INTRODUCTION

Management of forest resources is now facing the challenge of meeting the needs of sustainable forest products that continues to increase, not only in terms of quantity and quality, but also diversity of species composition. Indonesian forest conditions have been severely damaged, due to over-exploitation, land conversion, forest fires, and illegal logging (Tsujino, Yumoto, Kitamura, Djamaluddin, & Darnaedi, 2016). Activities such as land concession appeared to contribute to the declining of forest size and quality which in turn resulted in the decreased harvest of timber in the second cutting cycle.

Forest health is influenced by complex and interacting factors, such as pests and pathogens that can cause death and disturbing the balance of forest ecosystems (Castello & Teale, 2011). The development strategies of forest protection are often confronted against the low values of forest compared to crop plantations or agriculture, the large size and the diversity, the difficult access to the location and its distribution, and the long life (Sumardi & Widyastuti, 2007). On the other hand, the progressively increasing human needs demand more productive management.

Agroforestry is a combination of agricultural crops and forest tree. The combination in agroforestry raises the risks and opportunities of interferences such the pests and pathogens and also other natural enemies to exist (Schroth, Krauss, Gasparotto, Duarte Aguilar, & Vohland, 2000). Agroforestry alone can not solve all the problems associated with land management and also the application of agroforestry techniques on the land use optimization (Huxley, 1999). Agroforestry in which there are annual crops and trees, does not rule out the possibility of competition. Competition is defined as the interaction between individuals, by a shared need for resources in a limited supply, and leads to the reduction in endurance, growth, and reproductive competition among individuals (Speight, Hunter, & Watt, 1999). The occurrence of the disease can affect the production and utilization of trees and plants by reducing plant health and directly reducing yield, quality, or storage.

In Indonesia, the trees are cultivated by homegarden and dry field management which seems very simple and conventional. Homegarden and dry field is a form of agroforestry practices which its management is far from optimal. Trees,
fruits, shrubs, vegetables, medicinal plants and other crops where contribute staple food crops is from homegarden (Kumar & Nair, 2004). This study aims to provide information about the trees health and the system of agroforestry in homegarden and dry field to optimize the utilization of land and finally will produce a high yield.

MATERIALS AND METHODS

This study was conducted from Juni 2011 to Januari 2012 in Kulon Progo Regency, Yogyakarta province, where representative homegarden-dry field practices developing in Java. The method undertaken for this study was a Forest Health Monitoring Health Monitoring (FHM), an assessment of tree stands health by classifying the type and degree of damage per individual tree (Alexander & Barnard, 1994). The method undertaken was intended to make a statement on the forest ecosystems health status and trends.

Site and Sampling Selection

The research site was selected by purposive sampling method. The selected village area for sampling was categorized into three zones according to their altitude, namely: a low altitude (< 300 meters above sea level (asl), medium altitude (300-600 m asl) and high altitude (> 600 m asl) (Priyono, Sunarto, Sartohadi, & Sudibyakto, 2011). Each sample taken by each zone is three villages selected based on major commodities. Determination of land sample is taken based on land area, it is expected to represent data to be taken, that is a small area (<1000 m²), medium area (1000-2000 m²), and large area (> 2000 m²). The land area here is the land area owned by the respondents which include dry field and homegarden. Each class of an area is selected by 2 (two) respondents. So the total plot of the order is 108 plots.

Observation Plots

Sampling plots with the size of 20 m x 20 m (0.04 ha) were laid at the homegarden and dry field which selected by purposive sampling. The data were collected from both sites. Each tree in the plot is measured and observed the extent of the damage. Various measurements of trees were recorded based on Table 1, Table 2, and Table 3.

Assessment of Damage of Trees

The data was collected by assessing the damage on the selected samples. The symptoms of damage and the intensity of the attack were observed and measured. The damages were assessed using FHM method by observing the trees from all directions starting from the root.

Damage Site on Part of Trees

The site of damage that found on each tree were categorized according to the modification of Alexander & Barnard (1994) was presented at Table 1.

