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# Can fast-growing species form high-quality forests in Vietnam, examples in Thừa Thiên-Huế province

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**Photograph 1.**

The acacia even-aged plantations predominate the hills of Thừa Thiên-Huế province. Here, hybrid Acacias a year and a half old, except for the foreground: hybrids with some *A. mangium* seedlings 6 months old, Village 3 of Phú Sơn commune, 2006.  
Photography A. Robert.

## RÉSUMÉ

### ESPÈCES À CROISSANCE RAPIDE AU VIỆT NAM : DES FORÊTS DE QUALITÉ EXEMPLES DANS LA PROVINCE DE THỪA THIÊN-HUẾ

Les plantations forestières sont sujettes à controverses. Pourtant, en les plaçant au cœur de sa politique forestière, le gouvernement vietnamien semble avoir jeté les bases d'une politique forestière de qualité, ou durable. Les politiques de protection forestière dénuées de préoccupations économique-financières et qui ne proposent aucune solution de rechange aux habitants sont vouées à l'échec, puisque l'application des programmes forestiers requiert des moyens et que les forêts offrent des ressources souvent vitales pour les populations. Or, l'étude, multiscale et multisource, menée dans la province de Thừa Thiên-Huế, au centre du Việt Nam, montre que les forêts plantées d'*Acacia* spp. (*A. mangium*, *A. auriculiformis* et leur hybride) peuvent être des forêts de qualité. Les habitants prennent une part active aux programmes de plantations qui, leur offrant des ressources à court terme, améliorent leur qualité de vie. Parallèlement, ces plantations présentent des valeurs ajoutées environnementales : rétablissement rapide d'un couvert forestier sur les mamelons savanicoles, amélioration de la qualité des sols et augmentation de la superficie forestière, directement ou indirectement, en concourant au recul de l'exploitation des forêts spontanées. La surveillance et l'encadrement peuvent permettre de repousser les limites, désormais bien connues, des plantations : vulnérabilité accrue aux fléaux, risque d'érosion dans les coupes rases et frein à la reconquête spontanée. Le succès de la politique engagée par le gouvernement vietnamien, notamment la pérennité de la qualité des forêts plantées, dépendra de son engagement futur.

**Mots-clés :** acacia, monospécifique, espèce à croissance rapide, plantation forestière, forêt de qualité, gestion durable.

## ABSTRACT

### CAN FAST-GROWING SPECIES FORM HIGH-QUALITY FORESTS IN VIỆT NAM EXAMPLES IN THỪA THIÊN-HUẾ PROVINCE

Forest plantations are surrounded by controversy. Nevertheless, having placed them at the centre of its forest policy, the Vietnamese government seems to have laid the foundations of a policy for high-quality, or sustainable, forestry. Forest protection policies that do not address economic and financial concerns and propose no alternative solutions to inhabitants are doomed to failure, since financial means are essential to apply forest programmes and forests have resources that are often vital to populations. The multiscale and multisource study conducted in Thừa Thiên-Huế province, in central Vietnam, shows that forests planted with *Acacia* spp. (*A. mangium*, *A. auriculiformis* and their hybrids) can be of high quality. Inhabitants take an active part in the plantation programmes, which, by offering them short-term resources, improve their quality of life. These plantations also offer environmental added value: rapid restoration of forest cover on savannah hillocks, improved soil quality and larger forest areas, directly or indirectly, by helping to reduce extraction from spontaneous forests. Surveillance and framing can help to remedy the now well-known disadvantages of plantations: increased vulnerability to pests, risks of erosion in clear-cut areas and inhibition of spontaneous regeneration. The success of the policy initiated by the Vietnamese government, particularly the enduring quality of planted forests, will depend on its level of future commitment.

