whole forest ecosystem (Andriyana & Hogl, 2019; Tagliari et al., 2021). The CBFM, a pioneer modality of the PSF restoration programme anticipated local community, environmental volunteers (EV), other relevant government agencies, international and private/corporate agencies would join with SSFD and GEC in order to rehabilitate and

conserve the degraded PSF. As such, a multi-stakeholder partnership was developed with various agencies and individuals toward PSF conservation and restoration. This multi-stakeholder management was a newly introduced approach of PSF conservation in Malaysia, but due to lack of research we do not know how different actors were interacted, what was the institutional arrangement and what were the outcomes of multi-stakeholders' partnership. Having aforesaid research gaps, this study was designed with following objectives:

(1) To explore the institutional arrangement that influence interactions of different actors towards sustainable conservation and restoration of PSF in RMFR,
(2) To elucidate local peoples' perception on changes of *de facto rights* due to changes in governance regimes (SFM and CBFM).

We hypothesized that CBFM would facilitate participation of multiple actors in PSF conservation and thus create a conducive environment for broader community engagement in forest restoration as well as would have a significant influence on *de facto rights* (describe in 4.2.1).

4.2 Materials and methods

4.2.1 Theoretical framework

4.2.1.1 Institution and de facto rights

Institutions are traditional and/or prescribed rules, norms, values and practices that regulate peoples' behaviour towards resource management, govern decision-making process and power relations (Ostrom, 1990; Cleaver, 2000; Rudd, 2004). They have direct influence on the access and control over natural resources, facilitate human-environment relations and decrease transaction costs (Leach, Mearns & Scoones, 1999). Institutions may be informal and formal. Informal institutions are behaviours that are acceptable by a society and typically comprises habitual, customary rules, and social codes of conduct which are passed on to the generations; however, lack official codification (North, 1991; Rahman et al., 2017). Informal institutions depict the local governance system, which includes resource users' roles and responsibilities (Rahman, Hickey & Sarker, 2012). On the other hand, formal institutions are codified laws, formulated by various agencies like government, cooperatives, municipalities, and firms and when their members comply them, then they become rules (Hodgson, 2006). Rules create authority to undertake action and the authorized actions are called right (Ostrom, 1976). When rights are granted by formal rules are called *de jure rights* (Schlager & Ostrom, 1992). Formal rules determine the actions that are permitted, prohibited or required and prescribe sanctions for rule violation (Crawford & Ostrom, 1995). Formal institutions act as a patron and regulate the decentralized property right (Rahman et al., 2012). When rights are originated among resource users and not recognized by government authorities is called *de facto rights* (Schlager & Ostrom, 1992). *De facto rights* are exercised due to ignorance, tolerance and/or ineffective monitoring or enforcement of the act. Here, we considered *de facto rights* (without holding a permit/licence) that are traditionally followed by local people in accessing, extracting, and using forest resources near to them irrespective of formal institutions.

4.2.1.2 Analytical approach

We followed Ostrom's Institutional Analysis and Development (IAD) framework for this study because of its usefulness to describe and analyses forest and other natural resource governance (Andersson, 2006; Imperial, 1999; Wilkes-Allemann, Pütz & Hirschi, 2015). The IAD framework focuses on contextual factors (e.g., rules-in-use), and the action situation composed of actors (represents individuals or groups or organizations) located within action situations

(Figure 4.1). Action situation is a social space where actors with varied interests interact, exchange goods and services, make governance decisions, engage in patterns of interaction and produce outcomes (Andersson, 2006; Clement, 2010; McGinnis, 2011; Ostrom, 2011; Persson & Prowse, 2017). Action situations are formed by three categories of contextual factors which produce restrictions and/or incentives for some actions (Fidelman et al., 2012; Ostrom, Gardner & Walker, 1994). These are: (i) biophysical conditions (i.e. the physical state of the ecosystem considered), (ii) community attributes (i.e. socio-economic and cultural characteristics) that might enable or constrain effective collaboration between actors, and (iii) rules-in-use such as policy, legislation, strategies, management plans, norms, etc. that facilitates various actors to participate in PSF governance.

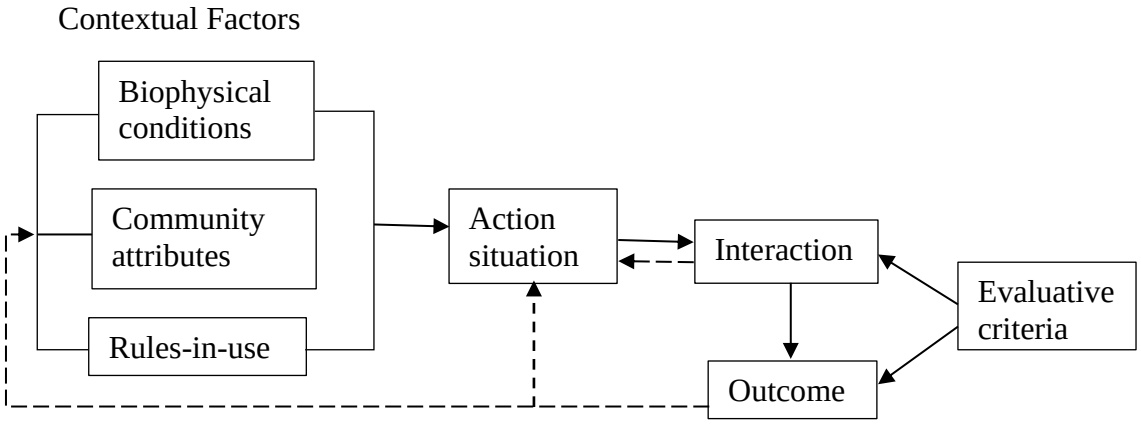

Figure 4.1 Institutional analysis and development framework used in this study (Source: Adapted from Ostrom et al., 1994; Ostrom, 2011).

IAD framework also recognizes the action situations at multiple levels (e.g. operational, collective choice and constitutional) that links with the operational level where stakeholders make decisions on resource management and planning, decide on the rules, norms or strategies for decision-making (Ostrom, 2005; Clement, 2010).

4.2.2 Data collection approach

I deployed both qualitative and quantitative methods to collect field data. For qualitative data collection, we organized a workshop, conducted four focus group discussions (FGD), and five key informants' interviews (KII). Use of data collection several tools were useful to triangulate the findings. First, a stakeholders' workshop was organized in July 2018 with the aim of i) identifying actors involved in PSF conservation and restoration in RMFR, their roles, and interaction, and ii) understanding existing institutional setting (rules-in-use) for actors' participation. Forty-nine participants from SSFD, representatives from local government

agencies, Department of Environment, corporate agencies, NGOs, research institutions, local community leaders, and academia participated in the workshop. We arranged brain-storming sessions in the workshop to understand the perception of different groups of participants on aforesaid two aims. We divided all participants into three groups namely (i) government and corporate officials, (ii) NGOs, research institutions, and academia, and (iii) local community people for brainstorming sessions. A checklist was prepared following Ostrom et al. (1994), Ostrom (2011), and Nath et al. (2017) to facilitate the brain-storming sessions (Appendix 5). This was complemented with four FGDs and five KIIs. Two separate checklists were prepared following Ostrom et al. (1994), Ostrom (2011) and Wilkes-Allemann et al. (2015) to collect more in-depth empirical data on the actors of PSF, their roles and interaction and institutional arrangements. (Appendix 1 & Appendix 2) (see Chapter 3 for details).

For quantitative data collection, I conducted household surveys in four adjacent villages (see Chapter 3 for details). A pre-tested structured questionnaire was used to collect data on their rights on access to forest resources and state of rule administering in two governance regimes (Appendix 3). We interviewed relatively elderly people (mean age 54 years) who could recall their rights on RMFR resources in two governance regimes.

4.2.3 Data analysis

Qualitative data were classified and coded according to the themes and issues, and then narrative description was followed to interpret the findings of stakeholders' workshop, FGD and KII. Descriptive statistics (e.g., frequency, percentage) were computed for *de facto rights* and administering rules. I conducted McNemar's test (Elmeros et al., 2006; Zar, 1984) to explore any significance difference for changes in forest rights expressed as exercised or not exercised (two categories, 2x2 contingency table) and for administering rules (at monitoring and enforcing and sanctioning) articulated as strict, occasional and overlooked (three categories, 3x3 contingency table), McNemar-Bowker test (e.g. Kossack & Bogner, 2012). Large sample sizes and no frequency of null values in the contingency tables enables this test between two governance regimes. Significance level was set at 0.05 probability level.

4.3 Results

The first section examines the existing formal institutions that provide rights to local community and other stakeholders to undertake various actions at RMFR in both SFM and CBFR. Next, these formal institutions are evaluated with the data gathered from informants to get an insight of the *de facto rights* practiced in two different governance settings. Then, administering rules in terms of monitoring and enforcement and sanctions was evaluated. The second section dealt with the rules-in-use that facilitated actors including non-state actors to participate in PSF governance functions and then actors' interaction was examined.

4.3.1 De facto rights

4.3.1.1 Formal institutions, regulation of rights and administering rules

Formal institutions

I explored a number of historical uses of RMFR including exploitation of forest resources, agricultural and recreational use (described in chapter 6). A number of laws and codes (formal rules) such as National Forestry Act of 1984, The Environmental Quality Act of 1974, The Waters Act of 1920, The National Land Code of 1965, Local Government Act of 1976, The Town and Country Planning (Act 1976) 1996 are in existence to create forest property (forest use and resource exploitation) rights to people and to guide overall development and management of peatland and associated resources (Table 4.1).

Table 4.1 List of main laws and acts related to RMFR management (source: SSFD, 2014)

Year	Name of the Law	Main Implementing Agency
1984	National Forestry Act of 1984	Selangor State Forestry Department
1974	The Environmental Quality Act of 1974	Department of Environment
1920	the Waters Act of 1920	
1965	The National Land Code of 1965	District Office
1976	Local Government Act of 1976	District Office
1996	The Town and Country Planning Act of 1976 was amended in 1996	District Office

However, the prime formal rule that are relevant to the PSF implementation in RMFR is the National Forestry Act (NFA) 1984 (described below).

National Forestry Act of 1984

According to Article 14 of the NFA of 1984, all forest produces in the PRFs and State Land are the property of the state authority. This Act granted the people a number of *de jure rights* such as forest access; resource exploitation and forest use through the provision of "licenses" and/or "permits". Similarly, a number of prohibited activities such as fire, forest land conversion, close of watercourse and the punishment in case of violation also integrated in this Act (described later). The enforcement of the Act and formal rights of management and development (to regulate internal use patterns and transform the resource by making improvements) are primarily entrusted to the SSFD in both SFM and CBFM (also see Appendix 6 for details).

Local peoples' perception on de facto rights

I explored local peoples' opinion on the state and changes in four *de facto rights* namely rights to access to forests, withdrawal of forest resources, use of forest land for agriculture, and use of forests for recreation during SFM and CBPRP. Respondents (60%) opined that they and their family members could easily access to forests without any permit from authority during SFM period, and during CBFM regime only 32% respondents exercised their rights to access forests with permit. This revealed a significant (McNemar's $\chi 2 = 49.42$, $p = .001$) reduction (46%) of access to forests during two management regimes (Figure 4.2). In consistent with this finding two key-informants from SSFD and GEC claimed that

> "Currently FD is stricter than before and gates have been constructed at each entry point; so, nobody can get inside without a permit".

In contrast, focus group respondents from village leaders expressed the following views:

> "People can enter into the forest without any permit irrespective of the SFM and CBFM although people know that they need a permit to enter".

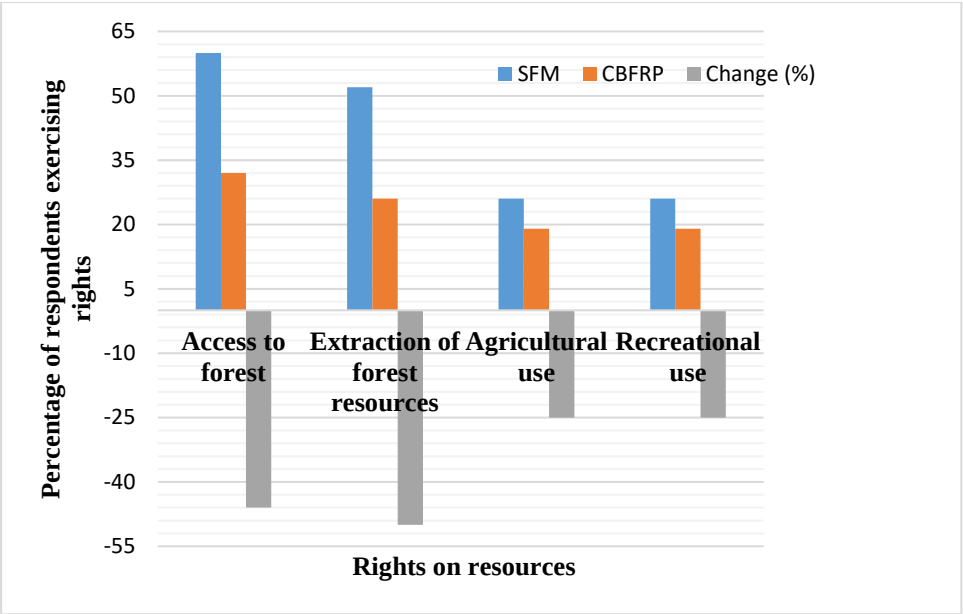

Figure 4.2 Rights exercised by the respondents in two different governance regimes (SFM and CBFM) and their change rate. Change rate was calculated as (sc–si)/si× 100, where sc and si are the number of respondents exercised different categories of rights in two different periods, c (during CBFM) and i (during SFM), respectively.

Further, *de facto rights* in the extraction of forest resources were exercised by 52% respondents in SFM and significantly declined by 50% (McNemar's $\chi 2 = 53.02$, $p = .001$) to drop 26% in CBFM. Similarly, participants of focus groups and key-informants suggest that during SFM (from 1960 to 2007) timber was extracted with licence; however, during CBFM no such licence was issued. Although people know the requirement of a permit to catch fish; nevertheless, fishermen did not care about it, as a key-informant pointed out that:

> "Many non-local fishermen (Orang Asli from Sungai Buloh) and some local people (recreational and for own consumption) used to fish in the RMFR without holding a permit".

In converse, a minority of other key-informants informed that although it was common to catch fish without a permit during SFM but presently, need to hold a permit from FD.

Regarding NTFPs, focus group participants from community described that

> "To collect NTFPs, NTFP collectors need to register with the local FD office and it is free of charge".

In contrast, one key-informant claimed that

> "Currently, NTFP collectors do not need to inform FD and they do not bother about rules".

During discussion one FG participants from FNSPSF depicted that so far, we know currently FD does not issue any permit to collect NTFPs. In consistent with this view, a senior FD official stated that

> "We know this kind of permit need certain amount to pay fees, and at the same time we need to issue a pass. However, sometimes we overlook it because area demarcating and pass checking is a very difficult and complex process; and also, the harvesting level is very low".

Overall, these results indicate an almost free extraction of resources during both SFM and CBFM; nevertheless, a considerable decrease was observed.

From the Figure 4.2 it can be seen that agricultural use of PSF was significantly reduced by 25% (McNemar's $\chi 2 = 4.35$, $p = .05$) from 26% to 19% during SFM and CBFM respectively. This finding is supported by workshop and FGDs as they reported that during the late 1990s and early 2000s the PSF experienced uncontrolled land clearing and forest fires and subsequently a huge area was encroached either for farm/farming activities, including settlements and infrastructure. A key informant who was a village leader and former secretary of FNSPSF stated that

> "Until 1989 logging was carried out extensively and then in the 1990s a huge peatland was burned. Subsequently, in 1990s and early 2000s, some outside (nonlocal) greedy people converted a huge area into oil palm plantation and vegetables. However, the government is strict now and do not allow anybody to plant oil palm or agriculture"

A prominent comment from FGDs was as follows:

> "The conversion had been stopped for the last 10 years and because of government commitment people now realised that planting agriculture is wasting money and energy".

They reported that currently this illegal occupation for agriculture and oil palm is substantially decreased.

Twenty-six (26%) percent respondents and/or their family members used the PSF for recreational purposes during SFM; however, significantly decreased by 27% (McNemar's $\chi 2 = 10.32$, $p = .001$) to fall 19% in CBFM. Discussions with FNSPSF and GEC staffs suggested that currently for ecotourism they need to get permission from the FD and some people were given training on ecotourism who are currently engaged in trail interpretation.

Perceived changes of administering rules

In this study, respondents' opinion on the status of forest monitoring and rule enforcement and sanctions (categories such as strict, occasional and not enforced or overlooked) on illegal forest access and use were examined (Table 4.2).

Table 4.2 Respondent's opinion regarding the status of monitoring, rule enforcement and sanctions in the PSF in two different governance regimes. Change calculated as (sc–si)/si×100, where sc and si are the different categories of rights in the years, c (current) and i (initial) respectively.

Activities such as illegal forest access, resource extraction, encroachment etc.	SFM, N (%)	CBFM N (%)	% change of current and initial	McNemar-Bowker $\chi 2$	p-value
Monitoring (n=167)				69.121	0.001
Strictly	10(6)	85(51)	750		
Occasionally	34(20)	22(13)	-35		
Overlooked/not monitored	123(74)	60(36)	-51		
Rule enforcement and sanctions (n=167)				85.162	0.001
Strictly	9(6)	96 (58)	967		
Occasionally	34(20)	14 (8)	-59		
Overlooked/not enforced	124(74)	57 (34)	-54		

Note: Values calculated from the respondents who answered the questions

Monitoring

Most (74%) of the respondents believed that no forest monitoring (e.g. surveillance, checking and patrolling) was conducted during SFM; conversely, about half (51%) indicated that strict monitoring was conducted during CBFM. During this period a significant increase (750%) in strict monitoring and a substantial decrease in overlooking (51%) was opined (McNemar-Bowker $\chi 2(3, N = 167) = 69.121$, $p = 0.001$) (Table 4.2). Stakeholders' workshop discussions indicate that during SFM lack of proper monitoring promoted a number of illegal activities including digging of logging canals by timer licence holders as well as illicit felling, indiscriminate fire and conversion of PSF into agriculture. In converse, currently local community assist FD in PSF monitoring as highlighted by a FNSPSF participant:

> "Fishers and NTFP collectors act as agents and report any encroachment and/or fire to FD and/or GEC. He explained that four years ago, one day one NTFP collector went into the PSF to collect leaves and then that night he met me and informed me some people got inside the forest and set fire. Next morning, we informed the FD and went inside the forest and saw a huge area was burning".

A similar view is expressed by one field level officer of GEC as she said:

> "Currently, local villagers help us through informing the forest offences like fire and/or encroachment etc.".

Rule enforcement and sanctions

About three fourths (74%) of the respondents opined that during SFM forest offences were overlooked by the authority and no punishment was imposed for forest rule violation. In converse, during CBFM strict rule enforcement and punishment for rule violation was reported by majority (58%) of the respondents. Strict rule enforcement and sanctions are increased sharply (967%); whereas, proportion of overlooked decreased (-59%) considerably. These changes are statistically significant (McNemar-Bowker $\chi 2(3, N = 167) = 85.162$, $p = 0.001$) (Table 4.2). Additionally, KIIs and FGDs revealed that rule enforcement was very unusual and some of the major insights from these discussions are as follows:

> "only a very few numbers of local people are involved in catching fish and collecting NTFPs and they never have seen FD to enforce rules if they are not related to big trees".

Similarly, one senior official from FD stated that

> "we sometimes overlook the collection of NTFPs and fish because the harvesting level is very low".

Besides, one area of enforcement was highlighted by FGDs and KIIs as being particularly effective under the NFA, 1984 as they said:

> "Ten years back some villagers cleared some forest areas for agriculture and oil palm cultivation and at that time there was no restriction. But at the beginning of the CBFM, FD destroyed those and took back the land in their custody".

Likewise, a senior officer with FD made the following comment:

> "In 2008, we identified a patch of PSF that had been illegally encroached long time ago for settlement, agriculture and oil palm plantation. That time, we conducted a big eviction drive: we forcefully removed the houses, destroyed all of the agricultural crops and oil palm plantations and clear the land for restoration. Similarly, last year we also destroyed about 15 ha oil palm plantation with joint operation including police and army".

A senior forest official stated that:

> "Last year we arrested 9 people when they entered into the forest to collect oil palm fruits illegally and then sued against them and put them in the jail".

4.3.2 Analysis of multi-stakeholder PSF governance

Following the IAD framework, I first examined the contextual factors in particular rules-in-use, followed by the actors and their interaction.

4.3.2.1 Rules-in-use

Institutions (rules-in-use) strongly frame action situations by defining various stakeholders' rights and scope to be involved in PSF governance. My review of secondary data and discussions with focus groups and key-informants identified a number of institutions including international and national policy, project documents, management plans, and local level agreements that were influencing the RMFR governance. For instance, ASEAN Peatland Management Strategy (APMS) 2006-2020, Forestry Policy (National Forest Policy 1978, Amended 1992), National Policy on Biological Diversity 1998 (2016-2025 revised), National Action Plan for Peatlands (NAPP) 2011, Selangor Forestry Management Plan 2011-2020, and Integrated Management Plan (IMP) for North Selangor Peat Swamp Forest (2014-2023) (Table 4.3). All of these policy documents and agreements explicitly stressed the importance of community and other non-state actors' participation in PSF management. But with these rules, only a few main actors have the provisions for participation in decision making processes (described later). In KIIs, a senior official of FD opined that:

> "At this moment we do not have any clear policy or rule for peoples' participation in forest management decision making and/or delegation of any management power to community".

Table 4.3 Rules-in-use of multi-stakeholder participation in the PSF governance relevance to RMFR (Source: compiled by the author).

Legal instruments	Provisions	Remarks
International		
Strategy agreement ASEAN Peatland Management Strategy, APMS (2006-2020)	Multi-stakeholder partnership is encouraged	*
National		
Policies and Plans (a) The Forestry Policy (National Forest Policy 1978, Amended 1992)	Local community participation is encouraged	*
(b) Policy on Biological Diversity 1998 (2016-2025 revised)	Scope of public participation in forestry education and awareness Encourage forming community-based working and other stakeholder groups to work with the authority	** **
(c) National Action Plan for Peatlands (NAPP) 2011	Multi- stakeholders (e.g. government agencies, local communities and others.) co-operation is encouraged	*
State		
Management Plan Integrated Management Plan (IMP) for North Selangor Peat Swamp Forest (2014-2023)	Encourage multi- stakeholder involvement Emphasize to establish a formal partnership with FNSPSF to undertake forest restoration activities	***

Note: Procedures or mechanisms of participation were (**=defined, *=not clearly defined; ***= non-state actors' participation is considered as a part of implementation strategy)

In addition to that a number of a national and international agreements (project and MoU) has been signed among federal and state level governments, SSFD, international and national development partners, NGOs, and private corporate companies, to promote the conservation and restoration of RMFR and support local community development (see Table 4.4 for details).

Table 4.4 Project agreements

Legal instruments	Parties and Provisions
International	Government of Malaysia signed two project agreements with ASEAN such as ASEAN Peatland Forests Project (APFP) (2009-2013) and Sustainable Management of Peatland Forests in South East Asia (SEApeat) project (2011-2015) to rehabilitate the degraded PSF. These agreements encourage collaboration amongst the government, the private sector, NGOs and local communities and their participation is considered as a part of implementation strategy.
State and local level	GEC signed a project agreement with HSBC Bank Malaysia Bhd (2011-2020) to rehabilitate RMFR through community participation. Procedures or mechanisms of participation were defined A multi-stakeholder RMFR restoration project agreement between SSFD, GEC, Kuala Selangor District Council and Sime Darby Foundation (2014-2017) were signed to encourage partnership between government, NGOs, local community, private and government corporate agencies and their participation is considered as a part of implementation strategy.
Memorandum of Understanding (MoU)	Memorandum of Understanding (MoU) between SSFD and GEC (from 2010-13 and from 2016-2023) was signed to support community-based forest conservation and restoration of PSF in Selangor State. Local participation through the formation of CBOs and other non-state actors (e.g. NGOs, private corporate agencies, international donor agencies, environmental volunteers) participation is encouraged and their participation is considered as a part of implementation strategy. Procedures or mechanisms of participation were defined.