<table>
<thead>
<tr>
<th>Code</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>No damage</td>
</tr>
<tr>
<td>1</td>
<td>Root (opened and stump)</td>
</tr>
<tr>
<td>2</td>
<td>Root and lower trunk</td>
</tr>
<tr>
<td>3</td>
<td>Lower trunk</td>
</tr>
<tr>
<td>4</td>
<td>Lower and upper trunk</td>
</tr>
<tr>
<td>5</td>
<td>Upper trunk</td>
</tr>
<tr>
<td>6</td>
<td>Crown trunk (main stem that supports crown)</td>
</tr>
<tr>
<td>7</td>
<td>Branches</td>
</tr>
<tr>
<td>8</td>
<td>Buds and shoots</td>
</tr>
<tr>
<td>9</td>
<td>Leaves</td>
</tr>
</tbody>
</table>

Damage Types

The type of damages of the tree caused by the biotic and abiotic factor according to the modification of Alexander & Barnard (1994) was presented at Table 2.

<table>
<thead>
<tr>
<th>Code</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>01</td>
<td>Canker or skin and cambium death which followed by the death of the wood inside the bark.</td>
</tr>
<tr>
<td>02</td>
<td>Present of fruitbody as indicators of decay</td>
</tr>
<tr>
<td>03</td>
<td>Open wound, skin peeling but no extensive decay</td>
</tr>
<tr>
<td>04</td>
<td>Resinosis or gumosis, damage with resin / gum excretion on the trunk or branches</td>
</tr>
<tr>
<td>05</td>
<td>Gall rust</td>
</tr>
<tr>
<td>11</td>
<td>Broken trunk or root (located 0,91 m from trunk)</td>
</tr>
<tr>
<td>12</td>
<td>Broom in the roots or branches (a bunch of leaves grow at the same site in the branches or roots).</td>
</tr>
<tr>
<td>13</td>
<td>Wounded or dead root</td>
</tr>
<tr>
<td>21</td>
<td>Die back</td>
</tr>
<tr>
<td>22</td>
<td>Broken branch or trunk</td>
</tr>
<tr>
<td>23</td>
<td>Excessive branching</td>
</tr>
<tr>
<td>24</td>
<td>Shoots or buds damage</td>
</tr>
<tr>
<td>25</td>
<td>Change of leaves color</td>
</tr>
<tr>
<td>31</td>
<td>Others</td>
</tr>
</tbody>
</table>
Disease Severity

Damage was recorded if the value of the severity reaches 20% at minimum (Alexander & Barnard, 1994). The classes of severity values were shown in Table 3 (Modification of Widyastuti & Sumardi, 1999).

Table 3. The classes of severity values

<table>
<thead>
<tr>
<th>Classes (%)</th>
<th>Code</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt; 30</td>
<td>1</td>
</tr>
<tr>
<td>30 – 50</td>
<td>2</td>
</tr>
<tr>
<td>50 – 75</td>
<td>3</td>
</tr>
<tr>
<td>&gt; 75</td>
<td>4</td>
</tr>
</tbody>
</table>

Data Analysis

The obtained data were qualitatively and quantitatively analyzed. Qualitatively with description and quantitative by using Cluster Analysis approach with Wards Method (using Software SPSS 16). Size of damage (LS) and the intensity of damage (IS) was calculated using the formula below:

\[
LS = \left( \frac{\text{Number of damaged trees}}{\text{Number of observed trees}} \right) \times 100 \% \\
IS = \left( \frac{(n0 \times z0) + (n1 \times z1) + \ldots + (n4 \times z4)}{N \times Z} \right) \times 100 \%
\]

where:
- LS = Size of damage
- IS = Intensity of damages
- n0 to n4 = Number of trees with damage score between 0 to 4
- N = Total number of trees in one plot
- z0 to z4 = Damage score between 0 to 4
- Z = The highest damage score

RESULTS AND DISCUSSION

Agroforestry Systems in Kulon Progo Based on the Structure and Function

The agroforestry techniques are able to improve the conservation of biodiversity (Schroth, Krauss, Gasparotto, Duarte Aguilar, & Vohland, 2000). In addition to improve the conservation of biodiversity, agroforestry systems also can enhance the ecosystem services provision. In example carbon stock and reduce net emission rates there also agroforestry system contribution (Markum, Arioseseloningsih, Suprayogo, & Hairiah, 2013; Santos, Crouzeilles, & Sansevero (2019) in their experiment showed that agroforestry systems provide more benefit of biodiversity and ecosystem services up to 45-65% than conventional production system.

This study was aimed to examine the management of agroforestry (AF) in the homegarden and dry field that were observed through the agroforestry system chosen by the farmers.

An AF system can be considered as a type of land utilization that specific to a location and describes the composition and structure based on the ecological aspects, the degree of management techniques and characteristics of the socio-economic (Nair, 1997). Therefore, AF system can be categorized according to the structural, functional, socio-economic, and ecological basis.

