

Effect of Acacia plantation on farmers' livelihood in Thua Thien Hue province, Central Vietnam

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Abstract

Thua Thien Hue province has considered Acacia plantation as an important resource for improving farmers' livelihood. However, impacts of tree plantations on rural development and environment is still a contentious issue. Hence, the present article was undertaken to investigate the changes of livelihoods assets after establishing acacia plantations. This study was designed as a cross-sectional investigation, in which 180 farmers from diverse socio-economic backgrounds were identified by the random sampling. Household survey and Key informant interview were applied for the study. Frequencies were compared by using Chi-squared test or Fisher's exact test. Mean was compared by t-test, Wilcoxon signed rank test and Analysis of variance. Overall value for livelihoods assets before planting Acacia was 0.41 compared to 0.65 after the establishment of Acacia plantations, indicating that Acacia plantation contributed more to livelihood improvement in Thua Thien Hue province.

Keywords: *Acacia plantation, livelihoods, Thua Thien Hue, Vietnam*

1. Introduction

Tree plantations have been increasing at the global scale (Rudel, 2009). Impacts of tree plantation have been widely discussed in many studies which suggest both benefits and drawbacks in terms of economic, social and environmental aspects. On the one hand, some previous studies suggest that tree plantations provide many benefits. In terms of economic aspects, Rudel (2009) stated that the global expansion of forest plantations plays important roles in rural livelihood diversification and poverty alleviation. Nambiar et al. (2015) pointed out that Acacia forest plantations in Vietnam support smallholders in terms of livelihoods and rural development. Regarding social aspects, tree plantations require not much labor compared to annual crops (Bentley, 1989). Large-scale monocultures of tree plantations also create employment for society (Ying et al., 2010). In terms of environment, the establishment of forested plantations can contribute to mitigate climate change via carbon sequestration (Hollinger et al., 1993; UNFF, 2003; Rudel, 2009; Pistorius et al., 2016). Plantation forests may help to reduce pressures on natural forests (Gladstone and Thomas Ledig, 1990; Bull et al., 2006; Jürgensen et al., 2014) that have higher values of environmental goods and services than that from planted forests (Zhang and Stanturf, 2008; Baral et al., 2016). On the other hand, drawbacks of planted forests also have been noted by a number of scholars. According to Cossalter and Pye-Smith (2003), 'fast-wood' plantations were criticized by environmentalists since they pose serious threats to wildlife, soil and water resources. Plantations also have negative impacts on society because the establishment of plantations leads to many conflicts between companies and local people (Gerber, 2011). The expansion of plantations may lead to a lack of agricultural crops lands for farmers (Schirmer, 2007), resulting in exacerbating poverty (Andersson et al., 2016). Moreover, the extensive establishment of plantations can boost phenomena of labour migration from rural areas to other places (Schirmer, 2007). In terms of

economic aspects, situations of oversupply which lead to a price reduction of timber products were observed in some parts of the world. In addition, due to the rapid expansion of plantations, the areas of pasture will be loss, which has negative impacts on the livestock sector (Tam, 2008).

In Vietnam, planted forests play a crucial role in the increase of forest cover. On average, plantation areas are expanded approximately 150,000 to 200,000 hectares per year. To date, approximately 3.6 million hectares of forest land are plantations and this figure is predicted to reach 4.15 million hectares by 2020 (Pistorius at al., 2016). The most common species in planted forests are exotic species such as acacias, eucalypts, pines, and rubber (Thai at al., 2010; Thulstrup, 2014). By the year 2015, Vietnam had around 1.1 million hectares of Acacia plantation areas (Pistorius at al., 2016). This species has been extensively planted in the last two decades, a trend that still continues (Nambiar at al., 2015). The rapid increase of Acacia, a species of Australian origin, are partly explained by a quick economic return (Pistorius at al., 2016). Hence, many tree growers who own small land parcels have considered Acacia plantation as a main livelihood (Nambiar at al., 2015; Maraseni at al., 2017). Using Thua Thien Hue province as a case study, the study was to assessed the change of farmers' livelihood after planting Acacia species by using the sustainable livelihood approach. Results from the study are imperative in formulating policies, plans and projects for betterment of people planting Acacia.