(Source: compiled by the author).

4.3.2.2 Actors and their roles

Participants in the stakeholders' workshop identified 44 actors (organizations) under seven categories including two ministries of Malaysian government, 28 government agencies, three NGOs, four private/corporate agencies, three local community-based organizations (CBOs), three universities and one research institute who were directly or indirectly involved in RMFR restoration and conservation. In the brain storming sessions, government and corporate officials identified 28 actors followed by NGOs, research and academia members (16 actors) and local community people (11 actors) (Table 4.5). Similar trend was observed in case of interaction among actors and frequency of interaction. Local community people reported 11 actors that were working actively in PSF restoration activities.

Table 4.5 Number of actors and their interaction explored in stakeholders' workshop held in 2018 in North Selangor

Three groups of participants in the workshop	No. of actors identified	No. of actors interact with more than one actor	Frequent/regular interaction with actors	Occasional interaction with actors
Government and corporate officials	28	18	49	30
Local community people	11	9	18	16
NGOs, researcher and academia	16	13	44	11

Based on level of engagement identified by the workshop participants, we divided all actors into core and support actors. Core actors were actively engaged in all and/or many of the RMFR governance functions (e.g., planning, implementation, maintenance, finance, coordination, monitoring) while support actors (agencies/individuals) played some occasional supportive roles. In addition, according to level of operation (hierarchic) actors were also categorized as local (had direct role at local level governance functions), state (influenced rules concerning forest management), and federal (shaped the rules that direct how decisions were used at the collective-choice level). Core actors at local level were consist of SSFD, other government administrative departments, NGOs, CBOs, international and private/corporate agencies, EV, and research institutions/universities (Figure 4.3).

The SSFD was entrusted legally to implement policies, protect forests and landscape. Local forestry administrations namely District Forest Office (DFO) and Forest Range Office (FRO), and GEC were actively involved in developing forest restoration and conservation activity plans and implementations of planned activities. The DFO supported RFO and GEC with guidelines and instructions for the implementation of approved activities (e.g., monthly tree planting). GEC supported SSFD to build up a multi-stakeholder partnership by engaging different actors aiming at to improve the governance of RMFR. In order to increase local community involvement in CBFM, local office of GEC at Raja Musa, North Selangor formed FNSPSF in 2012 involving 97 members from four adjacent villages of RMFR. GEC also helped to form two environmental clubs namely PFR in five high schools and JPFR in 13 primary schools (near to the RMFR) in 2012 and 2014, respectively. These local actors were actively involved in the implementation of restoration activities such as forest restoration, hydrological management, awareness campaigns and support plantation maintenances and patrolling.

GEC also established partnerships with several private, international, and corporate agencies. These actors contributed toward PSF restoration through funding and volunteering in tree planting activities. A key-informant of SSFD commented that GEC's main roles were to engage local people and other actors in the peatland restoration programme, create awareness about PSF, assist SSFD through providing technical advice and support implementation of restoration activities. GEC's roles in different action situations were supported by agreements between SSFD and GEC (Table 4.4). These agreements helped to form and mobilize CBOs, coordinate, and act with other actors in fund raising.

Local administrations such as Land and District Office (PDT) and Fire and Rescue Department (BOMBA) occasionally supported RMFR conservation operations. PDT occasionally participated in identifying PSF area boundaries (buffer zone) and enforcement for illegal occupancy. BOMBA provided training and arranged fire drills involving the CBOs, local community and small holder farmers on firefighting operations and monitoring of fire danger rating system. EV (e.g., local individuals and other environmental enthusiastic) actively participated in tree plantings, canal blocking and their maintenance, and provided donations for conservation operations. Although research institutions and scientists conducted research on various aspects of forest

restorations, ecosystem services, biodiversity, water table and community involvement in restoration process, they also volunteered in restoration programme.

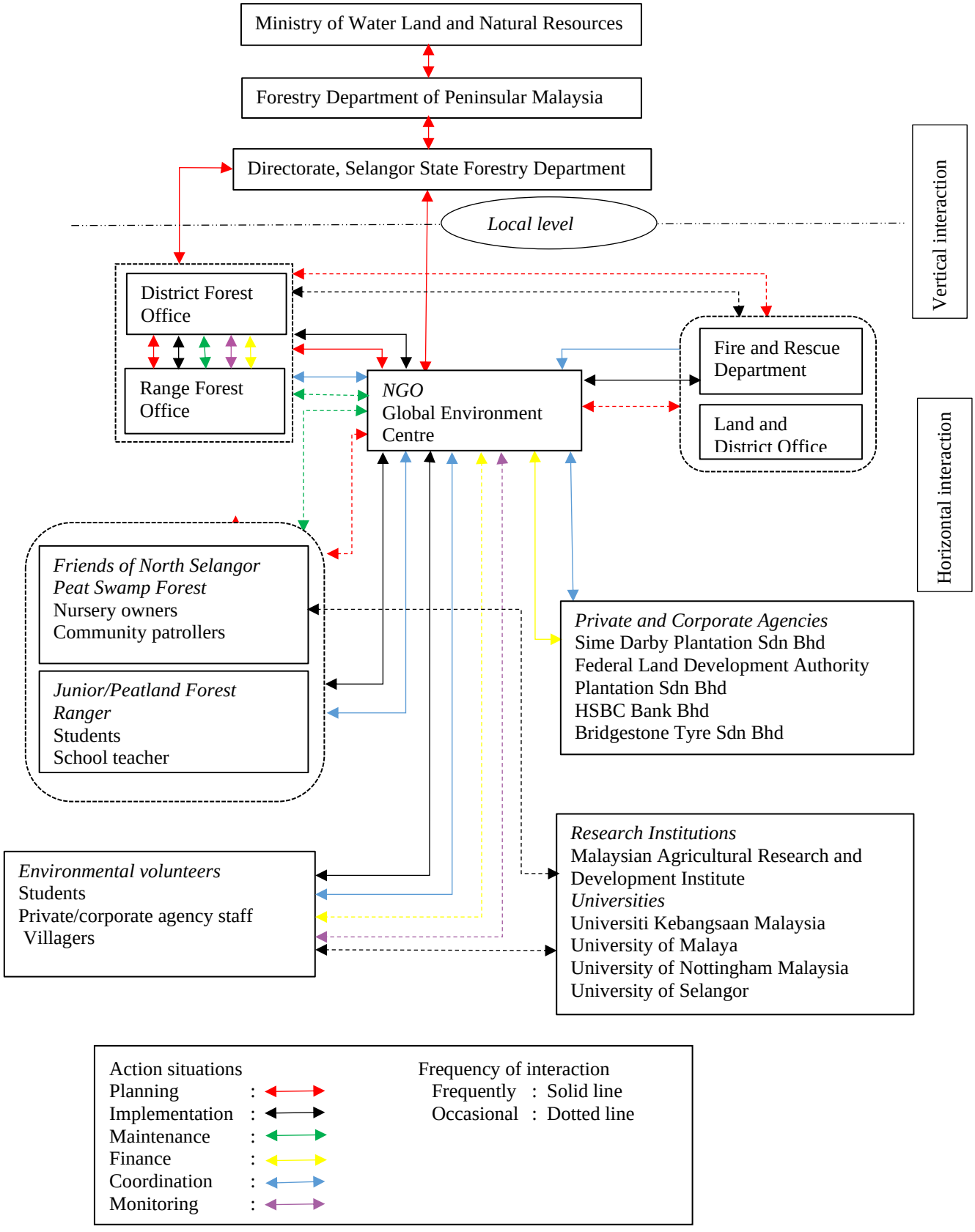

Figure 4.3 Existing actors, organizational hierarchy, and interaction among local level core actors for RMFR restoration and conservation (identified through a stakeholders' workshop in 2018).

4.3.2.3 Interaction among core actors

Multi-stakeholder forest restoration programme at RMFR led to horizontal (within local level) and vertical interactions (among local, state and federal level) among actors (Figure 4.3). Due to the growing concern of PSF degradation and increasing national and international initiatives of PSF conservation, these interactions have been expected to increase. An overview of organizational hierarchy and interaction among the core actors in different action situations (shown in different colour) and their frequency (solid and dot lines representing frequent and occasional) is shown in Figure 4.3.

Horizontal interaction was observed with local level actors. Within these actors, frequent interactions were noticed among local forest administration (DFO/FRO) and GEC when they develop PSF restoration and conservation plans. These actors interacted frequently with CBOs, EV, private and corporate agencies during tree planting, and canal blocking events. GEC also occasionally met FNSPSF to discuss community development plans and to inform restoration activities

Vertically, FRO frequently interacted with DFO (mid-level of SSFD organizational hierarchy) during planning, implementing, maintenance, finance, monitoring, enforcement of conservation, and restoration activities. On the other hand, DFO frequently interacted with the director of SSFD (state level highest organizational hierarchy) responsible for approval of annual conservation and restoration plans. SSFD had frequent interaction with the federal level Forestry Department of Peninsular Malaysia (FDPM) and Ministry of Water Land and Natural Resources (MWLNR) responsible for policy formulation and strategic planning for PSF management in peninsular Malaysia. Local GEC office frequently interacted with SSFD to prepare annual development plan. They also occasionally interacted with FDPM and MWLNR in the process of agreements development and signing.

4.4 Discussion

4.4.1 De facto rights

4.4.1.1 Formal institutions, regulation of rights and administering rules

According to the Malaysian National Forestry Act of 1984 every person required a valid permit or license under subsection [47(3)], [21(3) and 30(4)], [34 (c) (e) & 36(4)] respectively to exercise any forest rights (*de jure rights*) including access to forest, extraction of forest resources, and use of forest land for agriculture or recreation (Government of Malaysia, 1984). However, people perceived that in both SFM and CBPRP regimes they practiced considerable *de facto rights* and a significant reduction of exercising those *de facto rights* were observed in the CBPRP. Common property rights of forest user groups are quite common in many parts of the world (Agrawal, Chhatre & Hardin, 2008). Similar to this finding, high level of non-compliance of formal rules was reported in forest access at Mua-Livulezi Forest Reserve, Malaw (Senganimalunje, Chirwa & Babalola, 2015). In contrast, imposing permits and charges on some recreational activities were found the most influential management aspect at Penang National Park, Malaysia (Kaffashi et al., 2015). The CBFM has succeeded in reducing encroachment on forest lands in Bangladesh (Nath, Jashimuddin & Inoue, 2016). Article [4(c) (d) (e)] of NFA, 1994 delegated forest management rights to SSFD in both SFM and CBFM. However, the reduction of exercising *de facto rights* might be related to the increased commitment of SSFD in enforcing forest laws, introduction of forest monitoring through local community, and increased awareness of local community about forest laws. In addition, 25 years timber harvesting ban (since 2010) imposed by Selangor State Government might have an influence (SSFD, 2014).

Rules administering

Bixler (2014) suggested to develop monitoring and enforcement arrangements and responsibility sharing mechanism between actors that favour autonomy and create conditions for institutional innovation and adaptive co-management. Article 15(1), 32(1) of NFA 1984 prohibited taking of forest produce, occupy or carry out any activity upon any land within a PFR and State Land unless a permit and/or license, etc. Scholars (e.g. Gibson, Williams & Ostrom, 2005; Pagdee, Kim & Daugherty, 2006) reported that monitoring, enforcement and sanctions have strong associations with forest management success. I found that in the SFM,

monitoring (e.g. during licensed harvesting and/or for illegal firing and encroachment etc.) was almost absent; however, in the CBFR a substantial increase of monitoring in terms of information gathering from the local people and surveillance by employed patrollers and staff has been reported. Monitoring intensity and enforcement of existing institutions will change actor incentives and behavior and help achieve management objectives (Rudd, 2004). Currently, GEC played an important role in forest monitoring activities through gathering information from local people and passing to the FD. External aid agencies and NGOs is an important determinant of external monitoring and sanctioning (Coleman & Steed, 2009).

Rule enforcement and sanctions

According to the Article 88 (1) of NFA 1984 enforcement of rule violation was entrusted to the FD and/or police. In addition, for sustainable natural resource governance sanctioning is important for violation of any rule. Article 47(4), 15(2), 32(2) and 82(2)(3) of the NFA 1984 had the provisions of punishment for illegal forest access, resource extraction, use and conversion of forest land and fire. Results show that in the SFM, rule enforcement and sanctions were mostly featured by overlooked; whereas, a significant improvement in the strict enforcement was found in the CBFR. In Malaw, ineffective rule enforcement was reported by Senganimalunje et al. (2015) at a co-managed forest of Mua-Livulezi Forest Reserve. Success in forest management is strongly associated with effective enforcement of law (Pagdee et al., 2006). Insufficient rule enforcement at RMFR might be related to the inadequacy of staff and unawareness of local people about environmental value of PSF during SFM. However, increased attention of the State Government to the forest conservation and inclusion of local people and other stakeholders in PSF conservation was found. It can thus be suggested that CBFR has a positive impact on the rule enforcement which is important for the effective management of the forest. Further, rule sanctioning is associated with successful forest management, although, somewhat less strongly (Pagdee et al., 2006). NFA of 1984 has assigned sanctions in case rule violation under subsection 82(1) for fire, [82(1)(e)] for forest land conversion, and [98(1)] for watercourse close. In general, if a threat of detection and punishment is not credible, individual behavior is unlikely to change significantly even with formal rules in place. Thus, investments in monitoring and enforcing existing rules are important for successful resource management, but are not alone sufficient for long-run sustainability (Rudd, 2004).

4.4.2 Analysis of multi-stakeholder PSF governance

4.4.2.1 Rules-in-use

Institutions (rules-in-use) are an important mediator between the interaction of humans and their environment (Aggarwal, 2006). They strongly frame action situations by defining various stakeholders' rights and scope to be involved in PSF governance. Findings suggest that a number of international, national and state level policies and agreements had mandated the participation of local people and other stakeholders in the conservation and management of RMFR. Even though local people were considered as partners for the protection and restoration of the degraded RMFR as well as gaining benefits; however, the main challenge remains with the paucity of clear statement in existing rules relating to their roles, responsibilities, participation in decision making and forest management rights which are entrusted only to a few core actors (described later). In addition, project agreements were also valid for specific time period, which might impede the sustainability of the current multi-stakeholder forest governance. Previous research (e.g. Le et al., 2012; Nath et al., 2017) emphasized for formulating appropriate institutional arrangements for sustainable forest conservation and community benefits.

4.4.2.2 Actors, their roles, and interaction

Identification of actors is an important task in multi-stakeholder natural resource governance to improve the decision-making process and to enhance coordination among them (Wilkes-Allemann et al., 2015). We identified seven categories of actors who were involved in PSF restoration in RMFR. Wilkes-Allemann et al. (2015) and Nigussie et al. (2018) reported 13 and 4 categories of actors in urban recreational forest in Switzerland and a participatory soil and water conservation project in north-western Ethiopia, respectively. I found that GEC and SSFD played the pivotal role in the CBFM governance set up followed by CBOs, private/corporate agencies, EV, other government agencies and research institutions. Researchers (e.g., Andriyana & Hogl, 2019; Clement, 2010; Gupta et al., 2020; Lawrence et al., 2013; Wong et al., 2020) reported varied level of state and non-state actors' role in the natural resource management. It was observed that GEC and SSFD were involved in all six governance functions and interacted with most of the actors. Specifically, GEC had facilitated the collaboration among international, national and local actors for the restoration of degraded PSF in RMFR. Nath, Inoue & Pretty (2010) and Berkes (2009) reported that NGOs can act like a bridge to connect government agencies and local communities, and support organizational and

technical capacity building of the local people for sustainable forest conservation (Andriyana & Hogl, 2019; Balooni & Inoue, 2007; Barnes & Van Laerhoven, 2015).

Further, the role of forest administration and the interaction with other actors was found prominent in all three levels from local to federal level. Alike, forest department was found as the most powerful and influential actor in the participatory forest management in Bangladesh (Islam et al., 2015). In the Indian Himalaya's community forestry programme, government influenced the decision-making processes where NGOs have engaged in awareness creation and other empowerment programmes (Gupta & Koontz, 2019). Role of CBOs and EV and their interactions with other actors (e.g., GEC and SSFD) were mainly concentrated in the implementation of restoration activities and participating in trainings facilitated by GEC or other government agencies. They had no direct involvement in any decision-making process. However, Le et al. (2012) reported that local participation is important in every forest governance task including communication and co-operation with other actors. Research institutions were also found active in conducting studies in the study site in order to exploring and improved understanding of socio-economic and environmental problems and to recommend solutions. Similar observation was also reported by Purnomo et al. (2017) who expressed that among 20 actors, universities and research organizations are important actors as they conduct research on social and natural resource problems aiming to providing scientific and academic solutions. Therefore, it seems that all stakeholders did not participate and contributed equally in all action situations, and did not interact with every actor. However, overall findings suggest that all actors showed an effective collaboration among them which is important for the success of any multi-actor natural resource governance. These findings may help us to understand the current multi-actor collaboration process among the actors and the variations of actors' functions and interactions in various governance tasks at RMFR restoration site.

4.5 Conclusions and policy implications

The investigation of formal rules in regulating property rights has shown that generally local community exercised *de facto rights* (without a permit/licence) extensively in both SFM and CBFM; although, a significant decrease was found in CBFM. There is no uncertainty that high practice of *de facto rights* creates severe threat to the sustainability of the PSF and their

resources. In converse, decreased practice of *de facto rights* implies the effectiveness of CBFM in complying formal rules. The results of the research support the idea of strengthening the CBFM for sustainable forest management.

Most importantly, this study provided a snapshot of multi-stakeholder perspective of PSF governance in Malaysia based on an institutional analysis of RMFR restoration programme. In a multi-stakeholder forest governance, understanding the multifaceted roles and relationships between various actors are essential for sustainable collaboration in forest management. In Malaysia, like many other countries, multi-stakeholder governance is generally not yet considered to be an alternate and legitimate forest management regime. In the case of RMFR restoration programme, due to international and national interventions a complex multi-stakeholder PSF governance has been evolved. Most significantly, consistent efforts and commitment of GEC and SSFD were able to establish a strong collaboration among several actors. In addition, quite a few numbers of legal instruments have facilitated to develop and operate this partnership. Findings of this study demonstrated that the established "multi-stakeholder governance structure" is subject to criticisms as it was dominated by only a few (mainly SSFD and GEC) actors, had limited local participation in decision- making process, insufficient socio-economic activities, and inadequate and ad hoc nature of institutional arrangements which might risk the long-term participation and co-operation of local communities. In order to sustain an effective multi-stakeholder collaboration for sustainable conservation and restoration of the RMFR, I propose to reform the existing organizational hierarchy (Figure 4.4) and put CBOs under core actors where they would have direct interaction with local forest administrations (DFO and FRO).

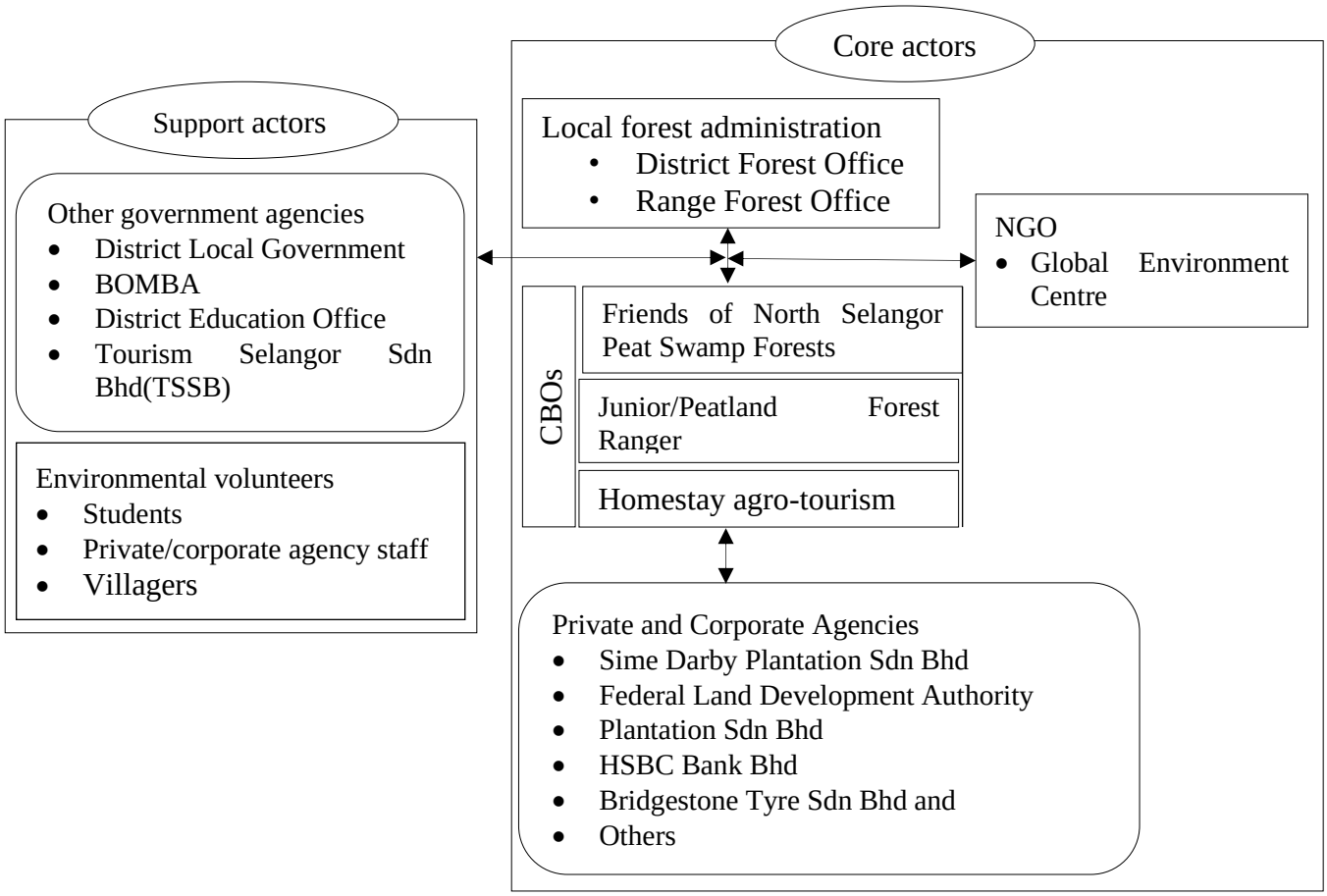

Figure 4.4 Proposed local level organizational structure for effective community participation in RMFR conservation

Additionally, we suggest for continuous support toward community development activities through different government programmes. Moreover, local community participation in PSF management needs to be institutionalized because current forest policy in peninsular Malaysia has not recognized community participation in forest management. Further, as participatory forest management is a new approach in the management of PSF in Malaysia, it is important to strengthen FD's organizational capacity including capability of working like a team with different stakeholders.