**Keywords:** acacia, single-specie, fast-growing specie, forest planting, high-quality forest, sustainable management.

## RESUMEN

### ESPECIES DE CRECIMIENTO RÁPIDO EN VIETNAM, BOSQUES DE CALIDAD EJEMPLOS EN LA PROVINCIA DE THỪA THIÊN-HUẾ

Las plantaciones forestales son causa de controversia. Sin embargo, al situarlas en el centro de su política forestal, el gobierno vietnamita parece haber establecido las bases de una política forestal de calidad, o sostenible. Las políticas de protección forestal desprovistas de consideraciones económico-financieras, y que no proponen ninguna solución alternativa a los habitantes, están condenadas al fracaso, puesto que la aplicación de los programas forestales requieren apoyo financiero y que los bosques proporcionan recursos, a menudo vitales, a la población. Ahora bien, el estudio multiscale y multifuente realizado en la provincia de Thừa Thiên-Huế, en el centro de Vietnam, muestra que los bosques plantados con *Acacia* spp. (*A. mangium*, *A. auriculiformis* y su híbrido) pueden ser bosques de calidad. Los habitantes toman parte activa en los programas de plantaciones que, al ofrecerles recursos a corto plazo, mejoran su calidad de vida. Paralelamente, estas plantaciones presentan valores ambientales agregados: rápido restablecimiento de la cubierta forestal en los cerros de la sabana, mejoramiento de la calidad de los suelos e incremento de la superficie forestal, directa o indirectamente, contribuyendo a disminuir la explotación del bosque espontáneo. La vigilancia y el encuadre pueden permitir superar los límites, actualmente bien conocidos, de las plantaciones: mayor vulnerabilidad ante las plagas, riesgo de erosión en las talas y freno de la recuperación espontánea. El éxito de la política adoptada por el Gobierno vietnamita, especialmente en cuanto a la calidad duradera de los bosques plantados, dependerá del cumplimiento de sus compromisos en el futuro.

**Palabras clave:** acacia, mono-específico, especie de crecimiento rápido, plantación forestal, bosque de calidad, manejo sostenible.

## Introduction

Plantations are central to Vietnamese forest policy. In 2006, plantations covered 14.3% of the area in Thừa Thiên-Huế province (figure 1), and 7.5% of the national territory (Gso, 2007). Although reforestation programmes may be “over-ambitious” and official statistics “too good to be true” (ROCHE, DE KONINCK, 2001, translated), the government has nevertheless been working in favour of forest protection since 1990. Up to that time, war and the expansion of agriculture and logging (TRAN, 2006; ROBERT, 2008) had reduced forest cover from 43% of country in 1943 to 27.2% (PHUNG TUU, 2002), or 17% according to more pessimistic estimates (DE KONINCK, 1998). To curb this decline, priority was given to single-species plantations of fast-growing species (photographs 1-2), which is considered in some quarters as giving priority to economic and financial value over ecological value. Yet these “highly controversial” plantations can foster the “sustainable development of tropical countries” (LOCATELLI *et al.*, 2003, translated). Looking beyond “sustainable development” itself, quality was proposed as an “operator of sustainability” because it is “more rooted in the concerns and aspirations of those who live on the spot than in a theoretical, widely artificial and abstract frame of reference” (BRÉDIF, 2008, translated). Can the planted forests of this province therefore be considered as high-quality forests, and do they help to improve living standards as much as environmental quality? This paper presents a summary of the results of a study conducted for a doctoral thesis. Using multi-scale and multi-source approaches, the study drew on national and provincial legislative texts and reports, an analysis of sylvostems and land use along transects (figure 2) and surveys of local authorities and populations living in the areas crossed by these transects, to identify their expectations and their actions (ROBERT, 2007).

## Short-term improvement in living standards and stakeholder involvement

### “Economic forests” as a short-term source of income ...

According to the Agriculture and Rural Development Department, “the Vietnamese government encourages the development of planted forests in a commercial perspective” (SNNVPTNT, 2002, translated). These forest plantations, called “economic” (*rừng kinh tế*), are intended to achieve self-sufficiency in paper pulp and to reduce timber imports. Most are monospecific and classified as productive (70.9% of provincial plantations, *ibid.*), with preference given to fast-growing species, especially *Pinus merkusii* and *Eucalyptus* sp. (including *E. urophylla*), to form until 1990 sporadic planted forests. The former, a local species growing on all soils (*ibid.*), is exploitable after fifteen years for resin or pulpwood, or after thirty years for timber (WCA, 2009). The cycle for *Eucalyptus*, planted preferably in moist fertile soils, is eight years (SNNVPTNT, 2002). Meanwhile, from 1985, *Acacia auriculiformis*, which is known to tolerate a wide variety of soil types,



Figure 1.  
Thừa Thiên-Huế, Central-Vietnam province.

was introduced in smaller areas. Realising that these plantations were more profitable, the province gave priority to this species. By 2000, species of the *Acacia* genus, all native to Australasia and planted as single-species stands, made up 29.2% of its planted forests, and 46.8% when mixed stands are included (figure 3); despite the lack of data, this area is thought to be on the increase. *Acacia mangium*, and subsequently the hybrid *A. mangium* x *A. auriculiformis* (called “hybrid *Acacia*” in this article), which is propagated by cuttings (photograph 3), can both be felled after 6-7 years for the paper industry (*ibid.*) and have superseded *A. auriculiformis*, which is felled for pulp at 8-10 years and timber at 10-15 years (WCA, 2009).