2. Study methods

2.1 Description of study area

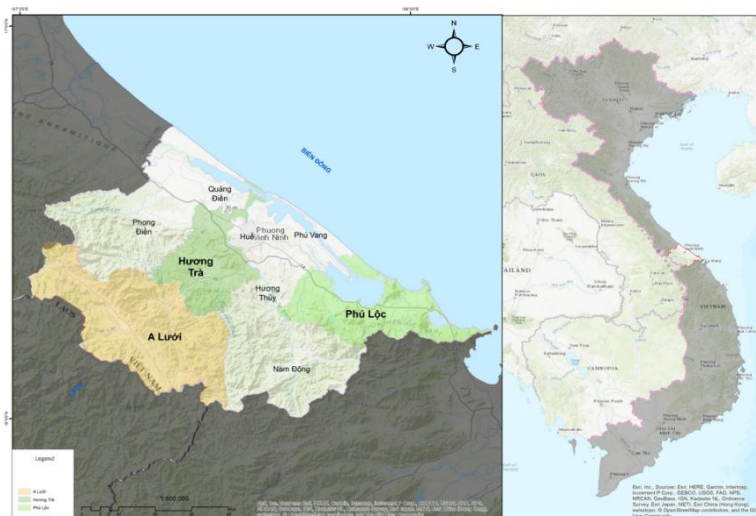


Figure 1. Location map of study area (Source: IREN)

Thua Thien Hue (TTH) province is located in the North Central Coast region of Vietnam with a total area of 503'321 ha (Figure 1). This province comprises of 9 districts, including Phong Dien, Quang Dien, A Luoi, Huong Tra, Hue, Phu Vang, Huong Thuy, Nam Dong, Phu Loc. Approximately 294'666 ha (~60%) of this province is covered by forests; of this total, 78'977 ha is planted forests with Acacia being a predominant species (Ha at al., 2011; Tam, 2008). Phu Loc, Huong Tra and A Luoi was choose purposively for study. More

specifically, **Phu Loc** district is a mixed region with upland, lowland and coastal areas. It covers an area of 72'036ha of which 30'891 ha is a forest (36.5% or 11'299 ha are planted forest). In Phu Loc, Acacia is a dominant species in a planted forest, and this species was also first planted in this district. **Huong Tra** district, a mixed landscape between uplands and lowlands with 13'753 ha being planted forest (TTH-FPD, 2018), accounting for 60% forest areas, is the second district establishing Acacia plantations. This district planted Acacia in common around in 2000. **A Luoi** district, a mountainous area (7'079 ha planted forest vs 87'863 ha natural forest), is the final district

establishing Acacia plantations. This district is home of several ethnic minorities such as Ta Oi, Co Tu. In A Luoi, planted forests are adjacent natural forests.

2.2 Data collection

This study is designed as a cross-sectional study. 180 participants were recruited into the study. Participants were divided into 90 farmers with FSC (*) and 90 without FSC certificate (**).

(*) There was 780 farmers participating in FSC scheme as of 2018 (FOSDA, 2018). Using equation from Yamane 1967 ($n = N/(1+N(e)^2)$), at 10% significance, the calculated sample size (n) required are 90 farmers. (**) Since there is no population of farmers without FSC certificate, this study decides to select 90 farmers without FSC (equal to farmers with FSC)

2.3 Assessment of livelihood

Livelihood is a multidimensional and complex term, hence numerous definitions have been suggested to describe and represent the term. In the study, we used the sustainable livelihood approach suggested by DFID, 2000 to analysis the change of livelihood assets. Specifically, 13 variables corresponding to the five sources of capital were analyzed to understand livelihood capital changes after the establishment of Acacia plantations.

Physical capital (PC) changes were measured by the changes of (X1) Household assets, (X2) House quality, and (X3) Transport potential to plantations. Household assets consist of television, motorbike, car, tools supporting for agricultural and non-agricultural purposes (sawn log, grass-cutter, excavator, truck). Transportation plays important roles in transporting wood and moving into Acacia plantations. *Natural capital (NC)* changes were measured by the changes of (X4) Water availability, (X5) Soil fertility, (X6) Wildlife appearance, and (X7) Landscape beauty. The changes in all variables were perceived by respondents. *Human capital (HC)* changes were measured by the changes of (X8) access to medicines and (X9) level of investment in education. The change of access to medicines is associated with the change of health status of local people, influencing on sustainable development. Investment in education for yourself refers to knowledge gained from training. When farmers access to new knowledge, it is easier for them to adopt new technology, to solve farm problems, to give decision-making in farm production, and to improve technical skills (Udayakumara & Shrestha, 2011). *Social capital (SC)* changes were measured by the changes of (X10) Land conflict, (X11) Interaction, (X12) Participatory. Land conflict or dispute is an issue worth discussing in Vietnam. Conflicts may happen among farmers, especially farmers with the share boundaries or between farmers and State Forestry Company. Interaction mentioned the interaction among farmers such as sharing experiences, helping others in plantation activities. Participation level into organizations was measured by the level of participation in a meeting. *Financial capital (FC)* changes were measured by the changes of (X13) Income after planting Acacia species. This study only discusses the level of income change after selling Acacia products. The change in income from Acacia plantations may affect silvicultural practices. Before planting Acacia is a point of time when farmers have not planted Acacia yet while after planting Acacia is a point of time this survey was conducted (in 2018).