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Chapter 5 : Ecological Outcomes of Community-based Restoration Programme in Raja Musa Forest Reserve

Abstract

The restoration of degraded peat swamp forest is a global priority that aims to restore the lost and/or degraded hydrological conditions and vegetation cover as well as to reduce the fire incidences. This study investigated the ecological outcomes (restoration approach, survival rate and growth of planted trees, status of natural regeneration) of a community-based restoration of degraded PSF being implemented by the SSFD and the GEC in 1,000 ha of degraded RMFR in Peninsular Malaysia. Restoration approach was explored through focus group discussions with GEC staffs and key-informant interviews with SSFD officials. Data on plantation establishment, water table monitoring and fire incidences were gathered from official records of GEC local office at Raja Musa. Planted tree growth and natural regeneration data were collected through a series of vegetation survey. Findings indicated that the GEC adopted an innovative approach of PSF restoration where volunteers participated in canals blocking to keep PSF wetted, monthly tree planting events, community patrolling (to monitor water table data from piezometer and fire incidences) and education and awareness creation campaigns. Canal blockings helped to maintain a mean ground water level of -24.96 cm. Due to continuous motivation and awareness creation among surrounding villagers, fire incidents in RMFR were reduced. Between 2008-2019, 323.72 ha plantations were developed mainly with *Euodia redlevi* tree species and few trees of *Shorea leprosula*, *Myristica lowiana* and *M. pruinosa*. The mean survival percentage of planted trees was 65%. Mean annual increment (MAI) of diameter and height of *E. redlevi* decreased from younger plantations (3-year) toward older ones (5-, 7-year). Overall, MAI (dbh and height) across four tree species between age groups was found significantly different ($p=0.001$). Regeneration study identified 16 tree species with an average density of 17,798 seedlings ha^{-1}. *E. redlevi* was dominant, but only 10.60% of its regeneration attained young tree stage. Suggestions are made to expedite restoration with diverse tree species and to ensure post-planting maintenance for greater survival of planted trees.

Keywords: Peat swamp forest, restoration, community participation, plantation, natural regeneration, hydrology, fire

5.1 Introduction

Ecological restoration of peatlands involves measures designed to re-establish the damaged ecological processes and functions to a state similar to or as near to their natural state as possible (Dinesen & Hahn, 2019). Since the early 2000s, several peatland restoration techniques have been applied in SEA, including drain blocking (Panda et al., 2011; Ritzema et al., 2014); replanting (van Eijk et al., 2009; Graham, Turjaman, & Page, 2013); assisted natural regeneration (ANR) (Parry, Holden, & Chapman, 2014) and unassisted natural regeneration (Gunawan et al., 2012; Blackham, Webb & Corlett, 2014). The main aim of those restoration programme was to re-establish ground water table (GWT), reduce fire incidences and increase vegetation cover (Ritzema et al., 2014; Alderson et al., 2019). Dohong, Aziz & Dargusch (2018) reported an improved hydrological condition, reduction of fire incidences, increased spontaneous natural regeneration and early year success of plantations in a degraded PSF in Indonesia. However, in many cases restoration programme does not make a smooth transition from degraded conditions to a pristine ecosystem state (Bullock et al., 2011; Matthews, Spyreas, & Endress, 2009).

In order to restore the lost ecological functions of the degraded PSF (1,000 ha) of RMFR, a community-based PSF restoration programme had been started in 2008 (SSFD, 2014; Nath et al., 2017). Forest restoration helps to regain ecological functionality of degraded landscapes and improves socio-economic benefits of local people (Chazdon et al., 2020a; Gregorio et al., 2020). The restoration of degraded forest lands is a global priority that aims to restore ecosystems and their functions in ways that provide multiple socio-economic benefits (UNFCC, 2019; Chazdon et al., 2020b; Ota et al., 2020).

This community-based PSF restoration programme at RMFR was a pioneer attempt in Malaysia to restore degraded PSF. Empirical studies were conducted to understand the effectiveness of community participation in PSF restoration of RMFR. For examples, Nath et al. (2017) explored local peoples' appreciation on the values of PSF and Alam et al. (2021) investigated the institutional analysis of multi-stakeholder engagement in RMFR. Previous research on ecological outcomes of community-based PSF restoration is currently lacking. Researcher (e. g. Uddin et al., 2014) reported that studies on plantations performance help to explore growth and suitability of planted tree species. Moreover, presence of successful natural regeneration, species composition, and structure enable to reveal the status and quality of a forest to formulate conservation strategies, and species management (Yang, Yan, & Liu, 2014;

Rachmat et al., 2018; Susilowati et al., 2019). Therefore, this study i) explored the strategies of community-based restoration of degraded PSF, ii) assessed ecological outcomes in terms of tree species composition, survival rate, and growth of planted trees in restoration sites, and iii) assessed natural regeneration status.

We hypothesized that restoration programme would improve the hydrological condition, reduce fire incidences and enhance vegetation cover.

5.2 Materials and methods

5.2.1 Study site

This study focused on the highly degraded peatland forest (HDPF) (focal study area 1, Figure 1.1 in Chapter 1) and low degraded peatland forest (LDPF) (focal study area 2, Figure 1.1 in chapter 1) (described later) and the vegetation survey was conducted during August-October 2019 (for study area details please see section 1.5.1).

5.2.2 Sociological survey

In order to collect data on PSF restoration approach including hydrological, revegetation, fire incidences and community involvement process in PSF restoration, we conducted focus group discussions with GEC members and key-informant interviews with SSFD officials (see Chapter 3 for details). In addition, secondary data (official documents) on plantation, water table monitoring and fire incidences were collected from GEC local office at Raja Musa.

5.2.3 Vegetation survey

Forest stratification

First, a vegetation survey team was formed, comprised of me and my supervisor, one GEC staff, two local people (who were involved with restoration activities), and one retired forestry practitioner included as an expert to identify the naturally regenerating species. Then, we collected restoration data (e. g. canal blocking, clay dyke, ground water level, planted area, planted species, fire incidences) from GEC's local office at Raja Musa, North Selangor. Subsequently, we visited the study sites several times for reconnaissance surveys and as volunteers during monthly restoration events. Based on land cover types, we grouped the restoration zone into HDPD and LDPF, which is a small patch of logged-over forest.

Community-based restoration was carried out in HDPF areas with tree planting and LDPF was protected without any intervention with the aim of achieving assisted natural regeneration (ANR) (Figure 5.1-C). In HDPF, we noticed planted forests (PF) and large area covered with grasses. (Figure 5.1-A, B). Small agriculture drainage ditches separated the whole plantation area into different patches; however, there were no clear boundary demarcations or signboards to distinguish year-wise plantations. In some parts, there was un-even aged mixed plantations. Vegetation survey team members were involved in restoration programme and they could divide the PF into four age classes based on their recall: (i) 7-year (plantations established in 2011, 2012 and 2013), (ii) 5-year (2014, 2015 and 2016), (iii) 3-year (2015, 2016 and 2017), and (iv) 1-year (2018 and 2019) old plantations.

Figure 5.1 Vegetation survey at three different stratum of forests (A) grassland, (B) planted forest and (C) assisted natural regeneration at RMFR

Sampling procedure and data collection

Following Uddin et al. (2014), we laid out 32 (3 in 7-year, 8 in 5-year, 7 in 3-year and 14 in 1-year old plantations) temporary quadrat of 20m x 20m in size for investigating growth and survival percentage of trees in PF. Quadrat were laid out deliberately in each age group so that data are representable to the general condition of that age group. Within each quadrat, we recorded name of tree species and number of trees. We measured height (m), and diameter at breast height (dbh, cm) of trees in 3-, 5-, and 7-year-old plantations (Figure 5.2-A).

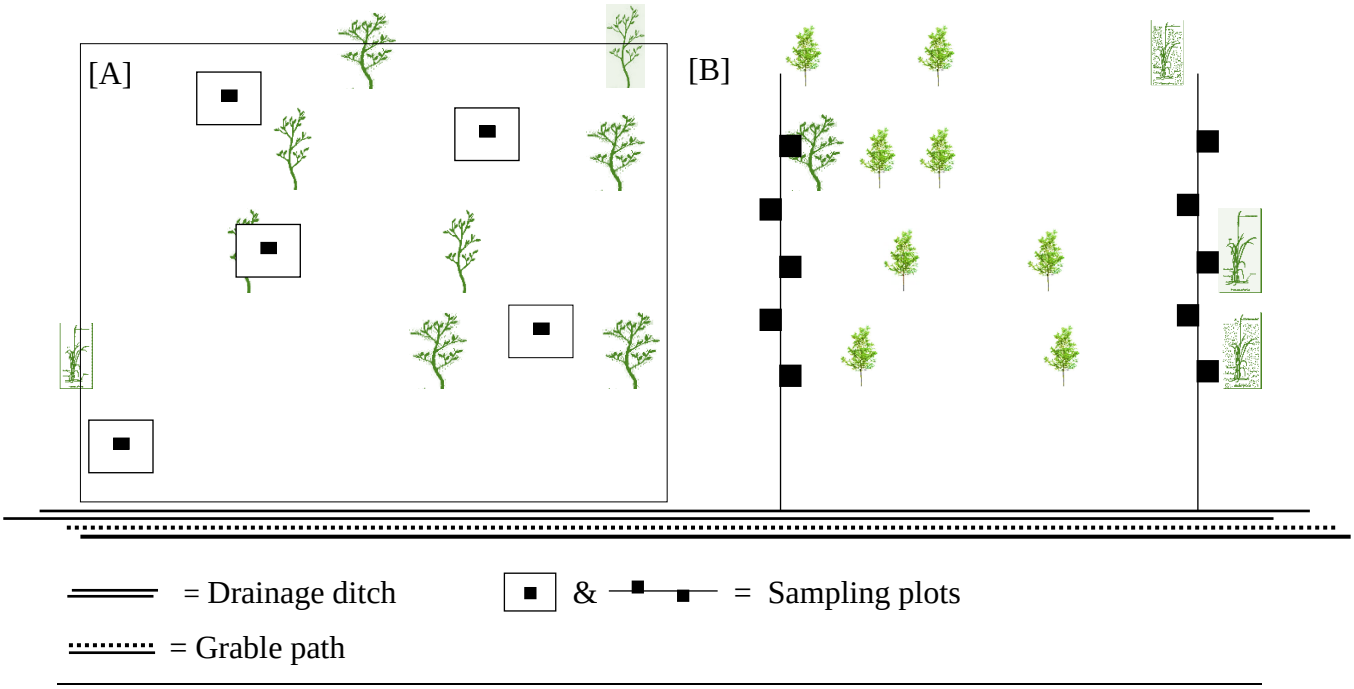

Figure 5.2 Layout of quadrat according to the transect line plot method [A] planted forest (PF) and [B] assisted natural regeneration (ANR), and grassland (GL) (adapted from Roy, Ruel, & Plamondon, 2000; Uddin et al., 2014)

For assessment of natural regeneration in the PF, 32 smaller quadrats of 2m x 2m in size were laid out at the center of each 20m x 20m quadrat (Figure 5.2-A). Likewise, for ANR site, 20 temporary square quadrat (2m x 2m) were systematically placed along four transects randomly assigned perpendicular to the agricultural drainage canal boundary with a minimum transect interval of 100m. Then on each transect, 5 quadrats were systematically laid out, 8 m apart from each other and alternate side to the transect as suggested by Roy et al. (2000) and Uddin et al. (2014) (Figure 5.2-B). To represent natural forested conditions, survey quadrats were placed at 20 m from forest boundary. Similarly, for GL, eight (2m x 2m) quadrat were systematically laid out. Within each quadrat, we identified regenerating tree species, the number of individuals, and measured their total height (m). We grouped regeneration into three categories based on total height: a) seedlings (from 0.05-0.50 m); b) saplings (0.50-2m); c) young trees (> 2 m with a dbh of < 4.5 cm). The division of young plants were based on the judgment that woody young plants were taller than the understorey grass cover (average grass and fern height was about 2m in the study area) that were more likely to be survived (Yang et al., 2014).

5.2.4 Data analysis

Plantation data

Tree species composition, survival percentage in four age groups (7-, 5-, 4- and 1-year), mean dbh (cm), mean height (m), and mean annual increment (MAI) of the plated species were calculated. One-way analyses of variance (ANOVA) and t-test (as appropriate) were performed to test the difference among species in survival rate (SR) and growth parameters within and among different ages of the plantations.

Natural regeneration data

Tree species composition and structure was analysed following Soerianegara and Indrawan (1998), Tran, Iida, & Inoue, (2005), and Rahman, Rahman, & Chowdhury (2020). Vegetation structure was assessed by calculating regenerating tree density, relative density (RD), relative frequency (RF), relative abundance (RA), important value index (IVI) (Table 5.1), and recruitment.

Table 5.1 The list of equations used for calculating species composition and vegetation structure (Rahman et al., 2020)

Phytosociological attributes	Formula
Density (D)	$D=\frac{a}{b}$
Relative density (RD)	$RD=\frac{n}{N}$ x100
Frequency (F)	$F=\frac{c}{b}$
Relative frequency (RF)	$RF=\frac{Fi}{\sum_{i=1}^{s}(Fi)}$ x 100
Abundance (A)	$A=\frac{n}{c}$
Relative abundance (RA)	$RA=\frac{Ai}{\sum_{i=1}^{s}(Ai)}$ x 100
Importance value index (IVI)	IVI=RD+RF+RA

Where, a: total number of individuals of a species in all the quadrats; b: total number of quadrats studied; n: total number of individuals of the species; N: total number of individuals of all the species; c: total number of quadrats in which the species occurs; F_i: frequency of one species; A_i: abundance of one species

Conservation status of regenerating tree species was assessed following the IUCN Red List of Threatened species (IUCN, 2020) and categorized as not evaluated (NE), data deficient (DD), least concern (LC), near threatened (NT), vulnerable (VU), endangered (EN), critically endangered (CR) and extinct (Ex). Further, comparative recruitment of regeneration categories among dominant species and sites were calculated in terms of number of species and density

percentage (Tegene, Gamo, & Cheche, 2018). One- way analysis of variance and t-test were conducted (as appropriate) to find any significant difference in terms of density recruitment between sites and regeneration categories. Graphical presentation and data analysis were conducted using Excel 2016 and SPSS version 26.

5.3 Results

5.3.1 Forest restoration approach

In FGD, staff members of GEC commented that PSF restoration needs to be integrated with hydrological restoration, fire prevention, reforestation, and where possible to promote natural regeneration. They said that there are more than hundreds active canals in RMFR constructed to transport logs, which caused draining of PSF water. In order to restore hydrological condition (keeping PSF wetted), GEC in collaboration with SSFD and volunteers from surrounding villages (local people) and environmental enthusiastic built canal blocks from 2010 to 2018 covering a linear distance of 64.7 km against the targeted length of 90 km by 2023. In addition to canal blocking, they also built about 1.9 km clay dyke (at least 5 m depth and width) along the boundary of forests against a targeted length of 17 km. The clay dyke serves as a retaining wall and water storage, and prevent surface and subsurface seepage to adjacent areas. They maintain high water levels in the forest edges, which are more prone to fire incidents as edges are more degraded and closer to agricultural activities (Figure 5.3).

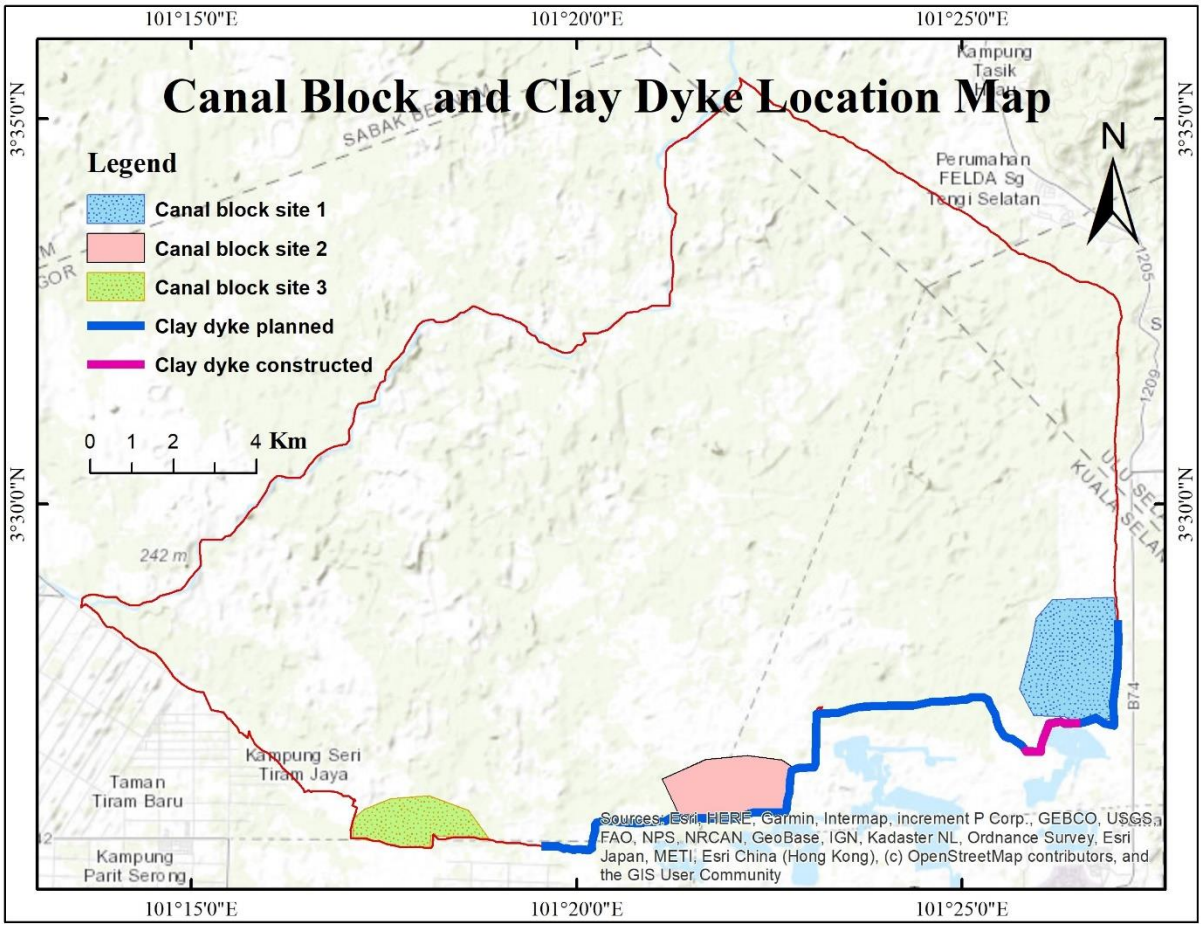

Figure 5.3 The hydrology restoration map of Raja Musa Forest Reserve showing the location of the canal blocks and clay dykes (Source: Google Earth and Esri ArcGIS 10.4)

The GEC installed 20 piezometers (2016-2018) in restoration site to estimate ground water level (GWL). The GEC's PSF patrol team (2 members) took piezometer readings in every month. Based on their record, the mean GWL was -28.6 cm (range -36.0 cm to -17.7 cm) in 2016 while in 2017 it was -26.12 cm (-38.6 cm to -12.2 cm) and in 2018 mean GWL was -20.16 cm (-52.9 cm to 4.7 cm) (Table 5.2) (GEC personal communication, June 2019).

Table 5.2 Month-wise mean ground water level (GWL) in RMFR restoration site (one observation per month in 20 observation wells) (source: GEC office, 2019)

Month	Year		
	2016 GWL (cm)	2017 GWL (cm)	2018 GWL (cm)
January		-31.5	-7.87
February		-18.7	-24.5
March		-19.6	-18.9
April		-25.0	-19.8
May		-17.4	-9.4
June		-34.1	-24.8
July	-17.7	-34.9	-39.7
August	-24.9	-38.2	-42.7
September	-36.0	-38.6	-52.9
October	-34.0	-29.3	4.7
November	-30.4	-12.2	-4.6
December		-13.9	-1. 5
Yearly average	-28.6	-26.12	-20.16

Note: water level, (-) indicate below and (+) indicate above ground level

Restoration site was subject to frequent fire incidents spreading from forest edges where local people burnt their bushy land for agriculture (oil palm plantations, vegetables, etc.) and/or unintentional burning by the fishermen. Between the years 2012 and 2018, a total of 2,851 ha PSF of RMFR has been burnt (Table 5.3). Of them, some areas are overlapped due to repeated burning of the same area; therefore, total affected area should be lower than this figure. Throughout the period, the worst fire outbreak was recorded in the year 2014, with a total affected area of about 1,510 ha. The severity of fire damages was high during the period 2012 to 2014 (in three years), when most (90.92%) of the area (2,592 ha) was burnt. The GEC staff members said that these fire incidents burnt about 200 ha of planted forests in the restoration site in 2012.

Table 5.3 Year-wise fire incidences in and around RMFR restoration site (source: GEC office, 2019)

Year Area	Extent of burnt area (approx. ha)(%)	Sources of fire
2012	382(13.40)	Oil palm plantation, clay mining, encroachment, fishermen
2013	700(24.55)	Oil palm plantation, fishermen
2014	1,510(52.96)	Hunter and Oil palm plantation
2015	150(5.26)	Fishermen
2016	100(3.51)	Fishermen
2017	0(0)	Not occurred
2018	9(0.32)	Fishermen
Total	2,851(100)	

In order to prevent fire incidents, the GEC had taken extensive awareness creation programme with active involvement of local people, local Fire and Rescue Department, and the SSFD. Patrol team members were patrolling the area twice a day to observe any fire incidents and forest encroachers. The GEC staff reported that due to continuous motivation and patrolling, fire incidences gradually declined and there were no serious fire incidents since 2015 (Table 5.3).

Focus group discussions and key-informants reported that the GEC in collaboration with the SSFD prepares plan for yearly reforestation activities and carry out monthly reforestation from February to November. During monsoon (December – January) there are no reforestation programme. The GEC invites volunteers from corporate agencies, educational institutions, NGOs, FNSPSF, local people, and other interested individuals to participate in monthly tree planting events. Usually, they advertise in GEC's website and Facebook, and interested volunteers (about 100 volunteers in every monthly planting event) confirm their participation by online registration. In every monthly planting event, 1-2 ha of degraded RMFR was being planted mostly with *Euodia redlevi*, a local pioneer tree species, which can survive in harsh condition in open GL. Seedlings (6-month old) are collected from local community nursery as a buy-back approach and usually 400-600 seedlings are planted per ha with a spacing of 3 m (plants to plants) by 5 m (row to row).

The GEC's staff commented that in the wider space they would plant other tree species when *Euodia redlevi* grows taller. Restoration site was full of hardy grasses, and they prepared land for planting by line clearing (1m wide x 30m long). The GEC arranged planting cost including seedlings and refreshment for volunteers through sponsorship such as international funders (e.g. EU, UNDP), and local corporate agencies (e.g. Sime Darby Plantations, HSBC Malaysia, Bridgestone Tyre Malaysia). The SSFD provides logistics and their staff help in land preparation and guidance on tree planting.

5.3.2 Plantation status and growth

The GEC's staff reported that they planted about 323.72 ha of HDPF at RMFR from 2008 to 2019 against the target of 1,000 ha (Figure 5.4). However, they had no plantation maps with clear demarcation of year-wise plantations. I noticed a mixture of 2-3 tree species in some plantation sites, probably due to replanted saplings when some planted seedlings died. Vegetation survey team members identified plantations of four age-classes (Figure 5.5). We

found that 7-year-old plantations consisted of three tree species namely, *Euodia redlevi* (96%), *Shorea leprosula* (2%) and *Myristica lowiana* (2%) (Figure 5.5-A). In 5-year old plantations, we found two tree species such as *E. redlevi* (95%) and *M. pruinosa* (5%) while 3- and 1-year plantations comprised only one species- *E. redlevi* (100%).