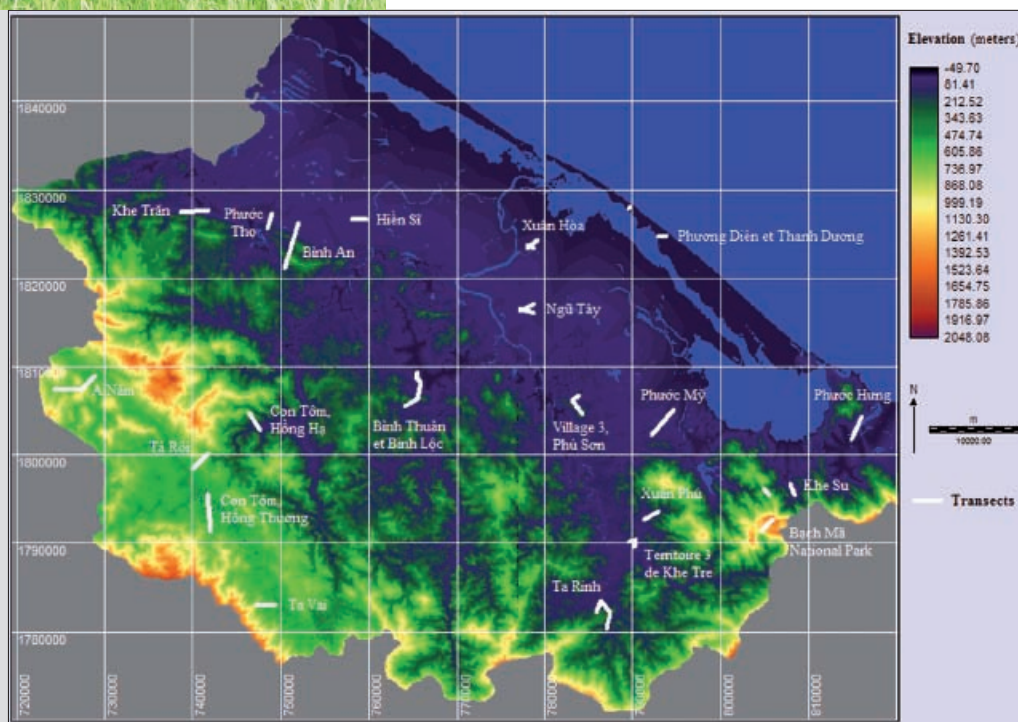
All stakeholders, international, state and private, now prefer the hybrid Acacia, which is “*more vigorous and adaptable than both parental species*” (GALIANA *et al.*, 2003), has denser wood than *A. mangium* (*ibid.*) and is more suitable for paper-pulp production than the species used up to now (LE DINH, 2009). Due to the lack of available reliable data on planted areas by species (FAO, 2009), the proportion of hybrid Acacias is unknown. LE DINH (2009) estimates that they already occupy several thousand hectares across the country and are gaining 500 to 700 additional hectares each year. Compared to the 2,486,200 ha of planted forests in 2006 and the 185,000 ha planted annually from 2000 to 2005 in Vietnam (Gso, 2007), these undated figures seem negligible. However, in the field (photographs 1-4), a number of provincial plantations now contain hybrid Acacias. Sales of the harvested wood bring in good short-term income (photograph 5), admittedly lower than from *A. auriculiformis*, but for many families, the time to wait before they reach felling age is too long. The branches are harvested for home consumption or sale as firewood (photograph 6) from the third year until felling, when the bark is also used for the same purposes.

### ... to encourage stakeholder involvement

Under legislation passed in 1988 and 1993, the government, as the only official landowner, allocates forest lands for a renewable period of fifty years. Demand is growing but development is hampered by inadequate family incomes and the slow land distribution process, which must also resolve conflicts that arise from the profits derived from plantations.