3. Results and discussions

3.1 Livelihood Dynamic

Table 1 Values of four capital assets before and after planting Acacia

Capitals	Before	After
Physical capital (PC)	0.24	0.66
Natural capital (NC)	0.51	0.61
Human capital (HC)	0.27	0.59
Social capital (SC)	0.61	0.74
Total score of livelihood assets (LA)	0.41	0.65

The overall value of livelihood capitals before and after the establishment of Acacia plantations was 0.41 and 0.65 respectively, showing relatively better livelihood after planting Acacia (Table 1). More specifically, physical capital increased from 0.24 (before planting Acacia) to 0.66 (after planting Acacia), the most significant change in four capital assets. This result indicates that assets, house quality and potential transport have improved in parallel with the Acacia plantation development.

There was an increase from 0.51 to 0.61 after planting Acacia of natural capital value, implying that the better ecosystem services after the establishment of Acacia plantation. Likewise, social capital increased from 0.61 to 0.71. This underlines that the interaction among people is closer than before. Human capital value doubled after establishing Acacia plantations (from 0.27 to 0.59). This highlights a collection of traits (education and health) has greatly improved. The average years since setting-up Acacia plantation were 18 years, meaning a period of time from “before” and “after” the establishment of Acacia plantations.

3.2 Livelihood Capital Change after Planting Acacia

Table 2 Livelihood capitals and decision variables before and after planting Acacia

Capital	Variables	Before	After	p-value
Physical	(X ₁) Household assets	0.15	0.57	p = 0.000***
	(X ₂) House quality	0.28	0.71	p = 0.000***
	(X ₃) Potential transport	0.27	0.70	p = 0.000***
Natural	(X ₄) Water	0.83	0.84	p=0.46
	(X ₅) Soil fertility	0.42	0.65	p = 0.000***
	(X ₆) Wildlife animal	0.55	0.23	p = 0.000***
	(X ₇) Landscape beauty	0.26	0.71	p = 0.000***
Human	(X ₈) Access to medicines	0.26	0.62	p = 0.000***
	(X ₉) Investment in education	0.28	0.57	p = 0.000***
Social	(X ₁₀) Land conflict	1.00	0.94	p = 0.0001***
	(X ₁₁) Interaction	0.43	0.64	p = 0.000***
	(X ₁₂) Participatory	0.39	0.62	p = 0.000***

Note: *** indicate p < 0.001

Physical capital

Overall, the values of all variables of physical capital (assets, house quality, potential transportation) have increased after establishing Acacia plantations, and the difference was

statistically significant ($p < 0.05$) (Table 2). More specifically, the value of assets increased from 0.15 to 0.57. Farmers stated that they used money gained from Acacia plantation to buy TVs, motorbikes, tools supporting for agricultural and non-agricultural purposes (chainsaw, grass cutter, truck), and even cars. Before planting Acacia, 66.1% of farmers stated they owned extremely few assets. This figure has decreased by half after planting Acacia trees. By contrast, the percentage of farmers who stated that they had “many” assets have increased from 3.9% before planting Acacia to 10% after planting Acacia. When it comes to house quality, it has increased approximately 2.5 times (0.25 to 0.71) after planting Acacia. Before planting, there were 48.3% farmers stated that their house quality was bad. Some farmers described “*I worried when storms came, my house may fall*” (male, 55); “*My house always leaked when it rained*” (female, 64). After planting Acacia, there were 49.4% of farmers said that their house quality was quite good. They explained that their house was updated after gaining income from selling Acacia plantations. Finally, the value of transport potential to plantations also increases about 2.5 times (0.27 to 0.70). To facilitate the exploitation, owners of Acacia plantation have to open roads (transporting wood from plantations to main roads) by their money while main roads are opened and/or improved by the government. Therefore, the percentage of farmers who stated the potential transportation was “easy” significantly increased from 0.6% to 32.8%.