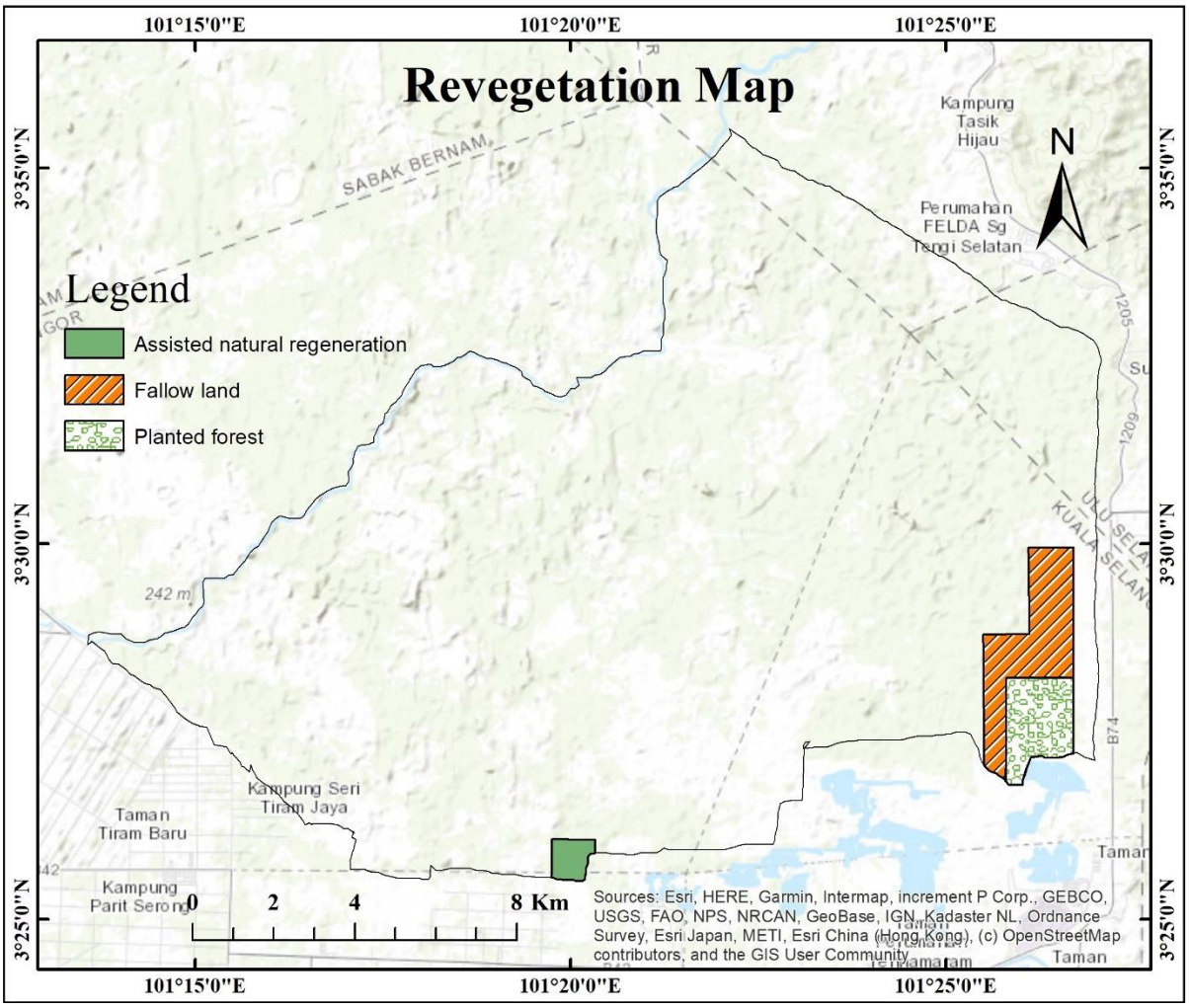

Figure 5.4 The revegetation map of Raja Musa Forest Reserve showing the planting progress in the community based forest restoraton site1. (Source: Google Earth and Esri ArcGIS 10.4)

During field survey, we observed few trees of *Durio carinatus*, *Syzgium campanulatum*, *Anisoptera marginata* and *Gonystylus sp*. scattered in the 5- and 7-year-old plantations. We estimated the highest survival percentage (77%) in 3-year plantations and the lowest (52%) was in 7-year-old plantations (Figure 5.5-B). The mean survival percentage in the studied plantations was 65. The differences in survival percentages of planted trees among four age-classes were not statistically significant ($p>0.05$).

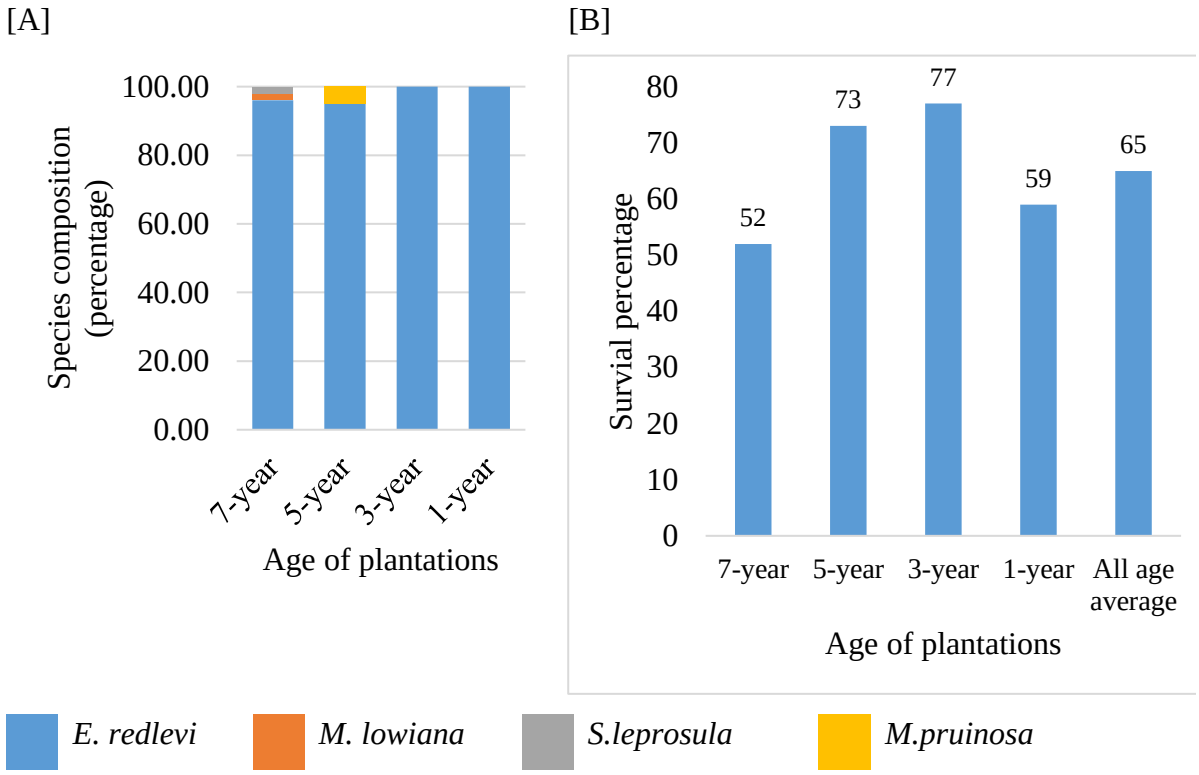

Figure 5.5 Species composition [A] and survival percentage [B] of planted trees of different ages in restoration site of RMFR, North Selangor, Malaysia (F (3, 32) = 2.868, p=0.054).

In 7-years old plantations, *M. lowiana* showed the highest height (6.60m) and diameter (dbh, 8.68cm) and there were no significant differences with regard to height and diameter growth among three tree species. In 5-year-old plantations, dbh (7.76cm) growth of *M. pruinosa* was significantly higher than that of *E. redlevi* (4.44cm) (p=0.001). But, height growth *M. pruinosa* (6.80m) was not significantly higher *than E. redlevi* (5.14m). Mean height and DBH growth of *E. redlevi* was 3.74 m and 3.89 cm respectively for 3-year-old plantation (Figure 5.6-B, A).

At 7-year, MAI of height was highest for *M. lowiana* (0.94m/year) followed by *E. redlevi* (0.87 m/year) and *S. leprosula* (0.80m/year) (Figure 5.6-D). However, the MAI of dbh was highest for *M. lowiana* (1.24cm/year) followed by *S. leprosula* (1.13cm/year), and *E. redlevi* (1.08 cm/year) (Figure 5.6-C). Height and dbh growth rate of *M. lowiana* was 1.08 and 1.15 times

faster than *E. redlevi*, respectively. Further, the growth rate (height and dbh) of *M. pruinosa* at 5-year (1.36 m/year and 1.55 cm/year) was 1.32 and 1.74 times faster than that of *E. redlevi* (1.03 m/year and 0.89 cm/year), respectively. The growth rate (dbh) of *M. pruinosa* was significantly (p=0.001) higher than *E. redlevi*. The MAI (height and dbh) of *E. redlevi* at 3-year-old plantations was 1.24 m/year and 1.29 cm/year, respectively.

In three age groups, *E. redlevi* was common tree species and diameter growth rate (MAI) decreased from younger plantations (3-year) toward older plantations. However, MAI (height) fluctuated from the highest in the youngest plantation (1.29cm/year, 3-year) and then declined to 0.88cm/year (5-year), before climbing to 1.08 cm/year for the oldest (7- year) plantation. Overall, growth rate (dbh and height) across four tree species between age groups was found significantly different (p=0.001).

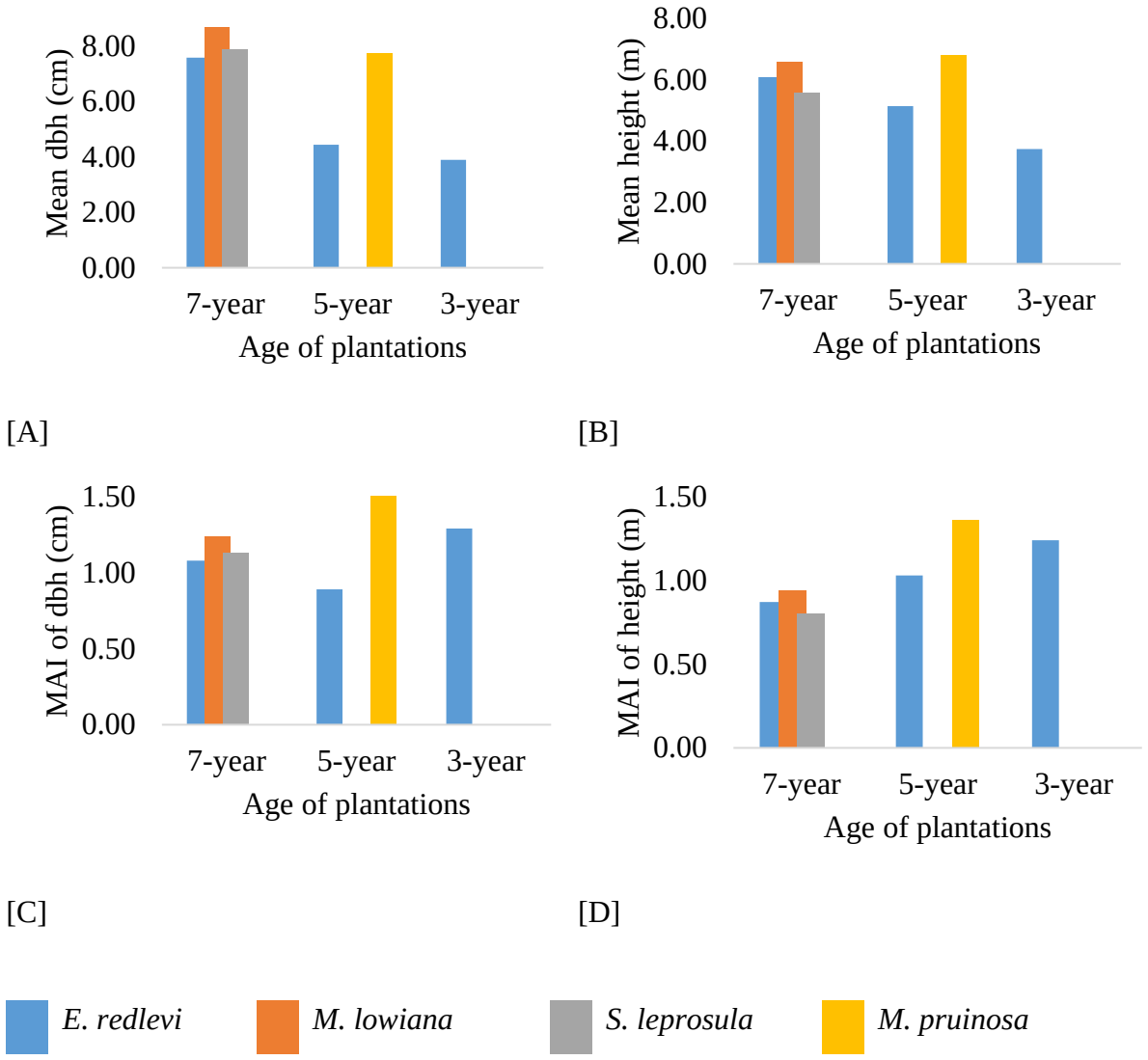

Figure 5.6 Mean diameter at breast height [A], mean height [B], mean annual increment of diameter [C] and mean annual increment of height [D] of planted trees of different ages in the restoration site of RMFR, North Selangor, Malaysia

5.3.3 Natural regeneration and conservation status

A total of 387 individuals of 16 species under 13 families were recorded from all three sites (Table 5.4). ANR site contains the highest species composition with 15 species under 12 families followed by PF with 5 species of 5 families and GL with 2 species with 2 families. *Acacia mangium* was an exotic species to the PSF. Clusiaceae, Dipterocarpaceae, and Fabaceae were the dominant families representing two species each, and Euphorbiaceae and Rutaceae were common in all three locations.

Out of 15 species in the ANR, two species (*A. dammara, V. pauciflora*) was recorded as VU (vulnerable); two (*S. leprosula, M. lowiana*) as NT (near threatened) and three (*E. petiolatus, E. serrata, L. gracilipes*) as LC (least concern), and five species were categorized as NE (not evaluated). Among five regenerating tree species in PF site, one is VU (*A. dammara*), one is LC (A. *mangium*) and one NE (*S. cerinum*). However, conservation status of three species (*E. redlevi, M. pruinosa* and *P. singularis*) was not available in IUCN red list.

Regeneration density was the highest in ANR site (26,625 ha^{-1}) followed by PF site (25,104 ha^{-1}) and GL site (1,875 ha^{-1}). In ANR, the highest density (17,500 ha^{-1}) was contributed by *E. redlevi* followed *by M. pruinosa* (4,125 ha^{-1}), and *Campnosperma coriaceum* (1,500 ha^{-1}). In PF and GL sites also *E. redlevi* showed the highest regeneration (20,104 ha^{-1} and 1,250 ha^{-1} respectively). This shows that *E. redlevi* was the most densely occurring regenerating tree species in this study area. Analysis of IVI revealed that in three sites (e.g. ANR, PF, and GL) *E. redlevi* was the most dominant regenerating tree species followed by *M. pruinosa* in the degraded RMFR areas.

Table 5.4 Seedlings' density (ha^{-1}), relative density (RD), relative frequency (RF), relative abundance (RA) and importance value index (IVI) and conservation status of regenerating tree species in (a) ANR, (b) PF and (c) GL sites in RMFR, Selangor, Malaysia

SL No.	Scientific Name	Family	Conservation status	Density	RD (%)	RF (%)	RA (%)	IVI
(a) Assisted natural regeneration site								
1	*Campnosperma coriaceum*	Anacardiaceae	NE	1500	5.63	2.22	23.97	31.82
2	*Agathis dammara*	Araucariaceae	VU	125	0.47	2.22	2.00	4.69
3	*Calophyllum sclerophyllum Vesque*	Clusiaceae	NE	125	0.47	2.22	2.00	4.69
4	*Garcinia nigrolineata*	Clusiaceae	NE	125	0.47	2.22	2.00	4.69
5	*Shorea leprosula*	Dipterocarpaceae	NT	375	1.41	2.22	5.99	9.62
6	*Vatica pauciflora*	Dipterocarpaceae	VU	500	1.88	2.22	7.99	12.09
7	*Diospyros maingayi*	Ebenaceae	NE	750	2.82	2.22	11.99	17.03
8	*Elaeocarpus petiolatus*	Elaeocarpaceae	LC	375	1.41	2.22	5.99	9.62
9	*Macaranga pruinosa*	Euphorbiaceae	-	4125	15.49	35.56	4.12	55.17
10	*Parkia singularis Miq.*	Fabaceae	-	250	0.94	4.44	2.00	7.38
11	*Engelhardtia serrata*	Juglandaceae	LC	125	0.47	2.22	2.00	4.69
12	*Litsea gracilipes*	Lauraceae	LC	375	1.41	2.22	5.99	9.62
13	*Myristica lowiana*	Myristicaceae	NT	125	0.47	2.22	2.00	4.69
14	*Syzygium cerinum*	Myrtaceae	NE	250	0.94	4.44	2.00	7.38
15	*Euodia redlevi*	Rutaceae	-	17500	65.73	31.11	19.98	116.82
				26625	100	100	100	300
b. Planted forests sites								
1	*Euodia redlevi*	Rutaceae	-	20104	80.08	41.94	58.57	180.59
2	*Macaranga pruinosa*	Euphorbiaceae	-	3125	12.45	38.71	9.86	61.02
3	*Agathis dammara*	Araucariaceae	VU	938	3.73	9.68	11.84	25.25
4	*Syzygium cerinum*	Myrtaceae	NE	833	3.32	6.45	15.78	25.55
5	*Acacia Mangium*	Fabaceae	LC	104	0.41	3.23	3.95	7.59
				24895	100	100	100	300
c. Grass land sites								
1	*Euodia redlevi*	Rutaceae	-	1250	66.67	66.67	50	183.33
2	*Macaranga pruinosa*	Euphorbiaceae	-	625	33.33	33.33	50	116.67
				1875	100	100	100	300

IUCN Red list categories: NE: not evaluated; DD: data deficient; LC: least concern; NT: near threatened; VU: vulnerable; EN: endangered; CR: critically endangered; EW: extinct in the wild; EX: extinct

Species-wise young tree recruitment

In ANR site, nine species attained young tree stage (> 2 m with a dbh of < 4.5 cm) with the highest recruitment for *E. petiolatus* and *C. sclerophyllum* (100% each) followed by *M. pruinosa* (69.70%), *P. singularis Miq. and S. cerinum* (50% each) and the others ranges from 16.67-33.33%. No successful recruitment was found for other six species. In PF sites, among five regenerating tree species, only two species such as *E. redlevi and M. pruinosa* had young tree recruitment rate of 4.15% and 6.67%, respectively. In GL, no young tree recruitment was observed (Table 5.5).

Table 5.5 Species wise density distribution of regeneration categories and successful recruitment in the sampling sites [successful recruitment=No. of young tree/No. of (seedling + sapling + young tree) x100]

Species	Seedlings density	Saplings density	Young trees density	Successful recruitment (%)
Assisted Natural Regeneration				
Campnosperma coriaceum	1250 (7.63)	-	250 (3.51)	16.67
Agathis dammara	125 (0.76)	-	-	-
Calophyllum sclerophyllum	-	-	125 (1.75)	100
Garcinia nigrolineata	125 (0.76)	-	-	-
Shorea leprosula	250 (1.53)	-	125 (1.75)	33.33
Vatica pauciflora	500 (3.05)	-	-	-
Diospyros maingayi	500 (3.05)	125 (4)	125 (1.75)	16.67
Elaeocarpus petiolatus	-	-	375 (5.26)	100
Macaranga pruinosa	1000 (6.11)	250 (8)	2875 (40.35)	69.70
Parkia singularis Miq.	125 (0.76)	-	125 (1.75)	50
Engelhardtia serrata	125 (0.76)	-	-	-
Litsea gracilipes	375 (2.29)	-	-	-
Myristica lowiana	-	125 (4)	-	-
Syzygium cerinum	125 (0.76)	-	125 (1.75)	50
Euodia redlevi	11875 (72.52)	2625 (84)	3000 (42.11)	17.14
Total	16375 (100)	3125 (100)	7125 (100)	
Planted Forest				
Euodia redlevi	17188 (87.30)	2083 (47.62)	833 (80)	4.15
Macaranga pruinosa	1667 (8.47)	1250 (28.57)	208 (20)	6.67
Agathis dammara	-	938 (21.43)	-	-
Syzygium cerinum	833 (4.23)	-	-	-
Acacia mangium	-	104 (2.38)	-	-
	19688 (100)	4375 (100)	1042 (100)	
Grassland				
Euodia redlevi	625 (50)	625 (100)	-	-
Macaranga pruinosa	625 (50)	-	-	-
	1250 (100)	625 (100)	-	

Note: a= Assisted Natural Regeneration; b= Planted Forest; c= Grassland; Figure in parenthesis indicates percentage value

5.4 Discussion

5.4.1 Forest restoration approach

Multi-stakeholder engagement in the restoration of degraded PSF was a pioneer intervention in peninsular Malaysia. The GEC and SSFD adopted a comprehensive approach with active participation of wider community to restore the degraded RMFR. Forest restoration is a multi-stakeholder process that requires much more than simply planting trees; it involves halting and reversing degradative pathways and creating transformative restoration systems (Chazdon et al., 2020b; Ota et al., 2020). Canal blocking, clay dyke construction and fire prevention are essential steps towards restoration process. Researchers (e. g. Panda et al., 2011; Ritzema et al., 2014) reported that canal blocking contributed to the improvement of GWL in the degraded PSF. Improved hydrology could be an important factor for reducing fire hazard and creating conditions for forest vegetation re-establishment (Jauhiainen et al., 2008; Page et al., 2009). Findings of this study indicate that average GWL was maintained from -28.6 cm to -20.16cm during 2016 to 2018. Wösten et al. (2008) suggested to maintain the GWL between -40cm to +100cm to prevent peat subsidence, and control fire. Fire prevention and control is one of the crucial aspects of PSF conservation. Langner & Siegert (2009) reported that tropical PSF are more vulnerable to destruction by fire compared to other forest types due to high organic matter in the peat soil and by characteristic it is extremely flammable when dry. The GEC's staff commented that there were no major fire incidents in the last few years, which might be due to the water table improvement, regular monitoring, and awareness creation among the smallholder farmers in surrounding areas. Musri et al. (2020) reported that the efforts to restore and rehabilitate the degraded area of RMFR showed positive results where the incidence of forest fire has been greatly reduced.

5.4.2 Plantation status and growth

In heavily degraded PSF, restoration through natural regeneration of tree cover may take long time and thus active replanting is essential (Page et al., 2009; Giesen & Nirmala, 2018). Findings indicate that during the last ten years less than one third of the targeted area was replanted. If this rate continues, it will take another 20 years to restore 1,000 ha, which suggests the effectiveness of revegetating activities was predominantly minimal. Therefore, a crash programme is needed to bring the whole area under plantations. Replanting was carried out

mostly with *E. redlevi* followed by some *M. pruinosa*. These are pioneer species, fast-growing, and can provide shade to others to grow approximately after three years (Awang et al., 2019). Older plantations were relatively rich in species number due to vacancy filling with other species. Most of the PSF restoration projects select only a few species to plant (Graham, Giesen, & Page, 2017). However, Giesen (2015) suggested to select a broad range of suitable species for tropical PSF restoration for floral and faunal diversity, enhancement of physical characteristics, and eco-system services. Graham et al. (2017) listed a number of pioneer species (e.g. *C. coriaceum, S. leprosula, Diospyros maingayi, Koompassia malaccensis, Syzygium zeylanicum*) and climax species such as *Alseodaphne coriace*a and *Tetramerista glabra* for PSF restoration.