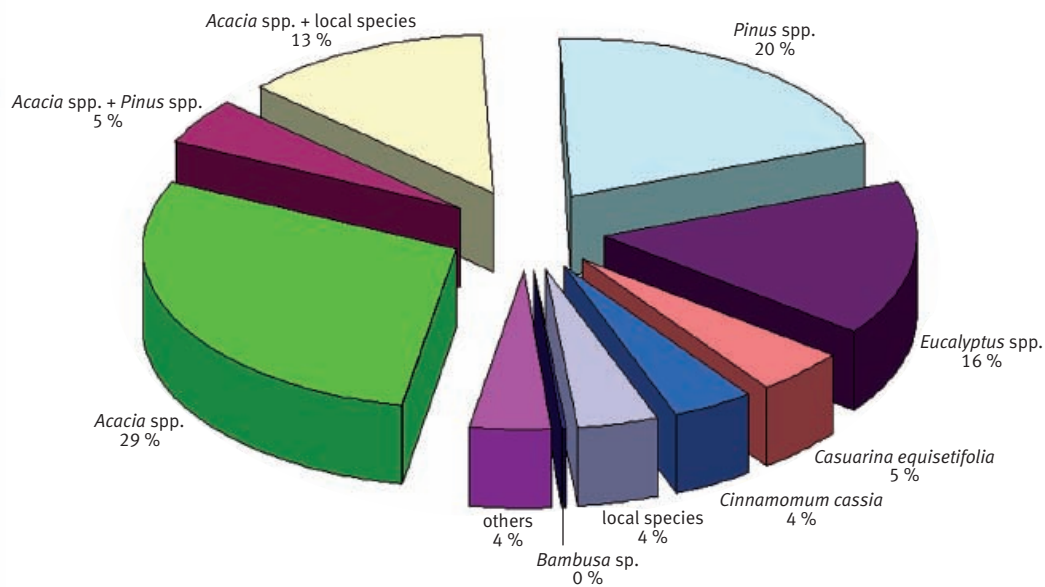
#### Photograph 2.

Single-species and even-aged plantation: hybrid *Acacias*, fast growing, provide tree cover four years after planting, Bình Thuận, 2006. Photography A. Robert.



**Figure 2.**

Localisation map of field transects in Thừa Thiên-Huế province (UTM 48N/ WGS84). Based on transects sampling, the field study was conducted in 2006 and 2007 thanks to the support of Tropenbos International (Dutch NGO working for forest conservation and sustainable development).

**Figure 3.**

Acacia, the main genus used for plantations in Thừa Thiên-Huế province in 2000. Percentages of the planted forests area occupied by the main species, according to data of SNNVPTNT, 2002.

Vietnam's vast even-aged acacia plantations are still under the management of state bodies, especially State forest enterprises (SFE, now known as forest companies or forest management boards), the main managers of forest lands. All plantations in the province were under state responsibility until 2002, and 71% in 2004 (TTHSO, 2005). The financial means of these state bodies are higher and sometimes augmented by international organizations. Their activities are being taken over by private companies with sufficient capital and an interest in the profits to be made from the plantations. Inhabitants, often with support from international organizations or national reforestation programmes, are becoming involved in forest projects over smaller areas, but many families, especially the poorest, cannot do so.

Given the lack of disposable income, family plantations are often small and multi-aged. Villagers in the coastal plain have received no financial support to plant the few lands available. The first beneficiaries were inhabitants in the hills, where savannah lands were extensive and are now replaced by vast planted forests (photograph 1). Today, all the areas around the villages studied include some plantations, which are owned by some of the villagers on the lands closest to villages, and by the state bodies on the more distant slopes. The plantations are now spreading higher up the mountain. People able to make the initial investment are willingly planting trees. With their profits from the first cut, they extend the planted areas, sometimes to the detriment of the non-irrigated crops that are often grown in amongst village plantations; plantation incomes take longer to materialise but are more substantial, especially when cassava or non-irrigated rice are co-planted in the first year, which also facilitates maintenance of the plots. The only crop competing with the forest plantations is rubber, on the gentler slopes.

**Photograph 3.**

Hybrid *Acacias*, obtained by cuttings in the forest nursery of Hai Cat. They are often obtained by cuttings, rarely by seeds due to the risk of regression (GALIANA *et al.*, 2003). They are favored by the forest nursery of Hai Cat, founded in 2003 thanks to the support of the French Nord-Pas-de-Calais region (1,5 million seedlings on the 2 millions annually produced), Forest nursery of Hai Cat, 2005. Photography A. Robert.



**Photograph 4.**

Hybrid *Acacias* are the only seedlings growing in the nursery of Phong Điền SFE, Phong Điền SFE, 2005. Photography A. Robert.