Natural capital

Among four variables of a natural asset, only the value of wildlife (frequency of appearance wildlife in plantations) decreased from 0.55 to 0.23 after planting Acacia plantations (Table 2). According to respondents, wildlife such as wild boar, deer, jungle fowl often came their plantations to seek food such as cassava (43,9% those planted cassavas before planting Acacia). After planting Acacia, wildlife animals lost sources of food. Moreover, activities in Acacia plantations, especially noise from logging operations (chainsaw, grass-cutter, truck), and hunting activities explain somewhat why the frequency of occurrence of wild animals was lower than before. After planting Acacia, the percentage of farmers who stated “sometimes” and “usually” seeing wildlife significantly decreased. The decrease in wildlife species implies the loss of biodiversity. This finding corresponds well with Pirard et al., [2017] who found that wildlife animals decreased after establishing plantations. Water value increased by 0.01, and there was no significant difference in the value of water resources between before and after establishing Acacia plantations ($p > 0.05$). Further analysis, 55% of farmers in A Luoi supposed that the problem of water was “extremely serious” and “serious” before planting Acacia, and this figure after planting Acacia was 50%. They (respondents in Huong Lam and Dong Son communes, A Luoi district) explained that this area was formerly an airport namely A So (16.118843, 107.329331) where was exposed to a lot of chemical toxins such as dioxin during the time war (before 1975). This has negative impacts on water sources. Approximately 1% respondent in Huong Tra and about 4% of respondents in Phu Loc district supposed that after planting Acacia, the problem of water was serious. They explained that during the harvesting time of Acacia, branches fall into streams, obstructing the flow. Soil fertility value increased from 0.42 to 0.65, indicating the quality of soil better after planting Acacia. This concurs well with a finding from Hung et al., [2017] who found Acacia species have valuable contributions to soil fertility. Before planting Acacia, there was 51.1% of farmers stated that soil fertility was bad, as illustrated in the following quotes: “*Before planting Acacia, I already planted eucalypts, and I think soil has been badly affected*” (Male, 62); “*Soil fertility in my commune (Dong Son commune, A Luoi district) was bad due to a toxin in the time war*” (male, 61). After establishing Acacia plantations, the percentage of farmers said that soil fertility was “fair” and

“good” have increased by 19.5% and 20.5% respectively. A farmers described “*I can apply intercrop such as cassava in Acacia plantations*”. Among 4 variables of natural assets, landscape beauty value increased the most, nearly 2.7 times. Respondents explained before planting Acacia, the landscape was unattractive because only shrubs such as reeds existed. Therefore, 37.2% and 48.3% of farmers said that landscape beauty was “ugly” and “middle” respectively. After the establishment of Acacia plantations, people found beauty in a landscape (48.9% farmers stated “beautiful” and 33.9% of farmers sated “very beautiful”). This finding differs from a published study from Pirard et al., [2017], who found that Acacia plantations do not have aesthetic value compared to Pine and Teak. However, similar finding was found by Kull et al., [2011] who stated that Acacia tree tends to be appreciated for aesthetic value.