This study revealed various types of crops grown by the community (Table 4). The high diversity formed the ecological resilience and provides capabilities to enhance the ecological function (Vandermeer, Lawrence, Symstad, & Hobbie, 2002). Agroforestry also influences other ecosystem services, such as pest control (Karp et al., 2013). Generally, the choice of trees planted by the community influenced by socio-economic factors, functionality and ecological, majority purpose plant are for food, fire wood and ornamental plants in the community in Bengkulu, Indonesia (Wiryono, Puteri, & Senoaji, 2016). Then, household economic condition, homegarden investment, sizes of garden, labor investment and market access affect on agroforestry composition and income (Kabir, Rahman, Rahman, & Ando, 2016).

Based on the species composition and spatial arrangement pattern used to determine the AF system in Kulon Progo. The classification spatial arrangement pattern are alternate row, alley cropping, random mixture and trees along borders (Nair, 1993). The homegarden and dry field observed in the study area of Kulon Progo can be grouped into six systems, namely, a) Homegarden agroforestry system 1, b) Homegarden agroforestry system 2, c) Homegarden agroforestry system 3, d) Dry field agroforestry system 1, e) Dry field agroforestry system 2, and f) Dry field agroforestry system 3.

Homegarden Agroforestry System 1

This homegarden agroforestry system is dominated by forest trees and Multipurpose Tree Species (MPTS) plants. A number of multipurpose tree species are widely cultivated in agroforestry system (Bagwari & Todaria, 2011). Teak (Tectona grandis) and mahogany (Swietenia mahogany) were timber commodities that serve as major constituents of this system. Widyastuti, Hadi, &
Table 4. The utilization of tree species in each zone

<table>
<thead>
<tr>
<th>Zone (m asl)</th>
<th>Type</th>
<th>Uses</th>
<th>Tree species</th>
</tr>
</thead>
<tbody>
<tr>
<td>I (&lt; 300)</td>
<td>Homegarden</td>
<td>Fruits</td>
<td>Clove (Syzygium aromaticum), duvet (Syzygium cumini), cacao (Theobroma cacao), mango (Mangifera indica), kenari (Canarium sp.), melinjo (Gnetum gnemon), jackfruit (Artocarpus heterophyllus), petai (Parkia speciosa), watery rose apple (Syzygium aqueum),</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Wood</td>
<td>Teak (Tectona grandis), mahagony (Swietenia mahogany), randu (Ceiba petandra), albizia/batai wood (Falcataria moluccana), trembesi (Samanea saman), Hibiscus sp.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Fodder</td>
<td>Kluwih (Artocarpus camansi), lamtoro (Leucaena leucocephala)</td>
</tr>
<tr>
<td>II (300-600)</td>
<td>Homegarden</td>
<td>Fruits</td>
<td>Avocado (Persea americana), durian (Durio zibethinus), duvet (Syzygium cumini), watery rose apple (Syzygium aqueum), jengkol (Archidendron pauciflorum), petai (Parkia speciosa), manggis (Garcinia mangostana), jackfruit (Artocarpus heterophyllus)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Wood</td>
<td>Akasia (Acacia sp.), dawad (Erythrina variegata), teak (Tectona grandis), mahagony (Swietenia mahogany), rosewood (Dalbergia latifolia), sungkai (Peronema canescens), trembesi (Samanea saman), albizia/batai wood (Falcataria moluccana).</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Dry field</td>
<td>Fruits</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Durian (Durio zibethinus), horse mango (Mangifera foetida), manggis (Garcinia mangostana), petai (Parkia speciosa), jackfruit (Artocarpus heterophyllus).</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Wood</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>albizia/batai wood (Falcataria moluccana), sungkai (Peronema canescens), salam (Syzygium polyanthum), rosewood (Dalbergia latifolia), teak (Tectona grandis), mahagony (Swietenia mahogany).</td>
</tr>
<tr>
<td>III (&gt; 600)</td>
<td>Homegarden</td>
<td>Fruits</td>
<td>Avocado (Persea americana), clove (Syzygium aromaticum), pomelo (Citrus maxima), langsat (Lansium domesticum), jackfruit (Artocarpus heterophyllus), petai (Parkia speciosa), rambutan (Nephelium lappaceum), sawo (Manilkara zapota), sukun (Artocarpus altilis).</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Wood</td>
<td>Albizia/batai wood (Falcataria moluccana), langsat (Lansium domesticum), randu (Ceiba petandra), suren (Toona suren), teak (Tectona grandis), mahagony (Swietenia mahogany), trembesi (Samanea saman), waru (Hibiscus tiliaeaceus).</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Dry field</td>
<td>Fruits</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Avocado (Persea Americana), clove (Syzygium aromaticum), kedondong (Spondias dulcis), melinjo (Gnetum gnemon), horse mango (Mangifera foetida)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Wood</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Albizia/batai wood (Falcataria moluccana), teak (Tectona grandis), mahagony (Swietenia mahogany), trembesi (Samanea saman), waru (Hibiscus tiliaeaceus).</td>
</tr>
</tbody>
</table>