**Photograph 5.**

A short-term income: six years after planting, acacia can be felled. Yet, here is *A. auriculiformis*, which has a slower growth: trees, mixed with some eucalyptus, were planted 14 years ago by Khe Tre SFE in the framework of a governmental plantations programme; after clear-felling, land will be allocated to the households, Territory 3 of Khe Tre, 2006. Photography A. Robert.

## Improving environmental quality in the short and long term

### Rapid restoration of forest cover and improved soils at local level

*Acacia* spp. is being planted by all the different stakeholders in savannah lands where spontaneous reforestation was apparently being inhibited (photograph 7) by over-exposure to sunlight, competition from heliophyllous species, the lack or remoteness of seed trees, but also the human pressure and possibly also by edaphic degradation resulting from the use of defoliants during the war (PHUNG TUU, 2002; TRAN *et al.*, 2007; ROBERT, 2008). Only four years after planting, *Acacia* spp. provides tree cover at least 8 metres in height (photograph 2), with an understorey of shade-loving and especially herbaceous vegetation. The heliophyllous suite (photograph 1) gradually disappears except at forest edges (photograph 2) or in rare cases where trees remain sparse. *Acacia* spp. therefore helps to rapidly restore forest cover, including in areas that were defoliated during the war.

On the hillsides closest to the plain, the severely eroded soils have been impoverished for centuries by human pressures (photograph 7). *Acacia* spp. is helping to restore their fertility thanks to the symbiotic relationship between its nodulated roots and rhizobial bacteria fixing nitrogen in the soil. In hybrid acacias, these root nodes are two to four times more heavy and numerous than in related species (LE DINH, 2009). In plantations, however, the atmospheric nitrogen fixing properties of *A. mangium* is mostly inversely proportional to the nitrogen content of the soil (GALIANA *et al.*, 1996). This is increased by acacias thanks to their leaf litter, which averages 50% of fixed nitrogen (*ibid.*) in the case of *A. mangium*. The production of *A. mangium* and *A. auriculiformis* leaf litter over 7 to 8 years is comparable to that in moist tropical forests in soils of low to average fertility (BERNHARD-REVERSAT *et al.*, 1993). The provincial authorities, in citing this as a reason for abandoning eucalyptus in favour of acacia plantations (SNNVPTNT, 2002), are thus showing concern for improving soils and for the environment more generally.

### Increasing forest cover at smaller scales

Acacia plantations are helping to increase forested areas (figure 4). This pattern of recolonisation, spearheaded by fast-growing heliophyllous species, is also fostering the reintroduction, through plantations, of local shade-loving woody species. Initiatives such as these, successfully conducted by provincial forest authorities, accounted for 12.9 % of planted forests in 2000 (figure 3). However, local populations cannot take on projects of this type as they demand large investments, which will provide no returns for several decades. Could planted forests not be considered as a step towards spontaneous (this adjective is considered here as opposed to “managed” or “planted”, without excluding a possible past or present human pressure, unlike “natural”) forest regeneration, in cases where there are enough seed trees in the vicinity?

## Surveillance is essential to avoid risks of environmental degradation

### In the short-term, planted forests are vulnerable and prone to erosion

In 1997, the Vietnamese government imposed a blanket ban of unspecified duration on all logging in the province's spontaneous forests, which meant that compensation had to be made to protect the livelihoods of local populations and SFE income. It was decided to give priority to fast-growing single-species plantations to provide a short-term source of income. The process has been slow to materialise in the province, for two reasons. The inhabitants are still dependent on produce gathered in spontaneous forests because they do not all own planted forests or because the plantations are still too recent. Planted forests dominated by hybrid Acacias cannot meet the high demand for construction timber, and some forest owners are still felling trees in spontaneous forests. They were in the majority of 1990, but only a minority of villagers were involved in the practice by the time of this study. Firewood is now only collected in planted forests, three to four years after planting. In the areas around the villages with plantations of this age or more, spontaneous forests are regenerating and savannah lands are evolving towards the pre-forest stage. At national scale, it appears that spontaneous forest areas began to spread as soon as the reforestation programmes were introduced *circa* 1990 (figure 4). The time that elapsed before felling precludes any relationship of cause and effect. In fact, these programmes were accompanied by site work to assist spontaneous forest regeneration and, especially, the spontaneous forests were too remote to be used by most of the villagers as before. It is only in the long term that planted forests can be expected to attract populations away from spontaneous forests and to generate income to protect, preserve and extend them.