Early poor survival rate (SR) might be related to transplant shock, and wild boar grazing (rooting and trampling), which suggests that during the early years of plantation (1-3 year) vacancy filling and post-planting maintenance (e.g. weeding) was needed. The relatively poor SR of 7-year plantations might be related to fire damage (Nath et al., 2017). The SR of *S. leprosula* and *S. selanica* was found 59.5% and 40.5%, respectively in Indonesia (Subiakto, Rachmat, & Sakai, 2016). Findings indicate that SR of *E. redlevi* (76% at 3-year) and *E. redlevi* and *M. pruinosa* (74% at 5-year) was relatively high. These findings support the idea of higher SR of the pioneer species such as *Cratoxylum arborescens* (80%) and *M. pruinosa* (65.6%*)* at a 5-year plantation at a drained PSF Riau, Indonesia (Junaedi, 2018).

Overall, no significant difference was observed for growth (dbh and height) of three planted tree species at 7-year. In 5-year, between two, *M. pruinosa* performed better growth (dbh and height) despite the height growth was not significantly different. Irrespective of age, the best height and dbh growth among the four species was for *M. pruinosa* (height=6.80m) and *M. lowiana* (dbh=8.68cm), respectively. *M. pruinose* showed the highest MAI (dbh = 1.55 cm/yr and height = 1.36m/yr) in comparison to other three species. Junaedi (2018) reported dbh and height increment of *M. pruinosa* (dbh 2.59cm/yr; height 2.31m/yr) and *M. gigantea* (dbh 1.82cm/yr; height 1.42m/yr) at 5.5 years old plantations at a drained peatland in Riau, Indonesia. The growth rate of *S. leprosula* was similar to the findings of Subiakto et al. (2016).

5.4.3 Natural regeneration and conservation status

Sixteen regenerating tree species belonging to 13 families were found at the restoration site of RMFR. Previous studies recorded 48 tree species under 22 families at NSPSF (SSFD, 2014); seven tree species belonging to 7 families in a logged over PSF of Nenasi Pahang, Malaysia (Ismail et al., 2017), and 7–10 species in the burnt PSF of SEA (Giesen, 2009). The lower regeneration status might be due to hydrological degradation, repeated fire, conversion to other land uses, and aggressive growth of weeds. Species composition was rich in ANR followed by PF and GL. Similar to this finding, declining trend of regenerating species due to increased disturbance level in lowlands of Indonesia was observed (Page et al., 2009). Continued tropical PSF degradation and the declining trend of tree species composition could permanently cause the extinction of several important tree species along the peatland landscape (Astiani, 2016), if proper conservation measures are not taken. RMFR still contains a number of species whose survival was threatened according to the IUCN criteria of level of threat. For example, we found two VU (*A. dammara* and *V. pauciflora)*, two (*S. leprosula* and *M. lowiana*) NT and three (*E. petiolatus, E. serrata* and *L. gracilipes*) LC species in ANR; while, one (*A. dammara)* VU in PF (IUCN, 2020).

Density of regenerating tree species was highest at ANR site (26,625 ha-1) followed by PF (25,104 ha-1) and GL (1,875 ha-1). Similar trend was also reported by Gunawan et al. (2012) who assessed the density as 19,531 ha^{-1} and 12,344 ha^{-1} in two different level of degraded areas of a burnt PSF in Indonesia. However, this density was much better than a traditional plantation density (667 ha^{-1}, 3mX5m spacing). The IVI values signify the overall dominance and ecological success of a species in a forest stand (Winata, Yuliana, & Rusdiyanto, 2017; Das, Alam, & Hossain, 2018). Findings indicate that *E. redlevi* and *M. pruinosa* were dominant with the highest IVI values in study sites. Ismail et al. (2017) identified *Shorea platycarpa*, *Pometia pinnata*, and *Xylopia fusca* as dominant species in a degraded PSF in Peninsular Malaysia, while Saharjo, (2006) found dominancy of *Uncaria glabrata* and *M. pruinosa* in a burned PSF in Indonesia.

Due to various anthropological (fire, water drainage etc.) and environmental factors (light, nutrient, suppression, climber, weeds, animal etc.) not all species could develop as a young tree. Only nine tree species in ANR and two tree species in PF had reached young tree stage whereas in GL there were no young tree recruitment. *E. petiolatus* and *C. sclerophyllum* showed the highest successful recruitment (100%) in ANR. In PF site, among five species only

two species (*E. redlevi* and *M. pruinosa)* had a young tree recruitment; however, the recruitment percent was very low (4.15 and 6.67%). Therefore, it seems that degraded RMFR had a reasonable natural regeneration but poor recruitment. Poor survival of young trees probably resulting from both biotic and abiotic interferences (Haider, Alam, & Mohiuddin, 2017).

5.5 Conclusions

This community-based restoration of degraded PSF demonstrates several positive results. Restoration approach encouraged volunteers from wider community to take part in restoration activities thus created an opportunity for multi-stakeholder engagement. It created awareness among villagers on importance of RMFR, motivated them not to set fire when prepare their agricultural land, and thus could reduce fire incidents in recent years. Canal blocking and clay dyke were useful to keep degraded site wetted, reduce fire incidences and encourage natural regeneration. The speed of restoration was somehow slow as only few hectares of degraded PSF was replanted every year. Survival rate of planted trees was reasonable as trees had to compete with dense and hardy grasses. *E. redlevi* was dominant in plantations, and growth of planted trees were comparable to previous studies in Malaysia and Indonesia. Revegetating with a few species may impart long term changes in floral and faunal diversity, physical characteristics and eco-system services. Natural regeneration and young trees recruitment in ANR site were promising, which indicates that secondary PSF can support successful natural regeneration if this remains undisturbed and wetted. In PF site, natural regeneration (seedling and sapling stage) was very encouraging but limited by very low recruitment of young tree (e. g. species and percent). In open GL, there were no recruitment of young trees. Being said above, we have following recommendations for smooth restoration of degraded PSF in RMFR:

1. Annual plantation development target area needs to be increased so that HDPF can be brought quickly under tree coverage. In general, few hundreds hectare of plantations can be raised by the SSFD every year. Quick tree coverage would prevent further degradation of RMFR.

2. A mixture of suitable tree species can be planted to enhance the diversity. Species with low IVI value and IUCN listed threatened species may get priorities.

3. At least three years of post-planting maintenance (e.g. weeding, gap filling) is necessary in order to ensure an optimum tree density in plantations.

4. Enrichment plantations with native tree species can be carried out in vacant spaces of PF and ANR.

5. Ensure sustainability of other restoration actions such as GWL, fire prevention, community engagement and their socio-economic development.

Findings of this study would provide useful information toward planning successful peatland restoration programme in other parts of Malaysia and elsewhere having similar situation.

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Chapter 6 : Local Peoples' Perception on the effect of Management Regimes on Socio-economic and Environmental Benefits of Peat Swamp Forest

Abstract

Community-based forest management (CBFM) has become a wide-spread approach for degraded forest restoration, biodiversity and wildlife conservation, regain the lost ecosystem services and upliftment of local socio-economy in many countries of the world. In the PSF of Malaysia, this CBFM approach has been adopted to restore the degraded RMFR since back in 2008. However, there is scanty empirical evidence on the effectiveness of the CBFM in enhancing environmental and socio-economic benefits from this restored forest landscapes over time. In this paper we analysed local peoples' perception on the changes of environmental and socio-economic benefits due to the decade long community-based PSF restoration and their contribution to PSF conservation. Data collection was done through four focus group discussions, five key informants' interviews, and 200 structured household interviews. The analysis indicates that CBFM improves a number of environmental, economic and societal benefits to local people. For example, improves the condition of nature-based recreation, declines PSF conversion, increases income from tourism and community nursery establishment and providing societal benefits from nature education and research. However, people perceive that most of the important environmental benefits like, water storage and supply for irrigation, biodiversity and habitat conservation, carbon sequestration capacity of the PSF and economic benefits such as timber and NTFP supply has not showed any improvement yet. Although benefits from PSF conservation were minimal and no apparent improvements were observed in many environmental services; however, respondents sincerely wanted to contribute to PSF conservation through participation in various management actions in particular tree planting and awareness creation through volunteering. Even though, for sustainable community participation in PSF management benefit maximization to local community remained a big challenge. These results presented here may facilitate improvement in the community engagement process in PSF conservation and selection of appropriate management actions for enhancing the ecosystem services and benefits.

Keywords: Community-based forest management, peat swamp forest, restoration, socio-economic and environmental benefits, willingness to contribute

6.1 Introduction

Humans obtain many socio-economic and environmental benefits (i.e. ecosystem services, ES) from the natural ecosystems (MEA, 2005; Burkhard et al., 2012). Therefore, efficient management of the natural ecosystems is essential for sustaining their functions and flow of benefits. In the past several decades, failure of halting resource overexploitation and deforestation with centralized forest management prompted policy makers and scientists to adapt CBFM approach in many countries of the world (Dressler, McDermott & Schusser, 2015; Kumar, Singh & Kerr, 2015). This CBFM approach has become a viable alternative to the historical patterns of centralized forest management, where local communities are increasingly engaged in forest conservation, restoration of degraded forests and management (Paudyal et al., 2017). Several studies (e.g. Birch et al., 2014; Stevens et al., 2014; Paudyal et al., 2015; Nath et al., 2016; Rai et al., 2020) provided evidence of enhancing various ecosystem benefits such as food, timber, NTFPs, recreation, tourism and education, health, watershed protection and wildlife habitat, carbon sequestration, and improving local livelihoods through the CBFM approach. On the other hand, researchers (e.g. Galvani et al., 2016; Nath, Jashimuddin & Inoue, 2016) highlighted that when individuals obtain benefits from forests reciprocally, they contribute to their conservation and protection

NSPSF was under the management of Selangor State government as SLF until 1990 and was subjected to active logging since 1950s (Nath et al., 2017). In order to protect from further degradation, NSPSF was declared as a permanent forest reserve in 1990 where logging, development, and agricultural activities were prohibited, and management was transferred to SSFD (SSFD, 2014). However, Sasidhran et al. (2016) reported that PSF conversion was continuing even after declaration of permanent forest reserve and about 1,000 ha of degraded PSF in RMFR within NSPSF was converted into oil palm plantations and other cash crops by 2008.

In order to restore this 1,000 ha of degraded PSF, regain the lost ES flows and to improve the socio-economic condition of local people, the SSFD in co-operation with GEC had undertaken a community-based PSF restoration programme at RMFR in 2008 (SSFD, 2014; Nath et al., 2017). Forest restoration helps to regain ecological functionality of degraded landscapes and improves socio-economic benefits of local people (Chazdon et al., 2020a; Gregorio et al., 2020). The restoration of degraded forest lands is a global priority that aims to restore

ecosystems and their functions in ways that provide multiple socio-economic benefits (UNFCC, 2019; Chazdon et al., 2020b; Ota et al., 2020).

Ideally, the forests of Malaysia are under the management of state government. The transition of management regimes in RMFR from state forest management (SFM, years before 2008) toward CBFM, (years after 2008 to current) might have differential impact on the flow of environmental and local peoples' socio-economic benefits from PSF, which is not explored yet. Local situations are often better understood by local people than by outside experts (Nightingale, 2005; Ojha, Persha & Chhatre, 2009) and their perceptions of the value of different ESs are critical for future management (Paruelo, 2012; Smith & Sullivan, 2014; van Oort et al., 2015). As such, we examined i) local peoples' perception on changes in socio-economic and environmental benefits of PSF due to transition of PSF management regimes, and ii) their willingness to contribute to PSF restoration actions.

We hypothesized that transition to CBFM would improve the environmental and socio-economic benefits to the local people and people would positively contribute to the restoration actions.

6.2 Methodology

6.2.1 Data collection approach and variables

We adopted a sociological survey to collect primary data from multiple sources applying both qualitative and quantitative approaches. See Chapter 3 on Methodology that highlights the methods and data collection approach used. Here I present the details about the chapter specific variables, measurement and data analysis. For qualitative data, three checklists (e.g. for workshop, Appendix 5, FGD, Appendix 1 and KII Appendix, 2) were prepared following Mitchell & Cameron (1989) and Nath et al. (2017) to reveal the important ecosystem benefits of RMFR, variations of economic and societal benefits between SFM and CBFM, attitude towards the PSF restoration approaches, and WTC towards PSF restoration. Similarly, a pre-tested semi-structured questionnaire (Appendix 3) was used to gather quantitative data. Household data collection questionnaire was prepared following Nath et al. (2017) and outputs of workshop, FGD and KII. Local peoples' perception on changes of benefits (socio-economic and environmental) of PSF in two management regimes was assessed through HHs. Before interviews, respondents were briefed the objectives of this study and explained two

management regimes: SFM and CBFM. Respondents were elderly persons and so they were able to distinguish two management regimes. Following the Paudyal et al. (2017), perception of respondents was scaled between '0' and '5', where 0-1= no benefits to very poor/very low, 1-2 = poor/low, 2-3 = average/medium, 3-4 = good/high and 4-5 = very good/very high. At the beginning, respondents assigned a value for each benefit from 0 to 5 regarding their status during CBFM and the same process was repeated for SFM. They were allowed to change their ratings at any time.

To assess villagers' attitude towards management actions, a number of restoration and conservation activities related questions were listed in the HHs questionnaire based on FGD and KII outputs. Following Lankia et al. (2014), their responses were categorized as action is "desirable", "undesirable" and "cannot say". Those who responded "desirable", they were asked whether or not they were WTC towards PSF restoration actions. Those who were WTC toward PSF restoration actions, they were then asked whether they would donate money or volunteer restoration actions following Mitchell & Carson (1989) and Lankia et al. (2014).

6.2.2 Data analysis

Descriptive statistics (e.g. frequency, percentage, mean and standard deviation) of the variables such as socio-demographic attributes, benefits, attitude towards management actions and WTC were calculated. To find statistically significant difference of the benefits obtained from the PSF during SFM and CBFM (paired ordinal data), Wilcoxon signed-rank test (non-parametric) (Kijazi et al., 2010) was conducted. Chi-squared test was used to examine the association between respondents' socio-demographic attributes and their attitude (e.g. desirable, undesirable and can't say) towards management actions. Graphical presentation and data analysis were conducted using Excel 2016 and SPSS version 26, respectively.

6.3 Results

6.3.1 Characteristics of the respondents

Majority (70%) of the survey respondents were male. Mean age of the respondents was 54 years and about half of the respondents were belong to the older group (> 56 years). Older people were able to provide divergent opinion on the benefits of PSF as they lived there for long time. Most (62%) of the respondents had secondary level of education and almost equal

portion of respondents were engaged in service and small business (23% each) and agriculture (21%), and the rest 33% were engaged in other activities (e.g. home makers, senior retired persons, and students). The majority of the respondents (65%) had an average monthly income between RM 1000-2000 (1US$=4.16 as of August 2019). Most of (61%) of the households were located within 1-2km from RMFR (Table 6.1).

Table 6.1 Characteristics of respondents in the studied villages (Source Field work, 2019)

Variable	Frequency (N=200)	Percentage
Gender		
Male	140	70
Female	60	30
Age class (years)		
Young (18–35)	27	14
Middle-aged (36–55)	76	38
Older (56 and above)	97	48
Mean age (years)	54	
Education		
No formal education	9	4
Primary	51	26
Secondary and diploma	123	62
Graduate and post graduate	17	8
Occupation		
Agriculture	42	21
Service	46	23
Small business	46	23
Others	66	33
Mean monthly income (RM)		
1000-2000	130	65
2000-3000	43	22
>3000	27	13
Residence to PSF distance (km)		
1-2km away	121	61
3-4km away	47	23
≥5km away	32	16

6.3.2 Environmental and socio-economic benefits of PSF

Participants of FGD and KII commented that local people obtained a wide variety of benefits from RMFR. Although dependency of local people on forests was not high, yet some benefits were very important for their livelihoods. Participants in FGD expressed that RMFR is an important biodiversity conservation and carbon sequestration area, many people use this area for recreation and education purposes. They said that the most important benefit is irrigation

water. Majority of the surrounding people have oil palm plantations, paddy and other agricultural crops like pineapple, tapioca, fruits, yam plants and they get water from RMFR round the year for their agriculture and oil palm plantations. Some people also highlighted its importance of regulation of flood, and habitat for wildlife. In addition, a number socio-economic benefits like increase income through employment generation and small business opportunities, acquire environmental knowledge through education and training etc.

6.3.3 Perceived changes of economic and social benefits

Interviews with key-informants and participants in FGD revealed that villagers received economic and social benefits from RMFR in both management regimes. They stated that RMFR was historically valued for wild goods such as timber and NTFPs (e.g. wild vegetables, tender shoots for salad, medicinal plants, leaves for craft, rattan, resin, orchids, ornamental plants and palm leaves), fish and meat (e.g. wild boar, birds, swamp python) and water for paddy and oil palm cultivation. They reported that from 1960s to 1990s logging was permitted under licence and during that time some local people also collected wood from the PSF. But currently, being a permanent forest reserve, extraction of timber and non-timber forest products (NTFPs) was prohibited and thus there was a significant decline of availability of these products (timber from 3.95 to 1.47 and NTFP from 4.03 to 2.86) during CBFM (Table 6.2). Participants in FGD reported that in the past many people used to go to the forest to collect NTFPs but currently only a few people (1-2 groups) are involved in collecting NTFPs, catching fish, and hunting (e.g. wild boar, birds etc.). As, one elderly participant (KII) indicated that "*presently only 2-3 people go to the RMFR to collect leaves, and about 10 people to catch fish*". Similarly, the SSFD and GEC staff remarked that villagers were allowed to collect selected NTFPs (e.g. tender shoots of *Euodia redlevi*, leaves for crafts, etc.) during religious festivals.

During SFM, local people got jobs with logging companies who hired local people in timber extractions. In current CBFM, local people have several economic activities including jobs for local people in PSF conservation activities, small business (e.g. forest nursery), tourist guides in jungle trekking, and further enrichment of homestay agro-tourism. One SSFD official stated that-

"to support local business, we (SSFD and GEC) had an understanding and/or agreement with some of the FNSPSF members to establish and maintain community nursery for supplying seedlings for monthly tree planting programme via buy back system".

Apart from four community nurseries, the JPFR in collaboration with FNSPSF and technical support from the GEC established a community nursery in a local school. A teacher and advisor of school community nursery stated that in 2013 they raised about 500 seedlings and it was increased to about 4000 seedlings in 2019. They sell these seedlings to the GEC and SSFD for use in RMFR restoration programme at a rate of RM 5.0 (1US$=RM 4.20). The revenue earned from selling seedlings was used for student's welfare (e.g. food, souvenir, T-shirts, etc.) and field trips.

In addition, participants reported a range of societal benefits related to the PSF restoration and conservation which included learning opportunities like training on handicrafts and environmental issues, use of internet, communications, managerial skills development, and formation of social capital. The SSFD and GEC hired a number of local people in tree planting, canal blocking and maintenance, and patrolling activities as daily labourer or monthly employees. The GEC also assisted villagers to form FNSPSF, a village level registered association. As a registered association, FNSPSF receive support from local government's offices for village development. FNSPSF also received a two-year grant from the UNDP's Small Grant Programme (Malaysia) for socio-environmental development in their villages.

Local peoples' perception, obtained through household interviews, on changes of socio-economic benefits of RMFR between SFM and CBFM is shown in Table 6.2. Results indicate that employment opportunities in two management regimes were not significantly different, which support the opinion of FGD and KII. Respondents claimed that there was a significant ($p=0.001$) increase of tourism activities during CBFM (mean score 2.18).

Table 6.2 Changes of economic and societal benefits between SFM and CBFM regimes in RMFR, North Selangor, Malaysia.

Variable	Condition during SFM (N=200)	Condition during CBFM (N=200)	Wilcoxon signed-rank test	
	Mean±SD	Mean±SD	z	p-value
Availability of timber	3.95 ± 1.58	1.47±1.45	-10.97	0.001
Availability of non-timber products	4.03±.94	2.86±1.02	-10.68	0.001
Employment and small business opportunities	2.68±1.46	2.62±1.40	-0.234	0.812
Tourism at RMFR	1.72±1.71	2.18±1.67	-4.02	0.001
Water for agriculture	4.48±.91	3.30±1.11	-10.16	0.001
Land for oil palm and agriculture	4.20±1.06	2.68±1.31	-10.82	0.001
Nature education and training	2.52±1.60	4.01±1.08	-8.44	0.001
Research	2.44±2.03	3.82±1.33	-8.37	0.001

† = Values indicate means of scales [benefits and services are scaled from 0 to 5, where '0' equals no benefits, and '5' is equivalent to the full potential of benefits and services

Kampung Sungai Sireh is an important destination of homestay agro-tourism since 1995. Villagers reported that their homestay agro-tourism was further enriched through their involvement in PSF restoration programme and through their membership in FNSPSF.

A staff of SSFD stated that

> "after the gazettement of RMFR as a permanent forest reserve and participation of local people in PSF management, people are more aware of ecotourism activities. Homestay agro-tourism operators have gotten the opportunity to increase their income by expanding their services through eco-tourism specifically to the nature lover tourists, students and researchers".

This statement was supported by homestay agro-tourism manager, as he mentioned

> "currently, homestay owners are getting benefit by using the RMFR as an ecotourism (e.g. canoeing, river cruising, fishing, and jungle tracking) destination. For every visit of a group of tourists usually we get permit from the SSFD by paying RM 5.0 per person and we charge RM 20.0 for each person".

Respondents in HHs perceived a significant (p=0.001) decrease of irrigation water supply in two management regimes (Table 6.2). An elderly respondent expressed that "*local people are highly dependent on PSF water for their oil palm and paddy cultivation*". Discussions with FNSPSF members and villagers revealed that villagers (in particular at Kg Raja Musa) were experiencing irrigation water shortage in summer specifically for oil palm plantations. As a result, production of oil palm reduced considerably. In addition, one participant claimed that

> "water shortage for irrigating oil palm plantation started when CBFM began to block canals to maintain water table in the forests. After canal blocking no water flow inside the village".

Some participants reported that people in two other villages (e.g. Kg Sungai Sireh and Kg Sri Tiram Jaya) were very happy with the water supply from the forest to their paddy field.

Findings of FGD and KII revealed that during SFM regime, some villagers illegally converted a portion of PSF into oil palm plantations and other agricultural crops. But at the beginning of CBFM, the SSFD enforced law and recovered the land for restoration. They added that no new conversion was occurred in the last 10 years. Table 6.2 shows that there was a significant decrease of 'land for oil palm and agriculture' (scaled down from 4.20 to 2.68) during CBFM regime. However, a village leader from Kg. Raja Musa (KII) stated that most of the families (about 70%) of that village have oil palm plantations and as an economic activity they want more PSF land to convert into oil palm plantations. While others argued that "*we need to conserve the PSF because it' is just like a water tank and most of the irrigation water comes from the forests*,".

Participants of FGD and KII reported that various educational and training programme were conducted to improve the environmental awareness and knowledge of local community including school students. Local community and small holder farmers were provided training on firefighting operations, monitoring of fire danger rating system and arranged fire drill. FNSPSF members developed environmental knowledge through participating various outreach events such as the public talks, roadshows/exhibition organized by the SSFD, GEC, and other relevant agencies. In addition, one GEC staff reported that they arranged quite a few numbers of collaborative peer learning events (to know about the forests, their management and community involvement and development process) between FNSPSF and other peatland and mangrove community forest societies in different parts of Malaysia. Members of other community forest societies also visited FNSPSF for the same objectives. He added 2-3 members of FNSPSF were also sent to abroad to learn PSF and their management. Further, quite a few numbers of FNSPSF members received training on eco-tourist guide. In addition, as a co-curriculum activity GEC arranged field activities for selected school students attached with JPFR. Students participated in forest camping and visited forests to gain hands-on experience on tree identification, tree planting, nursery raising, soil study, peat recycling and other environmental education. GEC also invited students to participate in important days and events like national day, forest day, world wetland day. Villagers also perceived those opportunities for nature related education and trainings were increased significantly ($p=0.001$) during CBFM regime (Table 6.2).