S. M. Widyastuti et al.: Tree Health Typology in Kulon Progo

Wahyuono (2018) also mention that most teak was planted on homegarden agroforestry system in Kulon Progo. The non-timber trees that widely cultivated in this system are banana and coconut trees. This type of AF system located in zone 1 with an altitude below 300 m asl, the trees cultivated here was could be easily adjusted to their original habitat. People who live in low altitude areas have a higher priority for in the cultivation of agricultural crop using Surjan system. Surjan system is a cultivation method that allows one or more species of plants cultivated in a single plot (Nurcholis & Supangkat, 2011). Agroforestry pattern based on the spatial arrangement of this was a random mixture (Fig. 1). The community usually planted the trees to utilize the vacant space in the home yard.
The homegarden agroforestry system 2 was dominated by forest trees and MPTS plants. The major timber constituents of this type are mahogany and batai wood, while the dominant MPTS plants are fruit trees such as durian and jackfruit. This AF system located in the middle terrain with an altitude between 300-600 m asl. The spatial arrangement in this system was dominated by random mixture pattern, utilizing every available land for planting (Fig. 2).

Homegarden Agroforestry System 3

The homegarden agroforestry system 3 was dominated by forest tree, estate crops, and MPTS plants. The major timber constituent of this type is mahogany and clove tree is the dominant of estate crops. Clove is a commodity that serves
as a source of income for farmers in this area. Fruit trees cultivated in this AF system are jackfruit and avocado trees. This AF system located at an altitude above 600 m asl. The spatial arrangement pattern in this system was a random mixture (Fig. 3).

**Dry Field Agroforestry System 1**

This agroforestry system was dominated by forest trees and MPTS. The forest tree constituent of this type of AF system was dominated by teak, while the MPTS was dominated by *Gnetum* sp.. The estate crops that widely cultivated in this system were cacao. Oke & Odebiyi (2007) stated that the cacao-based agroforestry systems were able to provide more capacity for the production of wood and fruits. Cacao was widely cultivated in this area as it located at an altitude above 600 m asl, therefore it provides the optimal condition for cacao to grow and eventually provide more benefits to farmers. The spatial arrangement of this system was trees along the border (Fig. 4), because of its combination with agricultural crops. This system was located at an altitude below 300 m asl in the same level with level homegarden agroforestry system 1. The land management in this dry field system was not a priority for the communities.

**Dry Field Agroforestry System 2**

This agroforestry system was dominated by forest trees and MPTS. The dominant forest tree constituents were teak, mahogany and batai wood. The most cultivated fruit trees were durian and mango trees. This AF system was located at an altitude between 300-600 m asl. The spatial arrangements of this system were a random mixture and alternative rows (Fig. 5).

**Dry Field Agroforestry System 3**

This agroforestry system was dominated by forest trees, estate crops and MPTS. The dominant forest tree constituents were batai wood and mahogany, while the MPTS was dominated by clove trees. The most cultivated fruit trees in this system were jackfruit and avocado trees. Hani, Indrajaya, Suryanto, & Budiadi (2016) mentioned that agroforestry system in dry land Kulon Progo is dominated by batai wood on the shading less than 70 %. This AF system was located at above 600 m asl. The general spatial arrangement of this system was a random mixture (Fig. 6).