Planted forests are often criticised for their lack of biodiversity, which makes them very different from natural rain forests (ROCHE, DE KONINCK, 2001). Although it can be argued that plantations are preferable to savannah, the criticism is irrefutable where biodiversity is concerned. Even-aged single-species forests are also more vulnerable to dry-season forest fires (photograph 8) as well as to diseases and proliferating insect pests. Nevertheless, hybrid Acacias appear to be less vulnerable to the heart rot that affects *A. mangium* (GALIANA *et al.*, 2003; LEE, 2004). Acacia forests are also more vulnerable to storm damage (photograph 9). Hybrids appear to be more resistant, as they are more deeply rooted than related species (LE DINH, 2009). The inhabitants of Binh Lộc nevertheless prefer *A. mangium* for its greater resilience.



**Photograph 6.**

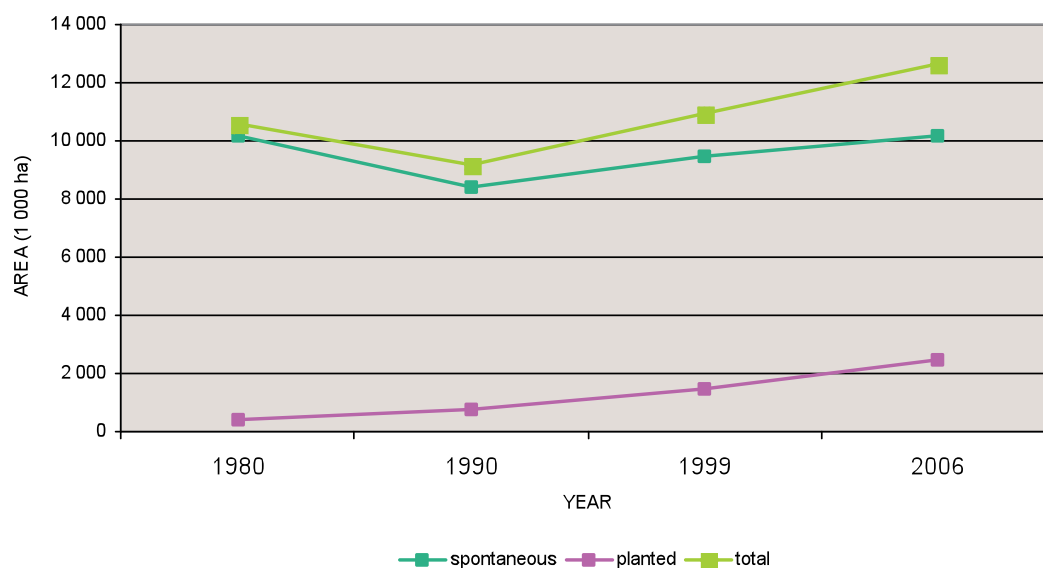
Acacia, a source of firewood three years after planting, Binh Lộc, 2007.  
Photography A. Robert.



**Photograph 7.**

On the hillsides closest to the plain, acacias grow and restore fertility of the soils impoverished by a secular anthropic pressure, Hiền Sĩ, 2006.  
Photography A. Robert.





**Figure 4.**

Evolution of forests in Vietnam, 1980-2006. The forest area increases thanks to the progression of planted forests and thanks to spontaneous recovery. According to data of PHUNG TUU (2002) and Gso (2007).



**Photograph 8.**

Hybrid *Acacias* forest devastated by fire, Territory 3 of Khe Tre, 2006. Photography A. Robert.

The tree cover provided by plantations slows down erosion in savannah lands in the province's rugged landscape where rainfall can be as high as 3,000 mm a year, especially in the Bạch Mã national park area in the southeast. Erosion here amounts to some 6 t/ha/year under forest cover, as against 50 t/ha/year after deforestation (MPA, 2003). Despite this, plantations are clear-felled (photograph 5) in the months of January to August. Cutover plots are often replanted only in December, for optimal results, and sometimes later if their private owners cannot immediately invest in new cycle. The soil then begins to erode (photograph 10). Although frequent burning of logged-over plots encourages spontaneous regrowth of acacias, the authorities are now repressing this practice, which dries out soils and threatens adjacent spontaneous forests. Encouraging families to adopt more selective practices would limit erosion, provide more regular income and would even be more profitable, since clear-felling of plantations, which are often of mixed age, removes their immature trees. Selective logging is a more difficult prospect for the vast SFE plantations, but it is nevertheless mandatory for protective forests planted on steep slopes. In productive forests, although these are clear-felled as a rule, some SFE are now leaving misshapen and too small trees where they stand.