KII from SSFD reported that several universities and research institutions were conducting research in RMFR on various aspects of forest restorations, ecosystem services, biodiversity, water table and community involvement in restoration process. In addition, university students visit the forest as a part of their field trips. Villagers also believed that research in RMFR had increased significantly (p=0.001) due to CBFM.

6.3.4 Perceived changes of environmental benefits

Results of HHs indicate that there was significant reduction (p=0.01) of environmental benefits such as biodiversity, wildlife habitat, wildlife sightings, carbon capture and pure environment in two management regimes (Table 6.3). However, people perceived that flood prevention capacity of the PSF was not decreased significantly (>0.05)

Discussion with the members of FNSPSF and other villagers revealed that overall biodiversity was reduced due to degradation of RMFR but they reported to the existence of jungle cats, bears and wild boars in the degraded PSF. An old participant (KII) stated that "*in 1930s about 18000 ha PSF had been converted to paddy field to meet food demand*". Additionally, a huge portion of PSF was burned (about 1000 ha burned in the 1990s and early 2000). All these events have had impact on biodiversity, wildlife habitat and carbon sequestration. However, they commented that due to current protection, awareness and collective actions, forests will regain previous condition and thus improve all these ecosystem services. Participants commented that canal blocking in RMFR effectively hold water in heavy showers and subsequently reduce flood. However, sometimes canal blocks were damaged or overflowed due to heavy rain which causes flood in adjacent farms and villages.

Table 6.3 Changes of environmental benefits between SFM and CBFM regimes in RMFR, North Selangor, Malaysia.

Variable	Condition in SFM (N=200)	Condition in CBFM (N=200)	Wilcoxon signed-rank test	
	Mean± SD	Mean± SD	z	p-value
Flood prevention	3.53±1.42	3.33±1.04	-1.66	0.09
Biodiversity	4.32±.86	3.20±.91	-9.923	0.001
Habitat for wildlife	4.30±.92	2.93±.95	-10.39	0.001
Wildlife sightings (i.e. animals, birds etc.)	3.81±1.18	3.40±1.10	-2.79	0.01
Carbon capture	4.18±1.13	3.27±1.00	-7.85	0.001
Pure environment (e.g. fresh air, etc.)	4.70±.94	3.41±1.02	-10.69	0.001

† = Values indicate means of scales [benefits and services are scaled from 0 to 5, where '0' equals no benefits, and '5' is equivalent to the full potential of benefits and services

6.3.5 Forest restoration actions and respondents' willingness to contribute

Respondents (villagers) live adjacent to RMFR and so they have long nature connectedness relationship. Because of their connectedness with forests and socio-economic benefits obtained from PSF, we assumed that they would actively participate in restoration actions. Participants in FGD and KII reported six key restoration actions such as tree planting and maintenance, canal blocking and maintenance, forest vigilance, fire control, trail construction, and education and awareness creation that were being carrying out in RMFR.

Household interviews reveal that tree plantings and maintenance stood as an activity that was found desirable to join by most (69%) of the respondents. However, canal blocking, trail construction, fire prevention and forest vigilance (for reporting fire and encroachment to FD), were more often found undesirable (55%, 55%, 51%, 51%, 50%) than desirable (26%, 27%, 37%, 36%) to join. Education and awareness creation divided the respondents, as approximately as many found it desirable (42%) as undesirable (40%). Overall, most (96%) of the respondents are interested to contribute to the desirable activities; while, only a negligible (4%) was found reluctant (Table 6.4).

Table 6.4 Respondent's attitude and willingness to contribute to management actions at RMFR, North Selangor, Malaysia (N=200).

Management actions	Respondents Frequency (%)	Willing to contribute Frequency (%)	Not interested Frequency (%)
Tree planting			
Desirable	138(69)	134(97)	4(3)
Undesirable	49(24)	-	-
Can't say	13(7)	-	-
Canal blocking and their maintenance activities			
Desirable	53(26)	51(96)	2(4)
Undesirable	109(55)	-	-
Can't say	38(19)	-	-
Forest vigilance			
Desirable	73(36)	67(92)	6(8)
Undesirable	100(50)	-	-
Can't say	27(14)	-	-
Fire prevention			
Desirable	73(37)	69(95)	4(5)
Undesirable	103(51)	-	-
Can't say	24(12)	-	-
Trail construction and maintenance activities			
Desirable	54(27)	53(98)	1(2)
Undesirable	111(55)	-	-
Can't say	35(18)	-	-
Education and awareness creation			
Desirable	83(42)	80(96)	3(4)
Undesirable	81(40)	-	-
Can't say	36(18)	-	-
Total			
Desirable	474(40)	454(96)	20(4)
Undesirable	553(46)	-	-
Can't say	173(14)	-	-

Association between respondents' socio-demographic attributes and attitude towards restoration actions

In Table 6.5, it is demonstrated that there were significant associations ($p<0.05$) between attitude towards tree planting and all demographic characteristics except household monthly income ($p=0.506$) and proximity to PSF ($p=0.707$). Forest vigilance is significantly associated with gender and occupation ($p=0.001$). Fire prevention, canal blocking, trail construction significantly related to gender ($p=0.001$), education ($p=0.01$, 0.01 and 0.05 respectively), occupation ($p=0.001$, 0.01 and 0.001 respectively). Awareness has a significant relationship with gender ($p=0.05$) and proximity to PSF (0.01).

Table 6.5 Chi-squared (Pearson) values for relationship between respondents' socio-demographic attributes and attitude towards management action (N=200)

Variable	Tree planting			Canal blocking			Forest vigilance			Fire prevention			Trail construction			Awareness		
	Desirable	Undesirable	Can't say	Desirable	Undesirable	Can't say	Desirable	Undesirable	Can't say	Desirable	Undesirable	Can't say	Desirable	Undesirable	Can't say	Desirable	Undesirable	Can't say
Gender																		
Male	105(76)	25(51)	10(77)	51(96)	62(57)	27(71)	67(92)	56(54)	17(63)	68(93)	57(55)	15(62)	52(96)	64(58)	24(68)	66(80)	49(60)	25(69)
Female	33(24)	24(49)	3(23)	2(4)	47(43)	11(29)	6(8)	44(44)	10(37)	5(7)	46(45)	9(37)	2(4)	47(42)	11(31)	17(20)	32(40)	11(31)
	χ^2=11.137 (df=2); p=0.01*			χ^2=26.313 (df=2); p=0.001*			χ^2=26.461 (df=2); p=0.001*			χ^2=29.815 (df=2); p=0.001*			χ^2=25.867 (df=2); p=0.001*			χ^2=7.071 (df=2); p=0.05*		
Age (years)																		
18-35	21(15)	2(4)	4(31)	11(21)	11(10)	5(13)	14(19)	10(10)	3(11)	14(19)	11(11)	2(8)	9(17)	14(13)	4(12)	14(17)	9(11)	4(11)
36-55	61(44)	11(22)	4(31)	23(43)	39(36)	14(37)	32(44)	35(35)	9(33)	31(43)	36(35)	9(36)	28(52)	36(32)	12(34)	36(43)	30(37)	10(28)
>56	56(41)	36(74)	5(38)	19(36)	59(53)	19(50)	27(37)	55(55)	15(56)	28(38)	56(54)	13(54)	17(31)	61(55)	19(54)	33(40)	42(52)	22(61)
	χ^2= 19.442 (df=4); p=0.001*			χ^2=6.047 (df=4); p=0.196			χ^2=6.954 (df=4); p=0.138			χ^2=5.901 (df=4); p=0.207			χ^2=8.756 (df=4); p=0.067			χ^2=5.508 (df=4); p=0.239		
Education																		
No education	5(4)	4(8)	0(0)	0(0)	9(8)	0(0)	1(1)	7(7)	1(4)	1(1)	8(8)	0(0)	0(0)	9(8)	0(0)	3(4)	5(6)	1(3)
Primary	27(20)	20(41)	4(31)	8(15)	33(30)	10(26)	13(18)	32(32)	6(22)	13(18)	32(31)	6(25)	8(15)	34(31)	9(26)	16(19)	25(31)	10(28)
Secondary /diploma	91(66)	24(49)	8(62)	37(70)	61(56)	25(66)	50(68)	55(55)	18(67)	48(66)	58(56)	17(71)	38(70)	63(57)	22(63)	52(63)	48(59)	23(63)
Graduate &d postgraduate	15(11)	1(2)	1(8)	8(15)	6(6)	3(8)	9(12)	6(6)	2(7)	11(15)	5(5)	1(4)	8(15)	5(5)	4(11)	12(14)	3(4)	2(6)
	χ^2=13.856 (df=6); p=0.05*			χ^2=15.880 (df=6); p=0.05*			χ^2=9.898 (df=6); p=0.121			χ^2=14.913 (df=6); p=0.05*			χ^2=16.859 (df=6); p=0.01*			χ^2=9.276 (df=6); p=0.174		
Occupation																		
Agriculture	35(25)	5(10)	2(15)	20(38)	16(15)	6(16)	24(33)	12(12)	6(22)	24(33)	14(14)	4(17)	19(35)	16(14)	7(20)	17(20)	13(16)	12(33)
Service	36(26)	8(16)	2(15)	13(25)	22(20)	11(29)	21(29)	21(21)	4(15)	24(33)	19(18)	3(13)	16(30)	23(21)	7(20)	25(30)	17(21)	4(11)
Small business	33(24)	10(20)	3(23)	12(23)	25(23)	9(24)	17(23)	21(21)	8(30)	15(21)	24(23)	7(29)	12(22)	24(22)	10(29)	18(22)	18(22)	10(18)
Others	34(25)	26 (54)	6(46)	8(15)	46(42)	12(31)	11(15)	46(46)	9(33)	10(14)	46(44)	10(42)	7(13)	48(44)	11(32)	23(27)	33(40)	10(27)
	χ^2=15.855 (df=6); p=0.05*			χ^2=18.628 (df=6); p=0.01*			χ^2=23.723 (df=6); p=0.001*			χ^2=26.607 (df=6); p=0.001*			χ^2=19.606 (df=6); p=0.01*			χ^2=10.661 (df=6); p=0.099		
Monthly income(RM)																		
1000-2000	93(67)	31(63)	6(46)	33(62)	75(69)	22(58)	46(63)	69(69)	15(56)	45(62)	72(70)	13(54)	33(61)	79(71)	18(51)	47(57)	59(73)	24(67)
2000-3000	27(20)	12(24)	4(31)	12(23)	21(19)	10(26)	19(26)	18(18)	6(22)	19(26)	18(17)	6(25)	12(22)	20(18)	11(31)	24(29)	11(14)	8(22)
>3000	18(13)	6(12)	3(23)	8(15)	13(12)	6(16)	8(11)	13(13)	6(22)	9(12)	13(13)	5(21)	9(17)	12(11)	6(17)	12(14)	11(14)	4(11)
	χ^2=2.780 (df=4); p=0.506			χ^2=1.742 (df=4); p=0.783			χ^2=3.822 (df=4) p=0.431			χ^2=3.638 (df=4); p=0.457			χ^2=5.351 (df=4); p=0.253			χ^2=6.380 (df=4); p=0.172		
House to PSF distance																		
1-2 km	85(62)	30(61)	6(46)	35(66)	65(60)	21(55)	51(70)	57(57)	13(48)	48(66)	60(58)	13(54)	37(69)	65(59)	19(54)	39(47)	56(69)	26(72)
3-4 km	33(24)	10(20)	4(31)	11(21)	27(25)	9(24)	12(16)	26(26)	9(33)	13(18)	27(26)	7(29)	10(19)	28(25)	9(26)	21(25)	19(23)	7(19)
> 5 km	20(14)	9(18)	3(23)	7(13)	17(16)	8(21)	10(14)	17(17)	5(19)	12(16)	16(16)	4(17)	7(13)	18(16)	7(20)	23(28)	6(7)	3(8)
	χ^2=1.750 (df=4); p=0.707			χ^2=1.576 (df=4); p=0.813			χ^2=5.278 (df=4); p=0.260			χ^2=2.265 (df=4); p=0.687			χ^2=2.315 (df=4); p=0.678			χ^2=16.862 (df=4); p=0.01*		

Willingness to contribute

In household interviews, we asked respondents whether they would be WTC to these restoration actions. Those who agreed to WTC, then we asked them whether they would volunteer or donate money for restoration. Majority of the respondents (n=138, 69%) stated to contribute to planting trees (Table 6.6). Nearly 90% of respondents stated to volunteer in PSF restoration actions. In case of education and awareness creation action, 36% of the respondents stated to donate money to organise these events.

Table 6.6 Respondent's willingness to contribute to management actions at RMFR, North Selangor, Malaysia.

Management actions	Donation Frequency (%)	Volunteering Frequency (%)
Planting trees (n=138)	9(7)	125(93)
Forest vigilance activities (for reporting fire and encroachment) (n=67)	4(6)	63(94)
Fire prevention (n=69)	4(6)	65(94)
Canal blocking and their maintenance activities (n=51)	3(6)	48(94)
Trail construction and maintenance activities(n=53)	7(13)	46(87)
Education and awareness creation(n=80)	29(36)	51(64)

Note: *values are calculated from the respondents who said the restoration action desirable

6.4 Discussion

6.4.1 Environmental and socio-economic benefits of PSF

Findings indicate that RMFR provide a wide range of socio-economic (agricultural water, NTFP, employment opportunities, eco-tourism business and nature based recreation and education) and environmental (such as biodiversity conservation and carbon sequestration) benefits which are important to local peoples' livelihoods as well as regional and national economy and environment. Respondents' appreciation on these values echoes the previous observations (Abdulkarim et al., 2017; Nath et al., 2017) who reported this PSF provide many ecosystem goods and services including timber, NTFPS, fish, irrigation water for agriculture, conserve biodiversity, tourism etc.

6.4.2 Perceived changes of economic and social benefits

Findings indicated that availability of timber and NTFPs was declined significantly. This might be due to the over exploitation of these resources (during the 1990s and early 2000s) in SFM as well as recent 25 years (from 2010 to 2025) government restriction of timber extraction from permanent forest reserve (SSFD, 2014). Supply of wild goods gradually increased in many community-based restored forests (Birch et al., 2014). After 25 years of community forestry implementation perceived ecosystem benefits were increased significantly in Nepal (Paudyal et al., 2015). It takes years to be able to enhance the supply of ecosystem goods and services following effective restoration.

Respondents positively reported that due to their participation in PSF restoration programme, people from around Malaysia and other countries know about their localities and so villagers feel proud of this recognition. Many foreign delegates including ambassadors of European countries visited RMFR. No apparent change in employment and small business opportunities was observed and the restoration programme created few alternate income generating opportunities including forest nursery, ecotourism, tour guides, patrolling, and handicrafts making. Ota et al. (2020) reported that restoring ecosystems and landscapes is a means to achieve multiple benefits and outcomes, rather than a goal in itself. Villagers of Sungai Sireh and Sri Tiram Jaya irrigate their 18,000 ha of paddy field with water flowing from RMFR for which they do not pay any fee. Nath et al. (2017) reported that the monetary value of the irrigation water supplied from the RMFR was about USD 159,070 per year. However, canal blocking caused water shortage

to irrigate oil palm plantation at Raja Musa and Bestari Jaya. Homestay ago-tourism was enriched by adding PSF as an ecotourism destination, which subsequently increased the versatility of tourism activities and number of visitors that influenced positively on local economy. Promoting ecotourism in the PSF can be an instrument to build a peoples' economy (Manalu, 2020) and to create job opportunities (Enuameh-agbolosoo, 2016)). Community and school's forest nurseries generated extra income for villagers and school. Nath et al. (2017) reported that four villagers had an annual income of USD 6977 by selling saplings from their nurseries. Training programme (e.g. eco-tourism guide, plantation and nursery development, firefighting drill, peer learning, handicraft, and managerial skill) organized by the GEC were useful for villagers and they were using that knowledge for their livelihoods. In a previous study in the same area Alam et al. (2021) reported that local people were enriched with environmental and livelihood development trainings useful for PSF conservation and local community development. Universities are conducting research on PSF and arranged field trip for their students which is important to increase understanding of the PSF that benefits students and the society as a whole.

Findings indicated that PSF conversion to agriculture had been reduced significantly which has a negative impact on the local economy. This reduction is partly because farmers want to participate in the conservation of RMFR to improve water supply in their paddy filed (Abdulkarim et al., 2017) as well as increased PSF conservation efforts of GEC and SSFD through community participation.

6.4.3 Perceived changes of environmental benefits

An insignificant decline of flood prevention capacity of the PSF was perceived by local people. In particular, people of Raja Musa and Bestari Jaya are experiencing water shortage in summer and flood in the rainy season. Possibly these are related to the reduction of water holding capacity of the PSF due to forest cover loss; and inappropriate canal blocking including absence of water gate provision; and lack of proper maintenance. Water provision and regulation were perceived as the most important ESs of the community forest plantation in eastern Bhutan (Rai et al., 2020). Further, the study found a significant reduction of many of other ecosystem services including biodiversity, wildlife habitat, wildlife sighting, carbon capture, pure environment) in the CBFMR compared to SFMR; despite, some wildlife sightings were reported by the focus group respondents. This might be related to the forest cover loss due to repeated fire, PSF

conversion into agriculture in the SFMR and the PSF restoration is in early stage in the CBFMR. In general, therefore, it seems that CBFMR could not yet make any positive impact on any of the environmental services. However, it has been suggested from previous studies many ESs were gradually increasing through restored forest cover and made improvements in habitat conditions, the richness and abundance of important plants and wild animals (Måren, Bhattarai & Chaudhary, 2013; Birch et al., 2014; Bhandari et al., 2016; Paudyal et al., 2017). CBFMR has enhanced carbon sequestration, and increased forest carbon stocks in the Himalayan forest, Nepal (Birch et al., 2014).

6.4.4 Forest restoration actions and respondents' willingness to contribute

This study identified six important restoration actions in which local community can contribute. Among them plantation activities were the most desirable activity followed by education and awareness creation; while, canal blocking, trail construction, fire prevention and forest vigilance were generally found undesirable by half of the respondents. In a previous study Nath et al. (2017) reported people are interested to join in tree planting, awareness creation and forest protection (e.g., patrolling, fire prevention) activities. Local people are well aware of the importance of trees as well as the ecosystem benefits of the PSF. In converse, canal blocking created water scarcity to some of the small holder farmers and flood in some cases due to dam collapse. Problems associated with dam collapsed due to strong water current and the fragility of the wooden structures was reported in a degraded PSF restoration site in Central Kalimantan, Indonesia (Ritzema et al., 2014). Further, benefits of trail construction and maintenance activities were not obtained by the local people.

The findings showed that attitude towards restoration actions was significantly associated with a number of selected attributes of the respondents. For example, forest vigilance with gender and occupation; fire prevention, canal blocking, trail construction with gender, education and occupation; and awareness creation with gender and nearness to PSF. Interestingly gender is significantly associated with all (six) of the management actions while occupation with five excluding awareness creation. The results may be explained by the fact that forest activities are very hardly because of inaccessibility and nature of work and hence might not be suitable for women. In addition, as the activities

are mostly volunteering so people of all professions are not interested to involve all of the activities.

Willingness to contribute

Findings indicate that local people were WTC to restoration actions (e.g. tree planting, canal blocking, forest vigilance, fire prevention, trail construction, and awareness creation) through volunteering and to some extent through donation. Roy (2016) in his study in Bangladesh's Sundarbans reported that 46% of the respondents were WTC to mangrove conservation through providing physical labour, monitoring, management, and awareness building. Respondents appeared to be more WTC as labour than money in the management of recreational quality on private lands in Finland (Lankia et al., 2014). Nath, Zhe Han & Lechner (2018) in their studies in three urban parks in Kuala Lumpur, Malaysia reported that more than 50% of respondents were interested in to participate in park management through volunteering and/or donation.

6.5 Conclusion

This study set out to identify and map the key ESs, economic and societal benefits and their changes over time due to the transition from SFM to CBFM over a decade long CBF restoration effort as well as peoples' WTC to the PSF conservation. Our results highlighted a high significance of water, NTFPs, carbon sequestration, wildlife and biodiversity conservation, nature-based recreation, education and income generation values of PSF conservation. CBF in the RMFR has demonstrated a capacity to increase some of the important ESs like nature-based recreation in particular river cruising, kayaking, and boating; economic benefits from eco-tourism and community nursery and societal benefits from nature education and research. Most importantly ecosystem conservation benefit of a substantial decline of PSF conversion to agriculture. However, CBF could not show any improvement of some other important ESs, for example, timber and NTFP supply, water storage and supply for irrigation, biodiversity and habitat conservation, carbon sequestration capacity of the PSF. From the analyses it may be concluded that, in general, most of the ESs that were aimed to re-established through CBF have not achieved yet, although some visible changes in economic and societal benefits were observed. Findings indicate that local community are very much inclined to the current CBF model. In terms of management actions, an encouraging support was

observed for activities like tree planting as well as education and awareness creation. It is also apparent that most of the people who supported the management actions showed their WTC to those actions. They preferred to contribute through volunteering than donation. Nevertheless, for sustainable community participation in PSF management benefit maximization to local community remained a big challenge.

This research extends our knowledge of the peoples' perception on the approach and CBFM approach's effectiveness in the PSF for enhancing the ESs, economic and societal benefits to the local and the wider community. In particular, the outcomes of this research could be useful for a number of purposes: (1) to determine the appropriate options of peoples' involvement process in the PSF restoration; (2) to identify and determine the proper management actions and the actions in where further efforts have to be given for achieving the aimed re-establishment and enhancement of the ESs and benefits; and (3) to assist in policy formulation and guiding on community based PSF restoration strategy in Malaysia and elsewhere.

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Chapter 7 : General Discussion, Recommendation and Conclusions

7.1 General Discussion

This thesis aimed to determine the effectiveness of community participation in the PSF restoration programme and the impacts of this community-based restoration programme on PSF restoration and community development at RMFR of Peninsular Malaysia. To the best of our knowledge, it is the first assessment on community-based PSF governance in Peninsular Malaysia that builds upon social and ecological conceptual frameworks, which elucidated the institutional settings, social capital and community participation in PSF restoration, analysed ecological restoration outcomes, and evaluated environmental and societal benefits derived from the PSF restoration. To achieve the aim, I employed both qualitative (social research) and quantitative (social and ecological study) method.

7.1.1 Social capital and level of community participation in PSF restoration and conservation

My thesis began with an aim of understanding the formation and functions of social capital among different stakeholders that influences local communities' participation in the PSF restoration programme. I also evaluated the sustainability of the main CBO (i. e. FNSPSF). Based on a quantitative and qualitative analysis of the attributes of social capital and using Pretty's typology of participation (elaborated in Chapter 3), I found that the restoration programme has successfully created some social capital by forming three local CBOs (FNSPSF, JPFR and PFR) and integrating with one existing CBO (Homestay agro-tourism Sungai Sireh). In addition, over the past decade, the main CBO (FNSPSF) has been developed quite a few networks with external agencies and other similar local CBOs in the country and abroad. These networks helped to learn from each other and their activities. However, the composition and functionality of the main CBO (e.g. FNSPSF) has been gradually declining over the years mainly due to erosion of trust in the authority (GEC and SSFD), lack of dispute resolution mechanism, and inadequacy of suitable site specific community development activities. This decline of social capital was a critical factor limiting the local participation in

the PSF restoration programme. Further, I found that although local communities participated in some of the collective actions of the restoration programme; however, their participation was mostly featured by Level 1-5 of Pretty's typology of participation (Level 1-7) suggesting moderate level of participation. Essentially, social capital formation has facilitated to engage local communities in collective actions; however, their participation in collective actions was limited by lack of trust in the authority, incapacity in the structural composition and operation of FNSPSF. On the other hand, social capital formation, function and participation in collective actions were influenced by forest dependency, importance of the PSF to the local community and socio-economic development opportunities created by the project for which overall low and differential village level participation was manifested. This indicates that for better project outcomes, more emphasis needs to be given to invest in community development and social capital formation (Nath, Inoue & Pretty, 2010). By increasing social capital through collaboration between agencies and local communities, this may further benefit natural resources management (Wagner & Fernandez-Gimenez, 2008).