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*Fig. 3. Homegarden agroforestry system 3 with random mixture pattern at altitude more than 600 m asl: 1) mahogany; 2) clove tree*
Fig. 4. Dry field agroforestry system 1 with trees along the border pattern at altitude less than 300 m asl: 1) teak

Fig. 5. Dry field agroforestry system 2 with random mixture and alternative rows pattern at altitude 300-600 m asl; 1) batai wood; 2) mahogany and 3) teak

Damage Type on Agroforestry System in Kulon Progo

The trees in the homegarden and dry field showed damaged such as the open wound, galls rust, broken branches, leaf spot, excessive branching, gummosis and termite attack. The type of damage on each system has a different intensity. This was caused by an interaction between altitude factor, species composition, spatial arrangement and the agricultural crops. Thus, effect of agroforestry system on pests and diseases not only depend on crop type but also on pest identity, microclimate, and the microclimatic preferences of the pest (Pumariño et al., 2015). Studies have indicated that a modification of micro-climate, hydrology, moisture, humidity, and surface temperature, increases the number of insect pests and pathogens, especially near the tree barrier (Schroth, Krauss, Gasparotto, Duarte Aguilar, & Vohland, 2000).
Fig. 6. Dry field agroforestry system 3 with random mixture pattern at altitude more than 600 m asl; 1) batai wood; 2) mahogany and 3) clove tree

Fig. 7. The intensity of: a) open wound, b) gall rust, c) broken branch, d) leaf spot

Remarks:

a = Homegarden AF system 1 (< 300 m asl, teak and mahogany, random mixture pattern)
b = Dry field AF system 1 (< 300 m asl, teak, alternative rows pattern)
c = Homegarden AF system 2 (300-600 m asl, mahogany and batai wood, random mixture pattern)
d = Dry field AF system 2 (300-600 m asl, teak, mahogany and batai wood, random mixture pattern)
e = Homegarden AF system 3 (> 600 m asl, teak and mahogany, random mixture pattern)
f = Dry field AF system 3 (> 600 m asl, batai wood, mahogany and clove, random mixture and alternative rows pattern)
Other studies pointed out that particular trees which serve as windbreaks or borderline, act as a barrier against pests and pathogens that spread through the air. These trees were able to suppress the attack, therefore they considered to have a protective action (Rao, Singh, & Day, 2000). The types of damage described as follows:

**Open Wound**

The open wound was found on all of the three zones of both homegarden and dry field. This condition shows that open wound damage had high severity therefore should be controlled speedily. The open wound can lead to more severe damage such as stem cancer, as the location of damage was generally in the major part. The highest severity of open wounds damage was found in the homegarden system 3 with the intensity up to 17.9 % (Fig. 7a). This high severity was caused by the environmental conditions of high altitude (above 600 m asl) increase the potential for pathogens to penetrate or infect the injured trees.

**Gall Rust**

Gall rust was found in batai wood. The highest gall rust damage was found in the AF system 3 that located in high altitude (above 600 m asl) with intensity of damage 5 % and 7.9 % found in homegarden and dry field, respectively (Fig. 7b). This damage was a pathogen symptom caused by *Uromycladium tepperianum*. *Uromycladium tepperianum* is a rust fungus that produced severe infections on its hosts (Wood, 2012). The disease has become an outbreak in Java (Rahayu, Lee, & Shukor, 2010), thus batai wood planted in humid condition were susceptible to this rust disease. The rust fungus caused a significant economic loss to plantations of batai wood (Wood, 2012).

**Broken Branches**

Broken branches were found in all of three zones. The damage was categorized as the highest intensity of the damage in the home and dry field system 1 and homegarden system 3. These AF systems were located in the low altitude (below 300 m asl) and in the high altitude (above 600 m asl) (Fig. 7c). These areas were often visited by a strong wind. Additionally, the attacks of pests or pathogens create branches become more vulnerable. Stem borer pests in clove trees cause approximately 1 mm holes in the skin surface of the branches. This condition will make branches become fragile and brittle.

**Leaf Spot**

Symptoms and signs of leaf spot disease in affected trees were generally similar by formed dead areas on leaves (necrosis). The size of necrosis varies from small to large with irregular to a uniform shape. The color of spots or necrotic areas also varies from yellow, brown to black (Anggraeni & Dendang, 2009). The highest severity of leaf spot damage (12.9 %) was found in dry field AF system 3 which located at high altitude (above 600 m asl) (Fig. 7d). The high humidity area is generally favorable for leaf spot causing pathogens, thus the infection and distribution of this type of damage in this area was higher than in the dry area. García-Guzmán, Trejo, Acosta-Calixto, & Sánchez-Coronado (2016) in their experiment said that relative humidity has positive correlation to leaf area damaged (leaf spot) in *Achatocarpus gracilis*.