### In the long-term, planted forests may jeopardise spontaneous reforestation

Before the Ministry of Agriculture and Rural Development (MADR) restricted forest plantations to savannah lands, young forest formations and even secondary forest were sometimes cleared to make way for “economic forests”. As one employee of the Forest Inventory and Planning Sub-Institute (Sub-FIPI) admits, there are still moves to return to this policy, including among the forest authorities, since several SFE are giving priority to profit over sustainable forest management and biodiversity conservation, which they leave to the management boards of protected forests. In this respect, far from helping to protect spontaneous forests, plantations can be an aggravating factor, and to avoid this, they require supervision. But they are hampering spontaneous reforestation even in the present-day context: spontaneous forest might have recolonised planted savannah lands, especially if there were nearby seed trees. Forest rangers are now banning plantations in savannah lands adjacent to spontaneous forests or where a few good-sized trees are growing. The MADR also recently decided to restrict plantations to areas felled for crops, excluding those felled for timber.

*Acacia* spp. has a broad ecological range, which accounts for its ready spontaneous growth. These heliophyllous species do not colonise spontaneous forests but are often found in savannah lands near plantations (photograph 11), and even more frequently in reforested plots where wood is already being cut, since germination of the seeds is encouraged by the fires used to clear the land. Young acacias then become established, compromising future land-use changes. They could therefore become invasive if any spontaneous forest close to plantations were burned, by delaying the reappearance of local species. Whether acacias are an invasive species is arguable, as data is lacking. LEE (2004) observes that it is, but uses this argument to refute the invasiveness sometimes attributed to *A. mangium*, on the grounds that in Malaysia, the species has not invaded any “natural” forests. OSUNKOYA *et al.* (2005) confirm that forests where there is little human interference do not tend to be invaded by acacias. Nevertheless, the heliophyllous *A. mangium* is clearly invasive, especially in full sunlight, for example in forests disturbed by drought and fire, as observed by the same authors in Brunei. It is therefore important to keep a check on the spontaneous expansion of *Acacia* spp. to limit the risk of invasion, particularly in view of its increasing prevalence in the province, in Vietnam, even in Southeast Asia, where the acacia plantations, especially *A. mangium*, occupy about 600,000 ha (GALIANA *et al.*, 2003).

## Conclusion

A high-quality forest policy implies the involvement of local populations and consideration for the economic and financial value of forested lands without disregarding their ecological value. Planted acacia forests, over and above the resources they provide, help to improve the environment, when they're established in degraded ecosystems. They enrich soils, increase forest cover and attract populations away from spontaneous forests. The limitations of even-



**Photograph 9.**

Acacias uprooted or topped by a storm. Here, *A. auriculiformis* planted in 1999 by the Phú Lộc service belonging to Forest Protection Department, Phước Hưng, 2007. Photography A. Robert.



**Photograph 10.**

Clear-felling: an erosion risk? Here, the cutover plot, private, will be replanted only during the next rainy season, Bình Lộc, 2007. Photography A. Robert.

aged single-species forests are now well known: increased vulnerability to various pests, risks of erosion after clear-felling, and preventing spontaneous reforestation, etc. The success of the policy introduced for forest protection will depend on the State's level of commitment. Acacia plantations can still remain high-quality forests, in Thừa Thiên-Huế, in Vietnam as a whole and even in the South-east Asian countries that have opted for reforestation of this type.



**Photograph 11.**

*Acacia* spp.: invasive species? They colonize spontaneously the savannah lands near plantations, Con Tôm Hồng Hạ, 2007. Photography A. Robert.