7.1.2 Multi-stakeholder PSF governance and regulation of rights

This research explored the multi-stakeholder PSF governance at RMFR by providing empirical information on the actors' interaction under the contextual factors in particular the rules-in-use towards sustainable PSF management. As highlighted by scholars (e.g. Zoysa & Inoue, 2008; Clement & Amezaga, 2008; Weiland, 2010), multi-stakeholder forest management approach is very effective to include various stakeholders with varied interests while at the same time obtaining conservation objectives. Understanding the roles and relationship among actors is essential for effective and sustainable collaboration in forest management. Based on a quantitative and qualitative analysis of institutions following IAD framework, elaborated in Chapter 4, I found that although the NFA, 1984 does not have any provision for community participation in PSF management; however, a number of legal instruments including forest policy of Malaysia, various international and national conventions, agreements, plans, etc. facilitated various actors' to interact in different PSF management functions (e.g. planning, implementation, maintenance, finance, coordination and monitoring) with an aim to restore the degraded PSF as well as to improve the local socio-economy. But this interaction among actors is highly impeded by their ad hoc and temporary nature and lack of clear policy statement to involve local community in planning (decision making process) (elaborated in Chapter 4). Further, the analysis identified seven categories of actors (e.g. SSFD, other government

administrative departments, NGOs, CBOs, international and private/corporate agencies, EV, and research institutions/universities) who were actively engaged in at least one of the PSF management functions and showed an effective collaboration and interaction among them. Among seven categories, the current CBFM is highly dominated by two actors e.g. GEC and SSFD. The CBOs (FNSPSF, JPFR and PFR) were found active only in the implementation of activities (such as tree planting, canal blocking, awareness campaign) and occasionally in maintenance and to support forest monitoring.

Impacts of governance regime on de facto rights

The comparative efficacy of the governance regimes (SFM and CBFM) on regulating forest property rights (*de facto rights)* is mainly determined by evaluating the key forest activities such as forest access, resource extraction, forest utilization of the study location (described in Chapter 4). Forest property rights of the study area (RMFR) in both SFM and CBFM were mainly regulated by National Forestry Act 1984, and implemented by SSFD. Most of the people usually practiced *de facto rights* almost freely in both SFM and CBFM regimes. People's traditional opinion on PSF utilization, lack of awareness towards forest laws, economic value of the PSF land and limitations of SSFD's organizational capacity (e.g. shortage of human resources, financial and logistic), and poor government's attention on PSF conservation specifically in SFM and lack of monitoring and enforcement might be linked to this free exercise. However, I found that governance regime (SFM and CBFM) has an influence on the local practice of *de facto rights* (forest property) and decreased practice of *de facto rights* are significantly linked to CBFM. Selangor State Government's increased realization and commitment towards PSF conservation helped SSFD to enforce law strictly on illegal activities and sanctions on rule violations which has an effect on the decreased exercised on *de facto rights*. On the other hand, involvement of local communities in monitoring illegal activities also helped to reduce exercising *de facto rights*. Scholars (e.g. Imperial,1999; Ostrom, Gardner & Walker, 1994) reported comparative advantages of polycentric institutional arrangements over centralized system of government. Controlling the practice of *de facto rights* is important for effective restoration of the degraded forests which might be achieved by effective PSF governance. The CBFM has shown its effectiveness regarding control of the practice *of de facto rights* in case of the RMFR. Hence, there is a need to recognize and extend the CBFM in other PSF in Malaysia and elsewhere. This study on forest property rights regulation in PSF

governance adds to the literature and provides policy prescription which could add to the discourse for reforms.

7.1.3 Hydrology, fire incidences and vegetation

Community-based PSF restoration programme at RMFR attempted to recover the PSF's ecosystem functions through hydrological restoration (e.g. canal blocking and clay dyke construction), revegetation through tree planting and assisted natural regeneration, and control PSF fire through building community awareness. More than hundreds active canals in RMFR were constructed in between 1950 and 1990 to transport logs, which caused draining of PSF water. Moreover, coal and sand mining ponds adjacent to the PSF also caused draining water through seepage. However, since 2008, construction of a major part of the planned canal block and clay dyke contributed to a gradual increase of the GWT and able to maintain a satisfactory level for the last few years. Drained and dried peat soil is highly flammable and very difficult to control fire once starts burning. This increased water table together with awareness creation among local people about fire hazards helped to reduce fire incidences in the PSF since 2015. It also developed a convenient environment for tree planting and encouraged natural regeneration. However, revegetation of highly degraded PSF through natural regeneration may take several decades and thus tree planting is vital to bring the HDPF under forest cover. The current replanting rate is very slow as only a few hectares were planted in each year. Therefore, rescheduling of annual replanting rate is essential to revegetate the HDPF faster in order to prevent further degradation and to recover the ecological functions of RMFR. The plantation was mainly carried with two fast growing pioneer species and enriched by replanting with a few other species during vacancy filling in the subsequent years of main plantation. Although it is justified to replant the highly degraded forest with fast growing pioneer species; however, to recover the ecological functions of the degraded PSF it is also important to replant with a diverse number of suitable native species. The survival rate of the planted trees was found encouraging even though the planted seedlings (usually one-meter height) competed with two-meter height *lalang* grasses (*Imperata cylindrica*) and tackled the early years' wild boar grazing damage. Growth rate of the planted trees were also comparable to previous studies in Malaysia and Indonesia. Overall, this validates the selection of these species as a replanting material. Natural regeneration in terms of species composition was encouraging at ANR site; however, as the level of degradation increases (as of PF and GL) the species composition decreased.

Regeneration density was vigorous and dominance (IVI value) of two species were observed in all three sites. ANR site contained six IUCN threatened species, while PF site one. Young tree recruitment in ANR site were promising, which indicates that secondary PSF can support successful natural regeneration if this remains undisturbed and wetted. In PF, young tree recruitment was very low, which suggests enrichment plantation with diverse species is required to improve the vegetation structure and composition. No recruitment of young trees in GL site specifies that revegetation with natural regeneration is not possible in HDPF site.

7.1.4 Environmental and socio-economic benefits

Local people identified six environmental and seven socio-economic benefits of the PSF important for local as well as global community (see Chapter 6). Community based restoration programme could not show any positive result yet on some of the environmental benefits, for example, habitat for wildlife, carbon and flood control capacity of the PSF. Usually it takes years to be able to regain the ecosystem functions and enhance the supply of ecosystem goods and services following effective restoration. Nevertheless, community-based restoration of degraded PSF demonstrates several positive outcomes in terms of socio-economic and environmental benefits. Local community are highly dependent on PSF for irrigation water and this community-based restoration programme showed positive outcomes in terms of water supply to the paddy field which is important to boast local economy. However, canal blocking caused the reduction of water supply to the oil palm plantations which might have a negative impact on oil palm production subsequently causes lowering income. In addition, CBFM increased a few societal benefits such as nature-based recreation, training, and education for the local community and the students as well as research opportunities for students and scientists. Some job and alternate income generating opportunities were also created. For example, homestay agro-tourism was enriched through expanding tourism destination to the PSF, increased income through establishment of community nursery and received fund (FNSPSF) for socio-environmental development of the locality. Reciprocally, villagers showed WTC to PSF restoration actions, in particular tree planting and awareness creation through volunteering which might be a win-win outcome.

7.2 Limitations

For social research, although we included a wide range of stakeholders (individuals and organizations) in workshop discussions but based on the objectives of the study further qualitative (FGD and KII) and quantitative (HHS) data collection was carried out focusing on some important stakeholders such as local community, GEC and SSFD. Due to the time constraint and beyond the scope of the study, it was not possible to interview all other stakeholders e.g. private/corporate agencies, other government agencies, EVs, and researchers etc. On the other hand, among local community small holders (agricultural and oil palm cultivators) and encroachers were not identified and interviewed as separate group and their views are likely to differ compared with those of other groups. However, we minimize these limitations by including some of them in the focus groups and randomly selected house hold interviews. This would have provided a better understanding of their views.

The other limiting factor was it was very difficult to find the household respondents (household head) on day time because they are very busy with their work schedule and some people are also stay outside (towns and cities) and come only in the weekends. In that case, we always tried to get the suitable time for them and collected their phone number to contact them to find a convenient time for interviews. In addition, some household survey participants specially women reluctant to spend an hour to provide information to the researcher.

7.3 Recommendations for strengthening community-based PSF governance in Peninsular Malaysia

Based on findings of this research, I organized my recommendations under three main areas. First, the study attempts to identify a set of recommendations to ensure effective and sustainable participation of local communities in PSF restoration and conservation. Second, recommendations are focused on sustaining and enhancing the multi-stakeholder collaboration for sustainable PSF conservation and restoration of the RMFR. The third set of recommendations are focused on qualitative (biodiversity rich) and quantitative (area) improvement of vegetation cover as well as enabling the environment for spontaneous natural regeneration through improving the hydrological condition for regaining the ecosystem functions of the degraded PSF.

7.3.1 Ensuring effective and sustainable local participation in PSF restoration programme

Using the insights gained from the analysis of the study area, recommendations are made to augment social capital in order to make local participation effective in the PSF restoration programme. Thus, the existing social capital (e.g. FNSPSF) needs to further strengthened by forming two new village level (grass root) organizations [such as Forest Conservation and Recreation Villages (FCRV) and Forest Restoration Villages (FRV)] to address the issues like site specific needs and remoteness of the site, and opportunities that exists in the site and/or created by the restoration programme. In addition, these two newly formed organizations should be supported constantly in the form of technical and financial resources particularly at the initial stages, through government programme to improve their capacity through training and awareness creation, long term funding, conservation and community development activities. Without ensuring social and economic incentives, the conservation initiatives will be further questioned by communities, as illustrated by the Joint Forest Management programme in the state of Haryana in India (Kumar, 2007). Gradually, these village level institutions should be linked with the SSFD and other stakeholders through the provision of legal framework.

While these recommended new local CBOs may be useful for the present circumstances; however, I am suggesting to assess the effectiveness of these local CBOs after five years.

7.3.2 Sustainable multi-stakeholder collaboration

Introduction of CBFM has encouraged local community to comply the formal rules related to forest property rights thus helped to reduce PSF degradation. The case study illustrates that the current multi-stakeholder collaboration process is carrying on the legacy of top-down approaches and attitudes including the dominance of two actors (e.g. SSFD and GEC), and local community had almost no role in decision making. Also struggling with insufficient socio-economic activities, and inadequate and ad hoc nature of legal framework. Therefore, this multi-stakeholder governance structure is pretty much vulnerable in terms of long-term local participation and sustainable co-operation. This risk needed to minimize by reforming the existing organizational hierarchy and brought FNSPSF as a key actor who can directly interact with local forest administration (e.g. RFO/DFO) as defined in Figure 4.4 in sub-section 4.5 of Chapter 4. In this proposed organizational structure local community would have the

opportunity to include their goals more easily and effectively. This process is more democratic in nature and prevents authority of an agency to impose its will on the others (Imperial, 1999). Local community participation in decision making will create sense of ownership which is required for higher project outcomes. On the other hand, enabling efficient local institutions and empowering communities are important tools to develop skilled people and organisations for multi-stakeholder PSF governance. Thus, PSF management programme and FNSPSF need sustainable, continuous and predictable sources of funding and assistance to carry out concerted local actions to address both conservation and community development objectives. While, stakeholder participation is a clear agenda in many international, national and local level policy documents, associated laws need amendment to enable various actors in particular local community to participate in decision making which is indeed missing at the moment in Malaysia. Forestry Department's organizational capacity needs to be improved through training and support other facilities in particular to work with other stakeholders as a team.

Proposed organizational hierarchy is expected to reshape the institutional process which is expected to bring change in institutional design and performance for desired policy outcomes.

The overview of legal provisions for community-based PSF governance in Malaysia shows that a temporary and ad-hoc legal framework is in existence to enable local community participation in PSF governance. However, it is far from integrated, comprehensive or consistently reflective of sustainable development goals (SDG) principles and objectives.

7.3.3 Vegetation cover and hydrology

The current slow annual plantation rate may not prevent further degradation of RMFR. It is recommended to increase the rate of annual plantation with suitable diverse species (e. g. species with low IVI value and IUCN listed threatened species) to bring the highly degraded area under forest cover quickly. To keep the optimal density and improve biodiversity of the planted forest, three post planting maintenance including gap filling with varied species is recommended. In addition, enrichment plantation should be carried out in ANR and PF with varied IVI low valued and IUCN threatened listed species. Other community-based PSF restoration interventions such as hydrological improvement, fire control, awareness creation and socio-economic development should be carried out sustainably.

7.4 Recommendation for future research

Given the findings of this thesis, I recommend the following areas for future research.

1. A detailed assessment needs to be done to understand the specific underlying problems and requirements for each degraded PSF, instead of applying the proto-type mechanisms. Since, community-based PSF restoration programme is a new PSF management approach in Malaysia and this approach is being implementing only a few PSF areas including PSF of Pahang Forest Reserve. So, it is recommended to go for further study in the Pahang State to better understand the community-based PSF restoration process under local context.

2. Although we rigorously identified the actors and their interactions, however power relationship among different actors were not thoroughly investigated in this study. So, further study is recommended.

3. The PSF restoration programme formed two school environmental clubs such as JPFR and PFR. They were involved in the restoration programme through participating various programmes in particular environmental awareness and knowledge gained programmes. However, the outcomes of the programmes were not investigated thoroughly yet. Hence, environmental awareness and knowledge gained by the school students can be investigated in future project.

4. This study investigated the ecological responses of the restoration intervention for a specified time. To better understand the ecological responses in terms of natural regeneration, floral and faunal diversity, ecosystem services, ground water table, and peat soil accumulation due to the restoration interventions a periodical basis investigation is suggested.

5. I estimated survival percentage of planted trees and their growth. These ecological outcomes might be influenced by site characteristics such as disturbance level, hydrology, soil properties, soil seed banks, seed germination, establishment of seedlings and management intensity, which deserve further studies.

6. This study assessed socio-economic outcomes in terms of local peoples' perception on changes of benefits between two management regimes. An economic valuation of selected ecosystem services would provide a better picture of socio-economic benefits of PSF. Studies on economic valuation of the PSF ecosystem services would help to better understand the PSF

ecosystem functions. Such research could also help better formulate strategies that enable restoration activities to be used as a green business opportunity and livelihood improvement by local communities.

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Appendices

Appendix 1: Checklist for Focus Group Discussion

(Following Institutional Analysis and Development Framework: Ostrom et al., 1994 and Social Ecological System Framework: Ostrom, 2011)

(a) For Local Community Leaders and FNSPSF members

General Social, Economic and Political Settings (S)

1. Economic Development: Increase income and improve livelihood, infrastructure (e.g., road, bridges etc.) development
2. Demographic trends: Increase/decrease population, male female ratio, labour force
3. Markets: Outside demand of the forest products, ecotourism etc.

Resource systems(RS)

Raja Musa Forest Reserve is a designated forest reserve which is composed of a specified territory of about 35,656 ha and containing forested areas

1. Existence of clearly defined forest reserve boundaries (physical and or natural features) with other category of lands (e.g., boundary between forest reserve and villages, private, agriculture, palm plantations, and other agencies land).
2. Clarity of subsystem boundaries i.e., between direct and indirect community involved managed area and other parts of the forests. And size of the restoration area directly involved community people
3. Infrastructure development inside the forest (e.g. buildings, roads, lakes, office, recreational facilities etc.)
4. Do you think the balance between resource (e.g., NTFPs, fish, water, tourism and or other products) extraction, and resource conservation is maintaining; Which is important for forest reversibility (i.e., to bring back the forest to its original condition) and keep the forest equilibrium
5. What benefits (e.g., tourism flourish, biodiversity conservation, increase fish resources, water conservation, fire hazard risk reduction, increase supply of irrigation and drinking water, carbon restoration etc.) would you expect if restoration (e.g., planting, encourage regeneration), restoration (canal blocking) or imposing restrictions (e.g., logging, limiting access) is done.

Resource units (RU)

Important resources (e.g., trees, shrubs, wildlife, and amount and flow of water, peat carbon etc.)

1. Economic value of forest resources (derived from the reserve and the community managed forest area e.g., timber, NTFP, water for irrigation and domestic use, fishes, tourism, carbon storage-global significance, etc.) to the local and adjacent people

2. Contribution of restoration and restoration activities in resource creation (e.g., improve biodiversity, NTFPs, ecotourism, carbon stock, water supply etc.)
3. Can you draw a diagram showing the spatial variations of forest resources (e.g., important wildlife, biodiversity, NTFPs, fishes, tourism spots, fire prone areas, restoration zone etc.) before and after (present condition) the restoration project being implemented by GEC?

Actors (A)

1. Socio-economic attributes of local people (e.g., main livelihood activities, or presence and characteristics of special group of people like ethnicity, fishers, NTFP collectors etc.)
2. Past historical utilization of Raja Musa Forest Reserve (e.g., main uses and users): main resources; main activities including tourism; resource exploitation etc.)
3. History and experience of past management system e.g., what was the management system and situation (major problems e.g., fire, canal digging, logging, palm conversion) before the implementation of restoration project by GEC
4. How did GEC involve in the restoration of the forest reserve?
5. What are their functions in social mobilization and forest restoration?
6. What/why and where are the activities GEC implementing? Can you show them in the map?
7. How and why did you get involve with community based restoration project?
8. What are the activities you performed for PSF restoration and conservation?
9. Do you like to support these activities in future too?
10. Did you form a committee? How did you form the committee and leadership (elected or selected)? What is the general perception of about the quality of other collaborators (actors) leadership in forest conservation and restoration?
11. How many local community groups are involved in restoration and conservation activities? Who are they (e.g., homestay, forest ranger, FNSPSF etc.)
12. How, when and why did they get involve in restoration and conservation activities?
13. Can you explain the contextual background of their involvement?
14. What are the activities they performed to achieve the PSF restoration and conservation outcomes?
15. Do you think they share a common knowledge or have a distinct mental model about those?
16. How did communities perform the restoration and reforestation programmes? Do communities have consulted before e.g., site selection for canal blocking and plantation, choice of species, sources of planting materials etc.
17. What are the outcomes of these activities?
18. How do you keep the records of activities (e.g., plantation journal, expenditure sheet, schedule of works, time of planting and other maintenance activities, species selection and method of planting, meeting minutes etc.)?
19. Are all of the groups active currently? If not, why?
20. Trust reciprocity/social capital within local community and with external actors (i.e., people share moral and ethical standards regarding how to behave in groups they form, and thus the norms of reciprocity, and have sufficient trust in one another)

21. Local people's knowledge about the attributes/importance of forests, and their understanding about the impacts of forest conversion, draining water, logging, fire etc. Do you think they share a common knowledge or have a distinct mental model about those?
22. Dependency (high, moderate, low) of local people on forest resources (NTFPs, timber, fuelwood, vegetables, fruits, fish, water, tourism) for their livelihood and how many actors rely on this forest for their livelihood?

Governance systems (GS)

1. Major rule making and implementing agencies involved in forest management, regulating and controlling use and protection. Specifically, to what extent local community have power and participate in?
2. Main NGOs involved and their functions in social mobilization and forest restoration
3. Relation, cooperation and communication among different actors (i.e., communities, government authorities, NGOs and others).
4. Right of access of local community to forest resources (e.g., for extraction/harvesting timber, NTFPs, fish etc.) and tourism (e.g., free of charge, with pass, seasonal, volume, monthly, weekly ete.)
5. Consistency between formal and informal forest use rights if any.
6. Key rules related to (i) resource extraction (e.g., NTFPs, timber, fruits, fishes, vegetables etc.), (ii) providing services (e.g. ecotourism, education and research etc.) and (iii) restrictions (e.g. species, temporal or spatial, particular land use) and (iv) forest conservation and management
7. Rule enforcing mechanism and current status
8. Local people's participation (active, passive, not involved) in decision making and implementation (creates space for and supports the participation of civil society, indigenous peoples and forest dependent communities in forest-related processes and decision-making)
9. Transparency of processes and accessibility of guidance on how to participate in forest-related planning, decision-making and implementation at all levels
10. Who participate in the meeting related to the forest reserve restoration and management, (e.g., community head, informal organization's representatives, or somebody else?)
11. Were the opinions of the villagers ever accepted by the forest office?
12. Did stakeholders relevant to the forest reserve management ever visited the village? If so, who and for what?
13. Presence of rules in favour of and or against the forest restoration and conservation
14. Existence of rules encouraging people's involvement in forest conservation activities
15. Who and how rules execute (for example, issuing tourist's and other forest resource extraction pass) and monitor if any violation occurred?

Interactions (I)

1. Coordination and information sharing (e.g., policies, development activities, management strategies etc.) between government agencies, NGOs, local communities and other actors.
2. Access to information (how widely policies and project documents accessible)
3. Can you explain some experiences of conflicts between actors as such tourist operators' vs loggers; palm cultivators' vs NTFP collectors, and so on.
4. How do you monitor the success or failure of the project activities (e.g., ecological indicators including the ecosystem services)?

Outcomes (O)

Social performance measures (e.g., efficiency, equity, accountability, sustainability)

1. Increase/ decline in availability of edible NTFPs for subsistence
2. Increase/ decline the number of tourists
3. Increase/ decline in production of agricultural crop due to increase in water supply from the forests.
4. Increase/decrease fish resources for self-use and or sale
5. Increase/ decrease forest products (e.g., leaves, rattan, fruit, vegetables ete.)
6. Increase/decrease the extent of collective action by communities working together for forest restoration

Ecological performance measures

1. Change in forest coverage
   - Increase/ decline in forest area
   - Increase/ decline in forest density
2. Change in biodiversity and ecosystem services
   - Increase/decrease in wildlife populations due to increased forest cover or protection
   - Increase/decrease in biodiversity
   - Increase/ decline stabilization of water flows and/or quality for local people.

Additional questions for Forestry Department

Actors (A)

1. Who are the main actors (use category such as government staffs, local leaders, NGO etc.) and their role (position, action and control) in forest management (e.g., only local office? Or even the local people have some role?)
2. Trust reciprocity/social capital with external actors (local forest officers)
3. Reasons for undertaking the restoration project?
4. What were the objectives of the project?
5. What is the role of forestry department in the restoration project?
6. How many collaborators are involved in the project? What are their roles?

7. How do you obtain community collaboration? And how do the local people contribute to forest restoration and conservation?

Governance systems (GS)

1. Land tenure security (due to classifying the forests in different management zones such as Water catchment, Restoration, Community Forestry, Biodiversity conservation, Recreation and Education/ Research zone
2. Presence of rules regarding clear delineation of community engaged forest area

Interactions (I)

1. Can you explain the appropriateness and adequacy of the current investment and activities in forest conservation and restoration? Are the activities planned and conducted with the consultation of local people?