Human capital

The value of access to medicine improved from 0.26 before planting Acacia to 0.62 after the establishment of Acacia plantations (Table 2). Before planting Acacia, their access to medicines is very limited because of financial constraints. However, after gaining incomes from plantations, people can buy tonics, do periodic health examination to improve their health condition. Therefore, the percentage of farmers stated that their ability to access to medicines at “very good” category significant increased from 3.9% to 30.6%. The value of investment in education increased from 0.28 to 0.57 (Table 2). Before planting Acacia, the majority of farmers stated that they did not invest (45.6%) and slightly invest (30%) in education. By contrast, after the establishment of Acacia plantation, their investment in education have increased. Farmers explained that after gaining income from Acacia plantations, they have spent more money on education for their children (study) and themselves (training, buying books such as a manual for planting Acacia techniques) than before. This has positive impacts on sustainable development. The score of conflict decreased from 1 to 0.94 (Table 2). This finding means there was almost no dispute about forestlands before the establishment of Acacia plantations. However, conflicts have appeared after planting Acacia (among forest growers or between farmers and forestry companies). After planting Acacia, the number of “extremely serious” and “serious” land conflict increased. This can be explained by the fact that people now recognize the economic efficiency of Acacia plantations. Hence, they often take advantage of every place to plant Acacia even on boundary separator, leading to forestlands disputes. The score of interaction indicator among people increased from 0.43 to 0.64. Before the planting of Acacia, most people were often only interested in how to escape poverty (mainly about food), and therefore they were less interaction in work (plantation activities). Currently, the interaction between Acacia growers has increased through activities in forest planting and management: “*I always share my experiences related to silvicultural practices with my neighbors*” (male, 57, Phu Loc district); “*I helped my relatives in planting Acacia, they also help me again*” (female, 58, Huong Tra district). The value of the level of participation in organizations increased from 0.39 to 0.62. There are two main reasons why the rate of participation in organizations is low in the past (before planting Acacia). Before planting Acacia, there were 33.3% of farmers did not participate in organizations, 30.6% of farmers “rarely” participating in organizations. A farmers explained “*I did not really understand their rights when participating in organizations, so I rarely joined meetings*”. After planting Acacia, the level of participation has increased, especially farmers participating in the FSC program. When participating in this program, they were trained in silvicultural techniques and received cash when participating in meetings. Therefore, it is not surprising that the level of participation in organizations has increased after planting Acacia.

Financial asset

The change of financial asset was assessed via the change of income after planting Acacia plantations. In this case, farmers who only planted Acacia were assessed, that was farmers planted other trees such as rubbers or pines and farmers doing agriculture were excluded. As a results, there was 82.2% (n=90) of farmers said that their income increase after planting Acacia while 17.8% of farmers stated that their income was not increase. Explaining for income increase after planting Acacia: *“Before planting Acacia, the main sources of income were collecting firewood, shifting cultivation, agriculture (both upland and wet rice). However, the amount of income from these sources was insignificant. After planting Acacia plantations, livelihood sources were diversified which including seedling nurseries, middlemen, carpentry, transportation, wage earners from forest activities (planting, thinning, pruning etc.), and in Acacia wood processing factories”* (head of TTH Forest Protection Department); *“Before 1995 (no planting Acacia), farmers were extremely poor; however, after farmers gained income from Acacia plantations, their lives were improved”* (head of a village); *“my life has improved a lot after planting Acacia, even I can buy a car”* (Male, 55); *“I only owned small Acacia areas; however, my income has increased. This is because I can work for large Acacia plantation owners”* (male, 38). *“I owned minimal Acacia areas, and no one hired me to work because I am weak. However, I can still earn money (although not much) by finding firewood”* (female, 52).

4. Conclusion

Acacia plantation has increasing become a policy tool for poverty alleviation in the rural areas of TTH province. However, the role of commercial plantation to poverty alleviation remains little understanding. We assessed the local livelihood improvement before and after acacia plantation introduced in TTH province. We assessed farmers' livelihood change based on the change of natural, physical, human, financial, and social capitals. We found that after planting acacia, the 5 capitals has resulted in significant increase. Weighted values of the five capitals after introducing acacia were higher than that for the time without acacia plantation suggesting that local livelihood have improved after acacia plantation was established. Therefore, acacia plantation should be promoted as a policy for poverty alleviation in Central Vietnam.