**Excessive Branching**

Excessive branching is a form of cluster or full-packed of branches produced as numerous branches grow in the same area of the living tree canopy. This type of damage is classified as a vegetative structure or abnormal organ. Excessive branching is a nonharmful damage. This type of damage was found in *jambu* trees grown in the AF system 1 and AF systems 3 (Fig. 8a). Excessive branching generally occurs in trees that do not obtain proper silvicultural treatments.

**Gummosis**

Gum is produced as a response to all types of wound, regardless to the cause, whether it is due to mechanical damage, pathogen or insects attack. The incident of gummosis in all three AF systems was low (Fig. 8b) because gummosis generally occur on the tree stem in response to injury. Gummosis often occurs as a result of cancer and stem borers attack.

**Termites Attack**

Termites attacked many plant species. Termites become economic pests when they start destroying standing trees (Verma, Sharma, & Prasad, 2009). Termites usually build their mud nests started from the basal of the attacked trees and build the tunnels into the living tissue and eventually kill the trees. The highest damage was found on the dry field and homegarden AF system type 2 by 22 % and 19.3 %, respectively (Fig. 8c). The high termites attack in this type of AF system was due to the presence of teak as the major constituent trees. Teak is considered as a preferable host tree for termites. Almost all of the teaks observed in these areas were attacked by termites. Hidayat, Yusran, & Sari (2014) also mentioned that termites are one of the pests that attack teak stands in Donggala.
From the clustering analysis for each cluster formed the following characteristics can be described:

**Cluster One**
Cluster one consists of 3 systems that are AF system of homegarden 1, AF system of homegarden 3 and AF system dry field 3. The pattern of cropping in cluster one has characteristic in a combination of forest plantation and plantation crops compared to other clusters. Cropping pattern is dominated by batai wood, Mahogany, Clove, and MPTS plant. This indicates that this cluster is dominated by varied species compared to other clusters. This cluster also has a high degree of damage compared to other clusters and varied types of non-forestry crops. Cluster 1 is categorized in half-healthy (Typology 2).

**Cluster Two**
Cluster two consists of 1 system that is AF system of dry field 1. The pattern of cropping in cluster two has characteristic in a combination with forestry crop and MPTS. Cropping pattern is dominated by the combination of Teak, Mahogany and MPTS plants. This indicates that this cluster is dominated by lower plant species than other clusters. The pattern of planting in this cluster also has a high damage intensity and the type of non-forestry plant that there is low variation. Cluster 2 is categorized as unhealthy (Typology 3).

**Cluster Three**
Cluster three consists of 2 systems that are AF system of homegarden 2 and AF system of dry field 2. The pattern of cropping on cluster three has a characteristic in a combination of forest crop and MPTS which is higher than other clusters. Cropping pattern is dominated by teak, mahogany, batai wood and MPTS. This indicates that this cluster is dominated by plant species with high variation compared to other

Remarks:
- a = Homegarden AF system 1 (< 300 m asl, teak and mahogany, random mixture pattern)
- b = Dry field AF system 1 (< 300 m asl, teak, alternative rows pattern)
- c = Homegarden AF system 2 (300-600 m asl, mahogany and batai wood, random mixture pattern)
- d = Dry field AF system 2 (300-600 m asl, teak, mahogany and batai wood, random mixture pattern)
- e = Homegarden AF system 3 (> 600 m asl, teak and mahogany, random mixture pattern)
- f = Dry field AF system 3 (> 600 m asl, batai wood, mahogany and clove, random mixture and alternative rows pattern).

Fig. 8. The intensity of: a) excessive branching, b) gummosis and c) termite attacks
clusters. The pattern of cropping in this cluster also has the lowest damage intensity and the lowest attack area compared to other clusters. Cluster 3 is a healthy category (Typology 1). Diversity increase in the homegarden and dry field is influenced by land width, market access and altitude (Suryanto, Widyastuti, Sarthohadi, Awang, & Budi, 2012).

CONCLUSION AND SUGGESTION

There were three typologies of trees’ health in Kulon Progo, such as typology 1, 2 and 3. Typology 1 is healthy with a high variety of species and mixed gardens (Homegarden AF 2 and Dry field AF 2). Typology 2 is Half Healthy with a high diversity of species and mixed gardens (Homegarden AF 3, Dry field AF 3 and Homegarden AF 1), and Typology 3 is Unhealthy with low type diversity and line pattern. (Dry field AF 1). The damages present in the homegarden and dry field were similar which are open wounds, gall rust, termite attacks, broken branches, gummosis, leaf spot and excessive branching.

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