Additional questions for Global Environment centre (GEC)

Actors (A)

1. Who are the main actors in this project?
2. Of these, which are very important for PSF conservation?
3. What are the functions of these actors?
4. How often GEC has communication with these actors?
5. Are these actors keen to collaborate for PSF conservation?
6. GEC's involvement in RMFR Restoration and Conservation, why and how?
7. What were the objectives of the project?
8. How do you select the activities? [by GEC only or in collaboration with community and other stakeholders]
9. What are the funding sources?
10. What are the strategies to sustain these activities?
11. Have you experienced any constraints during the implementation of these activities? If so, what are those and how have you dealt with them?
12. Can you explain the appropriateness and adequacy of the current investment and activities in forest conservation and restoration? Are the activities planned and conducted with the consultation of all stakeholders?
13. What, why and where are the activities GEC implementing for PSF restoration and conservation? Can you show in the map?
14. How did you perform the restoration and reforestation programmes? Site selection for canal blocking and plantation, choice of species, sources of planting materials etc.

Local community participation

1. How and why did local people get involve with community based restoration project?
2. Do the local communities form committees? How did you form the committee and leadership (elected or selected)?
3. How many local community groups are involved in restoration and conservation activities? Who are they (e.g., homestay, forest ranger, FNSPSF etc.)?
4. What are the activities they performed so far to achieve the PSF restoration and conservation objectives?
5. What are the outcomes of these activities?
6. Are all of the groups active currently? If not, why?
7. Do you have project activities related to community development?
8. What are those and who/how did you choose these activities?
9. What are the impacts of these activities?
10. What are the impressions of community people?
11. What is future plan for continuing community development?
12. How often GEC does meet community people/other stakeholders or invite them in meeting related to project?
13. Trust reciprocity/social capital within local community and with external actors (i.e., people share moral and ethical standards regarding how to behave in groups they form, and thus the norms of reciprocity, and have sufficient trust in one another)
14. Dependency (high, moderate, low) of local people on forest resources (NTFPs, timber, fuelwood, vegetables, fruits, fish, water, tourism) for their livelihood and how many actors rely on this forest for their livelihood?

Governance systems (GS)

1. How often GEC does meet community people/other stakeholders or invite them in meeting related to project?
2. Presence of rules in favour of and or against the forest restoration and conservation (for example, a memorandum of understanding signed between Selangor State Forestry Department and the Global Environment Centre (2010-13) to support community-based forest conservation and restoration)

Interactions (I)

1. Your opinion regarding investment activities of conservation and restoration programmeme (is it enough, are programmemes adequate and well consulted with local people?)
2. Communication among different actors e.g., government agencies, NGOs, Research institutes and local communities and frequency of communication?

Appendix 2: Checklist for Key-informant Interview

(A) Chairperson of FNSPSF

1. Currently how many members are there in FNSPSF and how many are active?
2. Number of executive committee members? Male and Female
3. Meeting organization of executive committee? How many times in a year?
4. What are the major executive committee meeting agendas?
5. Major decisions taken for restoration and community development?
6. Annual General Meeting? Do you perform every year? How many general meetings have FNSPSF organized so far?
7. Major General Meeting Agendas?
8. Major decisions of AGM?
9. How many people have attended the last AGM?
10. Who organize the EC and AGM meeting? FNSPSF or GEC?
11. What are the activities FNSPSF members participate?
12. GEC and SSFD organize tree planting, canal blocking programme, exhibition and other events regularly? How do FNSPSF involve with those activities and how many FNSPSF members participate in those activities?
13. How does FNSPSF address the benefit issue of the members and local community? Because benefit issue is one of the main causes of reducing the number of members?
14. Does FNSPSF get any project from GEC and/SSFD for PSF restoration which subsequently directly helps in community development?
15. Do FNSPSF or their members have any opinion/reservation about the canal blocking activities?
16. How many people are appointed by FNSPSF for restoration activities? Are the patrollers and piezometer readers appointed by FNSPSF or GEC directly?
17. Can you describe about the funding of FNSPSF?
18. Do you have any link or activities with the PFR or any other such organizations?
19. If yes, how do you link and what activities FNSPSF do with them?

(B) School Teacher of Junior Peatland Forest Ranger

1. When did Junior/Peatland Forest Ranger form?
2. What is the contextual background of forming the J/PFR? (by whom, why)
3. What are the objectives and activities of J/PFR programme?
4. When did you/your school join this J/PFR programme?
5. How many schools are involved in J/PFR programme?
6. How many members are there in your school?
7. How many teachers are involved in this J/PFR programme?
8. How many teachers are involved from your school?
9. What are the roles and responsibilities of the teachers in the J/PFR programme?
10. What are the roles and responsibilities of GEC/SSFD in the J/PFR programme?
11. What are the roles and responsibilities of your school in the J/PFR programme?
12. What are the activities/events organized by the J/PFR programme?

13. Do you/your school participate the activities/events organized by J/PFR programme? Yes/no; if yes, how many times?
14. Who arrange the activities/events?
15. Do you have a communication with GEC/SSFD? Yes/no; if yes, how frequent?
16. Do you get logistical support for organizing activities/events? Yes/no; if yes, from whom SSFD/FNSPSF/GEC?
17. Who is the trainer of the J/PSF education programme?
18. What are the methods of providing training and education regarding PSF ecosystems and their conservation?
19. What materials are used in the J/PFR training and education programme?
20. Do you have a communication with other schools regarding J/PFR programme? yes/no, if yes, how do you communicate? And how many times in a year? Why do you communicate?
21. Do you think J/PFR programme has a positive impact on the awareness creation and environmental education?
22. Do your school have any other club/s related to PSF and/environment? yes/no; if yes, what are those? and, what are the activities of those clubs?

(C) Homestay Agro-tourism Manager

1. When and how homestay Sungai Sireh started? What were its objectives?
2. Initially how many families and people were involved and how many are active now?
3. Causes of decline in the number of homestay operators' and their employees.
4. What are the facilities (e.g., toilet, kitchen, food, etc.) available in those houses?
5. What are the activities (e.g., paddy planting, boating, fishing etc.) and or services (e.g., accommodation, food, transport etc.) you offer to the tourists?
6. Number of tourists (including foreign visitors) arrival and revenue receipts in a year. Can you explain the trend of tourist arrival for the last few years?
7. Who are the main visitors (e.g., family, friends, students etc.)?
8. Causes of increase or decrease in the number of tourists?
9. What are the sources of benefits from the tourists other than accommodation and food?
10. What is the current capacity of tourists to accommodate in a day? Is it sufficient for high tourist season?
11. Do you have any special activities or offer for high tourist season?
12. How does homestay Sungai Sireh link with the GEC's initiative of ecotourism in Peat Swamp Forest? When and how did it start?
13. What are the activities and main attractions of ecotourism in Peat Swamp Forest?
14. Do you think introduction of ecotourism in Peat Swamp Forest give you an opportunity to bring back the non-active homestay operators and to expand your business?
15. Can you explain, how does homestay agro-tourism impact on social, economic and environmental condition of the area?
16. Existence of rules or any other legal instrument encouraging or discouraging local people to engage in homestay business?
17. How do you maintain the security of the tourists as well as the families?
18. What are the challenges (e.g., legal, investment, administrative, economic, demand etc.)?

Appendix 3: Household Survey Questionnaire

Restoration of Degraded Peat Swamp Forest through Community Participation: The case of Raja Musa Forest Reserve, North Selangor, Malaysia

This study aims to explore the local community's participation in degraded Peat Swamp Forest (PSF) restoration. In order to investigate the status and effectiveness of their participation, I will carry out some household surveys. This study is part of my research activities and the knowledge thus generated from it will be used for research and academic purposes. Any sensitive personal information will not be collected and the respondents will remain unidentified. I will collect information about communities' rights and status of PSF utilization, conservation and restoration in different institutional settings and how they are involved in Raja Musa Forest Reserve(RMFR) conservation and restoration.

If you have any question, you can ask me. You may also contact my supervisor Dr. Tapan Kumar Nath, Associate Professor of Nottingham University Malaysia at 01133118340 for any kind of enquiry related to this work.

Section 1

Respondent No. Date:

Village: Sex: Age:

Education: Occupation:

Theme 1: Basic household information

1. Village ◯ Sungai Sireh ◯ Sri Tiram Jaya ◯ Raja Musa ◯ Bestari Jaya
2. Sex ◯ Male ◯ Female
3. Age ◯ 18-30 ◯ 31-45 ◯ above 45
4. Education ◯ No education ◯ Primary ◯ Secondary ◯ Graduate
5. Occupation ◯ Agriculture ◯ Service ◯ Business ◯ Others
6. Average monthly income (RM) ◯ 1000-2000 ◯ 2000-3000 ◯ >3000
7. Residence (km) ◯ 1-2 ◯ 3-4 ◯ ≥5

Section 2

Theme 2: Institutions

Theme 1: State of *de facto rights* and rule administering [Please mark the chosen option with (✓) tick]

[Note: de facto rights (without holding a permit/licence) that are traditionally followed by local people in accessing, extracting, and using forest resources near to them irrespective of formal rules. Governance regime SFM: prior to 2008 'State land Forest' and 'Permanent Forest Reserve' and CBFM: after 2008 Community Participation']

1. Rights exercised by the respondents in two different governance regimes (SFM: and CBFM)

		SFM		CBFM	
	Do you or your household members	Exercised	Not exercised	Exercised	Not exercised
1	went or go to the forests?				
2	collected/collect forest resources? (e.g. timber, NTFPs, fish etc.)				
3	used/use forest land? (e.g. for agriculture, oil palm etc.)				
4	do ecotourism activities? (e.g. boating, watching wildlife, forests, recreational fishing etc.)				

2. Rule administering (status of monitoring, rule enforcement and sanctions) (e.g. for illegal forest access, resource extraction, encroachment etc.) in the PSF in two different governance regimes

What was/is the status of the followings?		SFM			CBFM		
		Strict	Occasional	Overlooked	Strict	Occasional	Overlooked
1	Monitoring						
2	Rule enforcement and sanctions						

Theme 3: Participation

Restoration project

3. Do you know about the RMFR restoration project? Yes/no; if no, **go to Q-6**; if yes
4. How did you know about the RMFR restoration project?
5. What are the objectives and activities of the RMFR restoration project?
6. During project planning and designing, did Global Environmental Centre(GEC)/SSFD do any local need assessment? Yes/no: if yes

7. Are the local needs and priorities integrated in the restoration project plan? Yes/no

Project meetings

8. Do you/your household participate in project planning meetings: Yes/no; if no, go to Q-13; if yes, how many times per year?
9. Were your views/opinions accepted by GEC/ SSFD? Yes/no; if yes; how often: frequently/sometimes
10. In project planning meeting, usually about what decisions are made?
11. Who arrange the project planning meeting?
12. How often GEC does meet you/community people/other stakeholders to discuss about the project? every month/quarterly/half yearly/yearly/never/don't know
13. Do project implementation plans develop with community participation? Yes/no/don't know

Project activities

14. Do you/your household member participate in the PSF restoration and conservation activities? Yes/no; if no, go to Q-16; if yes, how many times in a year?
15. What were the activities you/your household performed in the past one year?
16. Do you think the restoration activities (e.g. plantation, canal blocking, awareness creation etc.) were/are properly designed and appropriate for this area? Yes/no; If no; Why?

Project benefits

17. Do you get monetary or any other kind of benefit for attending the project activities or do it voluntarily? if voluntarily, go to Q-19
18. Benefits obtain

Benefits from		Yes	No
1	Joining patrolling activities		
2	Conducting nursery activities		
3	Monetary benefits as cooperatives		
4	Alternate income generation activities		
5	Permission to NTFP collection		
6	Permission to ecotourism activities		
7	Others, please specify		

19. Do you have any other long term benefit or stake?
20. Who are the main beneficiaries of the project activities?
21. Did you get any training from the project? Yes/no; if no, go to Q-24; if yes, what are those?
22. Do you have any importance of these trainings?
23. Are you applying these training in your daily life? Yes/no
24. Will you continue to involve in restoration activities after the project benefit is withdrawn? Yes/no

Project information sharing

25. Do you get project related information? Yes/no; if no, go to Q-28; if yes, how often: frequently/sometimes
26. How do you get project related information?
27. When do you know about project related decisions and/or activities? [before commencement/ something is already decided or happened]

Theme 4: Social capital

Friends of North Selangor Peat Swamp Forests (FNSPSF)

28. Do you know about FNSPSF? Yes/no; if no, go to Q-33
29. Do you know the objectives and activities of FNSPSF? Yes/no; if yes, what are those?
30. Are you/your household a member of FNSPSF? Yes/no; if yes, go to Q-36; if no,
31. Were you/your household a member of FNSPSF previously? Yes/no If no, go to Q-33
    8. if yes?
32. Why did you/your household quit?
33. Would you like to join? Yes/no; why?
34. How does FNSPSF decide the activities? Consultation (i) within community, or (ii) with GEC and SSFD
35. Do you participate in group decision making? Yes/no; if yes, how often: frequently/sometimes
36. Do you think current activities are appropriate for community development? Yes/no; why?
37. In the last 12 months, what are the major activities you have done with others for the benefits of the community?
38. Were those participations voluntarily, required or paid?
39. Do you like to continue your membership with the FNSPSF? Yes/no; why?

Junior Peatland Forest Ranger (JPFR) and Peatland Forest Ranger(PFR) Programme

40. Do you know about JPFR/PFR? Yes/no
41. Do you know the objectives and activities of JPFR/PFR Programme? Yes/no if yes, what are those?
42. Do you think this programme has a positive impact on the awareness creation and environmental education of school students? Yes/no; Why?

Section 3

Theme 5: Ecosystem Benefits and Services

43. What were/are the state of the ecosystem benefits and services you/household obtained/obtain from the RMFR before and after restoration activities? [Please give your opinion between '0' and '5', where '0' indicates 'no benefits and services' and '5' indicates 'fully stocked and high supply potential']

Products and services	Past condition, before 2008						Current condition in 2019					
	0	1	2	3	4	5	0	1	2	3	4	5
Water for agriculture												
Flood prevention												
Land for agriculture												
Land for oil palm												
Biodiversity												
Habitat for wildlife (e.g. animals, fishes, birds, snakes etc.)												
Wildlife sightings(i.e. animals, birds etc.)												
Carbon capture												
Prevent pollution												
Pure environment (e.g. fresh air, etc.)												
Place for relaxation												
Source of traditional medicine												
Recreational activities e.g. river cruising, kayaking, boating												
Recreational fishing												
Wildlife, bird watching												
Nature walks												

44. What were/are the state of the societal benefits and services you/household obtained/obtain from the RMFR before and after restoration activities? [Please give your opinion between '0' and '5', where '0' indicates 'no benefits and services' and '5' indicates 'fully stocked and high supply potential']

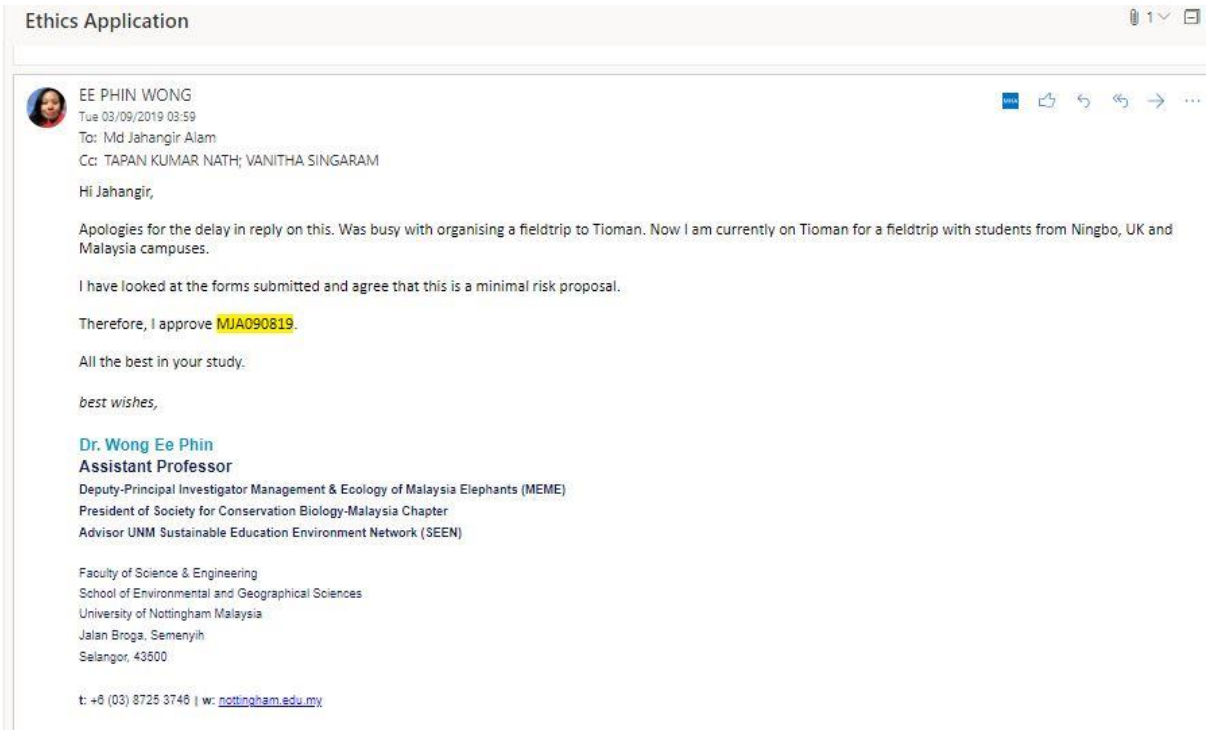
Benefits	Past condition, before 2008						Current condition in 2019					
	0	1	2	3	4	5	0	1	2	3	4	5
Timber												
Non-timber forest products												
Employment opportunities												
Tourism at RMFR												
Nature education												
Research												

Theme 6: Willingness to Contribute

45. Attitude and willing to contribute toward ongoing conservation and restoration activities of RMFR.

Activities	Desirable	Undesirable	can't say	Would like to donate		
				Money	Labour/ Time	Not interested
Planting trees						
Forest vigilance (for monitoring fire and encroachment)						
Fire prevention						
Canal blocking and their maintenance activities						
Trail construction and maintenance activities						
Education and awareness creation						

Appendix 4: Ethics approval



Ethics Application

EE PHIN WONG
Tue 03/09/2019 03:59
To: Md Jahangir Alam
Cc: TAPAN KUMAR NATH; VANITHA SINGARAM

Hi Jahangir,

Apologies for the delay in reply on this. Was busy with organising a fieldtrip to Tioman. Now I am currently on Tioman for a fieldtrip with students from Ningbo, UK and Malaysia campuses.

I have looked at the forms submitted and agree that this is a minimal risk proposal.

Therefore, I approve MJA090819.

All the best in your study.

best wishes,

Dr. Wong Ee Phin
Assistant Professor
Deputy-Principal Investigator Management & Ecology of Malaysia Elephants (MEME)
President of Society for Conservation Biology-Malaysia Chapter
Advisor UNM Sustainable Education Environment Network (SEEN)

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Appendix 5: Checklist for Workshop

Workshop of Community Participation in Conservation and Restoration of Peat Swamp Forest in Selangor

Date: 9th July 2018
Venue: Homestay Agro-tourism Office at Sungai Sireh

(The main aim of this questionnaire survey is to develop an institutional framework for sustainable conservation of peat swamp forest)

1. When the community-based restoration and conservation project begun, what was the condition of forests in project sites and outside the project sites?
2. If forests were degraded, what were the reasons and who were responsible for such degradation?
3. What kinds of forest products could you collect from forest reserves during that time?
4. What were the economic activities of local communities living in and around the forest reserves?
5. Did these activities affect destruction or conservation of forest reserves?
6. Did the forestry department or other agencies take any measure to prevent the destruction?
7. Who are the key users of forest reserves? What are their uses?
8. Who are the actors (people/agencies/government/private/education institute/associations) involved in forest reserves restoration and conservation?
9. What are the functions of these actors? Mention the function of all actors.
10. In your opinion, who are the most important actors for sustainable restoration and conservation of forest reserves? Please prioritize (1st, 2nd,….) them and write the reasons.
11. Please draw a diagram showing the interaction between the actors towards restoration and conservation of forest reserves. Interactions may be i) Frequent, ii) Sometimes and iii) None/rare.
12. Please write the purposes of interaction between different actors.
13. Do you think that the current interaction can be improved further? If so, please do find out the gaps and suggest improvement.
14. Do you think that all actors are consulted and their opinion are taken into consideration when making any decision on forest restoration and conservation?
15. How do get project related information? What is the information do you usually receive?
16. Do you think that after community engagement the forest conditions have been improved?
17. In your observation, what are the changes that happened in forest conditions after community engagement?
18. Can you please give some examples of socio-economic development initiatives through community-based restoration and conservation project?
19. How can you sustain these community development activities?
20. What are rules and/policies that are encouraged community engagement?

Appendix 6: Forest proprietary rights, prohibited, management and development activities in PFR under National Forestry Act 1984 relevant at RMFR (Source: Government of Malaysia, 1984)

	Formal rules/ statement	Sanctions of rule violation	Relevant agency
Forest Property Rights			
Forest access	Article 47(1)(c): no person shall enter into PFR without holding an 'entry permit' issued under subsection 47(3).	Person/persons will be fined RM 10000 or to imprisonment for a term not exceeding three years or to both such fine and imprisonment under subsection 47(4).	SSFD
Resource extraction	Article 15(1): no person shall take major (e.g. round timber, poles, fuelwood) and minor forest produce (all other forest produces not included as major forest produce) from PSF or State land without holding a valid license or permit under subsection 21(3) and 30(4).	Any violation of this subsection 15(1) will be fined RM500 and an imprisonment for any period between 1 to 20 years under subsection 15(2).	SSFD
Forest land use	Article 34 (c) (e): PFR can be used for research, education or training, recreational and cultivation of vegetables and fodder crops through the provision of 'use permit' issued under subsection 36(4). However, Article 32(1) states that no person shall occupy or carry out any activity upon any land within a PRF, unless he is the holder of a 'use permit'.	Any violation of this rule will be compensated with RM 50000 or to imprisonment for a term not exceeding 5 years or to both such fine and imprisonment subsection 32(2).	SSFD
Prohibited activities			
Fire	Article 82(1) of Act states that no person shall kindle, keep or carry any fire, or leave any fire burning, within a permanent reserved forest in such a manner as to endanger such reserved forest.	Any violation of this rule will be given a penalty of RM 50000 or to imprisonment for a term not exceeding five years or to both such fine and imprisonment under subsection 82(2).	SSFD
Forest land conversion	Article 82(1)(e) states that unless authorized under this Act, no person shall, in a permanent reserved forest— clear or break up any land for cultivation or any other purpose;	(2) Any person who contravenes subsection (1) shall be guilty of an offence and shall on conviction be liable— (c) if the offence is under paragraph (d), (e), (f) or (g), to a fine not exceeding ten thousand ringgit or to imprisonment for a term not exceeding three years or to both such fine and imprisonment. (3) Any person convicted of an offence under this section may, in addition to any penalty imposed on the conviction, be ordered to pay to the State Authority— (b) the costs of repairing any damage, in respect whereof the offence was committed, and any sum ordered to be so paid shall be recoverable as if it were a fine so imposed.	
Close of watercourse (watercourse means any	98. (1) Notwithstanding any other written law to the contrary, the Director may prohibit the use of any watercourse in a permanent	(2) Any person who fails to comply with any prohibition imposed by the Director under subsection (1) shall be guilty of an offence and shall on	

access by river)	reserved forest or of any forest road.	conviction be liable to a fine not exceeding fifty thousand ringgit or to imprisonment for a term not exceeding five years or to both such fine and imprisonment.	
Management and development activities			
Prepare and implement reforestation plans	Article 4(c) (d) (e) give the authority to the director of SSFD to prepare and implement reforestation plans; time to time review of the plan, and prepare and implement programmemes relating to amenity forests.		