## References

- BRÉDIF H., 2008. La qualité : un opérateur de durabilité. *In*: DA LAGE A., AMAT J.-P., FREROT A.-M. *et al.* (dir.), 2008. L'après développement durable – Espaces, Nature, Culture et Qualité. Ellipses, Paris, France, 323-330.
- BERNHARD-REVERSAT F., DIANGANA D. et TSATSA M., 1993. Biomasse, minéralomasse et productivité en plantation d'*Acacia mangium* et *A. auriculiformis* au Congo. *Bois et forêts des tropiques*, 238 (4) : 35-44.
- DE KONINCK R., 1998. La logique de la déforestation en Asie du Sud-Est. *Cahiers d'Outre-Mer*, 51 (204) : 339-366.
- FAO, 2009. Forestry country profiles: Vietnam. Description of plantation resources. <http://www.fao.org/forestry/country/18316/en/vnm/>, consulted in 2009/02/22.
- GALIANA A., GOH D. K. S., CHEVALLIER M.-H., GIDIM, 2003. Micropropagation of *Acacia mangium* x *A. auriculiformis* hybrids in Sabah. *Bois et forêts des tropiques*, 275 (1): 77-82.
- GALIANA A., N'GUESSAN KANGA A., GNAHOUA G.-M., 1996. Fixation de l'azote chez *Acacia mangium* en plantation. *Bois et forêts des tropiques*, 249 (3) : 51-62.
- GSO (General Statistics Office), 2007. Statistical yearbook of Vietnam 2006. Statistical Publishing House, Hà Nội, Việt Nam, 804 p.
- LE DINH K., 2009. The role of Acacia Hybrids in the Reforestation Program in Vietnam. Research Centre for Forest Tree Improvement - Forest Science Institute of Vietnam, <http://www.acacia-world.net/html/vietnam.html>, consulted in 2009/02/22.
- LEE S. S., 2004. Maladies et menaces potentielles des plantations d'*Acacia mangium* en Malaisie. *Unasylva*, Vol. 55 2004/2, n° 217 : 31-35.
- LOCATELLI B. *et al.*, 2003. Les plantations forestières au service du développement durable des pays tropicaux ? *In* : FAO. La forêt, source de vie : XII<sup>e</sup> Congrès forestier mondial, 21-28 septembre 2003, Québec, Canada, 9 p.
- MPA (Mekong Protected Areas), 2003. Thua Thien Hue Province. *In* : Field Study: Vietnam, p. 103-142.
- OSUNKOYA O. O., OTHMAN F. E. et KAHAR R. S., 2005. Growth and competition between seedlings of an invasive plantation tree, *Acacia mangium*, and those of a native Borneo heath-forest species, *Melastoma beccarianum*. *Ecological Research*, 20: 205-214.
- PHUNG TUU B., 2002. Inland plant ecology. *In*: WESTING A. H. *et al.*, 2002. Long-term Consequences of the Vietnam War. Report to the environmental conference on Cambodia, Laos, Vietnam. 2002, July 26-28. Föreningen Levande Framtid, Sweden, 5-7.
- ROBERT A., 2008. Conséquences environnementales d'une guerre chimique : la guerre du Việt Nam (1962-1971). Expositions scientifiques, Festival International de Géographie, 2-5 octobre, Saint-Dié-des-Vosges, France.
- ROBERT A., 2007. A field study to understand the responsibility of the war in the deforestation process in Thừa Thiên Huế province. *Tropenbos International-Vietnam Newsletter*, august: 3.
- ROCHE Y., DE KONINCK R., 2001. Les enjeux de la déforestation au Vietnam. *Vertigo*, Vol. 3, n° 1. <http://vertigo.revues.org/4113>, consulted in 2004/01/17.
- SNNVPTNT (Sở Nông Nghiệp và Phát Triển Nông Thôn [Agriculture and Rural Development Department]), 2002. Báo cáo lâm nghiệp. Báo cáo thực trạng và các vấn đề lâm nghiệp tỉnh Thừa Thiên Huế [Forest report. Forest states and problems in Thừa Thiên Huế province.]. Huế, Việt Nam, 55 p.
- TTHSO (Thua Thien Hue Statistical Office), 2005. Statistical Yearbook 2004. Huế, Việt Nam, 294 p.
- TRAN T., AMAT J.-P., PIROT F., 2007. Guerre et défoliation dans le Sud Việt-Nam, 1961-1971. Aux sources de l'histoire. *Histoire & Mesure*, XXII-1 : 71-107.
- TRAN T., 2006. Les perturbations anthropiques contemporaines dans les mangroves du Sud Việt-Nam. *Entre Nature, Civilisation et Histoire. Approches par modélisation et analyse spatiales.* Thèse dirigée par J.-P. AMAT, Université Paris IV-Sorbonne, France, 605 p. + annexes.
- WCA (World Agroforestry Centre), 2009. *Pinus merkusii* / *Acacia auriculiformis*. <http://www.worldagroforestrycentre.org>, consulted in 2009/02/22.