References

- Andersson, K., Lawrence, D., Zavaleta, J., & Guariguata, M. R. (2016). More trees, more poverty? The socioeconomic effects of tree plantations in Chile, 2001–2011. *Environmental management*, 57(1), 123-136.
- Baral, H., Guariguata, M. R., & Keenan, R. J. (2016). A proposed framework for assessing ecosystem goods and services from planted forests. *Ecosystem Services*, 22, 260–268.
- Bentley, J. W. (1989). Bread forests and new fields: the ecology of reforestation and forest clearing among small-woodland owners in Portugal. *Journal of Forest History*, 33(4), 188-195.
- Bull, G. Q., Bazett, M., Schwab, O., Nilsson, S., White, A., & Maginnis, S. (2006). Industrial forest plantation subsidies: Impacts and implications. *Forest Policy and Economics*, 9(1), 13-31.
- Cossalter, C., & Pye-Smith, C. (2003). *Fast-wood forestry: myths and realities* (Vol. 1). CIFOR.
- DFID, U. K. (2000). Sustainable livelihoods guidance sheets. *London: DFID*, 445.
- FOSDA (2018). Report on implementation of FSC program in Thua Thien Hue province.
- Gerber, J. F. (2011). Conflicts over industrial tree plantations in the South: Who, how and why?. *Global Environmental Change*, 21(1), 165-176.
- Gladstone, W. T., & Ledig, F. T. (1990). Reducing pressure on natural forests through high-yield forestry. *Forest Ecology and Management*, 35(1-2), 69-78.
- Hollinger, D. Y., Maclaren, J. P., Beets, P. N., & Turland, J. (1993). Carbon sequestration by New Zealand's plantation forests. *New Zealand Journal of Forestry Science*, 23(2), 194-208.
- Hung, T. T., Doyle, R., Eyles, A., & Mohammed, C. (2017). Comparison of soil properties under tropical Acacia hybrid plantation and shifting cultivation land use in northern Vietnam. *Southern Forests: a Journal of Forest Science*, 79(1), 9-18.
- Israel, G. D. (1992). Determining sample size.
- Jürgensen, C., Kollert, W., & Lebedys, A. (2014). Assessment of industrial roundwood production from planted forests. *Planted Forests and Trees Working Papers (FAO) eng no. FP/48/E*.
- Kull, C. A., Shackleton, C. M., Cunningham, P. J., Ducatillon, C., Dufour- Dror, J. M., Esler, K. J., ... & Midgley, S. J. (2011). Adoption, use and perception of Australian acacias around the world. *Diversity and Distributions*, 17(5), 822-836.
- Maraseni, T. N., Son, H. L., Cockfield, G., Duy, H. V., & Dai Nghia, T. (2017). Comparing the financial returns from Acacia plantations with different plantation densities and rotation ages in Vietnam. *Forest policy and economics*, 83, 80-87.
- Nambiar, E. S., Harwood, C. E., & Kien, N. D. (2015). Acacia plantations in Vietnam: research and knowledge application to secure a sustainable future. *Southern Forests: A Journal of Forest Science*, 77(1), 1-10.
- Pirard, R., Petit, H., & Baral, H. (2017). Local impacts of industrial tree plantations: An empirical analysis in Indonesia across plantation types. *Land Use Policy*, 60, 242-253.
- Pistorius, T., Hoang, H. D. T., Tennigkeit, T., Merger, E., Wittmann, M., & Conway, D. (2016). Business models for the restoration of short-rotation Acacia plantations in Vietnam. A project supported by the German International Climate Initiative. Unique forestry and land use GmbH, Freiburg, Germany.
- Rudel, T. K. (2009). Tree farms: Driving forces and regional patterns in the global expansion of forest plantations. *Land use policy*, 26(3), 545-550.
- Schirmer, J. (2007). Plantations and social conflict: exploring the differences between small-scale and large-scale plantation forestry. *Small-scale forestry*, 6(1), 19-33.
- Tam, L. V. (2008). *The forest land use and local livelihoods: Case study in Loc Hoa Commune Phu Loc district, Thua Thien Hue province*. (Thesis, Hue University of Agriculture and Forestry).
- Thai, H. T., Lee, D. K., & Woo, S. Y. (2010). Growth of several indigenous species in the degraded forest in the northern Vietnam. *International Journal of Physical Sciences*, 5(17), 2664-2671.
- Thulstrup, A. W. (2014). Plantation livelihoods in central Vietnam: Implications for household vulnerability and community resilience. *Norsk Geografisk Tidsskrift-Norwegian Journal of Geography*, 68(1), 1-9.
- Udayakumara, E. P. N., & Shrestha, R. P. (2011). Assessing livelihood for improvement: Samanalawewa reservoir environs, Sri Lanka. *International Journal of Sustainable Development & World Ecology*, 18(4), 366-376.
- UNFF. (2003). The Role of Planted Forests in Sustainable Forest Management. *United Nations Forum on Forests*.
- Ying, Z., Irland, L., Zhou, X., Song, Y., Wen, Y., Liu, J., ... & Qiu, Y. (2010). Plantation development: Economic analysis of forest management in Fujian Province, China. *Forest Policy and Economics*, 12(3), 223-230.
- Zhang, D., & Stanturf, J. (2008). Forest Plantations. *Reference Module in Earth Systems and Environmental Sciences*, 1673–1680.