

IDENTIFICATION AND SELECTION GUIDELINES FOR THE SEED SOURCE OF CEMPACA WASIAN

By:

ALFONSIUS THOMAS



MINISTRY OF ENVIRONMENT AND FORESTRY

ITTO PROJECT CFM PD 646/12 REV. 3 (F)

COOPERATION BETWEEN ITTO - BP2LHK MANADO

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EXECUTIVE SUMMARY

Tree quality improvement is an activity to increase forest productivity. Tracking tree provenance and observing its specific silvicultural needs are important steps in identifying the quality of local tree. As superior trees hoped to inherit superior progeny, the trees then can be used as seed sources for genetic and/or phenotypic improving purposes.

Seed is a progeny used for propagation purpose that usually has treated to increase its viability. Tree as seed sources is an individual tree that naturally growth or planted of certain species in an elected groups of stand, established and managed to produce qualified seeds.

Good quality seed demand is now increased by the time because of the increase in planting area of self-support community for community forests, industrial forests and for greening and land rehabilitation purposes. Through the program of "Seed for People", forestry department has been developing qualified seeds through establishing qualified forest stand to support the demand.

The aiming point of this research are to identify and to establish seed source location of Cempaka Wasian on six regencies in the Celebes Island (four regencies in North Celebes Province and two regencies in South Celebes Province).

The elected seed sources could be obtained from natural forest or planted forest that formerly did not preserved as seed sources. The election of seed sources was held as a response to the unavailability of qualified seeds that urged to be planted. The effort in preparing seed sources could be based on the statute of needed seed sources for developing purpose. It means that if the needed seed sources is not available yet, then the effort could be planned in a short term, middle term and long term purposes. Whereas, if the seed source of a certain species is available at a certain level of classification, then the effort that should be done is increasing the level of a stage higher than the preceding one in order to get the desired genetic quality.

The wood of Cempaca “Wasian” *Magnolia tsiampacca* (L) Figlar & Noot., tree is one of several commercial woods that has high economic values especially for traditional house. It is now categorized as a rare tree to be found in natural forest. That is why that Sulawesian people in several areas have been planting the tree since several decades ago like done by the people of North and South Sulawesi.

Based on research findings, stand location of Wasian (*M. tsiampacca* (L) Figlar & Noot., that established for seed sources in Sulawesi (North and South Sulawesi) are:

1. **Toulumuten** plantation, Minahasa Regency, Subdistrict Tondano Timur, political district of Kinar administered by the lurah. (North Sulawesi),
2. **Yayasan Masarang** plantation, Tomohon City, Subdistrict Tomohon Selatan, political district of Pinaras administered by the lurah. (North Sulawesi) ,
3. **Raruman** plantation, South Minahasa Regency, Subdistrict Tareran, Rumoong Atas II Village. (North Sulawesi),
4. **Lesung** plantation, South East Minahasa Regency, Subdistrict Tombatu, Tonsawang Village. (North Sulawesi),
5. **Tondok** plantation, Tana Toraja Regency, Subdistrict Sa’dan Balusu, Sangkaropi Village. (South Sulawesi), and
6. **Lempe** plantation, Tana Toraja Regency, Subdistrict Kapalapitu, Lolai Village. (South Sulawesi).

PREFACE

Demand of superior and qualified tree seeds is now high enough to supply for self-supporting basis community, community forest, industrial forest, and for greening and land rehabilitation purpose. To produce qualified forest stand, through the program of "Seed for People" developed by the Indonesian Forestry Department, the department is now using qualified tree seeds.

Seed from superior tree is one of the tree materials that can be used for propagation purpose. The superior tree that produce seeds can be individual or groups of trees that naturally growth in forests, planted in forest land and/or planted in farm/garden area. To be a tree or group of tree as seed sources, it needs certain verification and management as the tree or trees for seed sources produce qualified seeds.

Champac woods, especially Cempaca Wasian (*Magnolia tsiampacca* (L) Figlar & Noot., is now strived for Minahasan tradisional house, furniture and other purpose materials by small holder and property companies, craftmen and others. Starting from several decade ago, in natural forests, the Wasian tree was decreased in number and in diameter because of overharvesing, even now, it is very rarely to find the trees with diameter larger than 30 cm. That is why since year 1990's, much people started to plant the tree.

For many years, efforts of planting the Wasian tree are not supported by qualified seeds, and it is presume that in the near future, there will be produced unqualified Wasian wood. For long term purpose planning, in order to produce qualified Wasian wood, efforts in increasing its wood quality has started by doing this reseach.

Determination of Wasian stand on six locations in Celebes Island is an important step to start making qualified and superior seed to ensure sufficient seed stock to be supplied to whom that needs the seeds. The determination of seed sources from selected trees on the six locations is just for seed collection purpose. This is because of the trees owned by local people who can cut the trees at anytime they want.

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Alfonsius Thomas

Consultant National ITTO

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A. INTRODUCTION

1. Background

Tree quality improvement is an activity that related to genetically and or phenotypically improve partial or the whole tree performance. In general, certain woods from trees traditionally and locally used for building materials and furnitures with attractive motives and heavy-duty have good prospects to be improved. Currently, there are several tree species that planted by local people in monoculture or in agroforestry system. One of them is Cempaka Wasian (*Magnolia tsiampacca* (L) Figlar & Noot. Tracking tree provenance and observing its specific silvicultural needs are important steps in identifying local tree superiority. As superior trees hoped to inherit superior progeny, the trees then can be used as seed sources for genetic and/or phenotypic improving purposes.

Seed from superior tree is one of the tree materials that can be used for propagation purpose. The superior tree that produce seeds can be individual or groups of trees that naturally growth in forests, planted in forest land and/or planted in farm/garden area. To be a tree or group of tree as seed sources, it needs certain verification and be managed as the tree or trees for seed sources to produce qualified seeds.

Demand of superior and qualified tree seeds is now high enough to supply for self-supporting basis community, community forest, industrial forest, and for greening and land rehabilitation purpose. To produce qualified forest stand, through the program of "Seed for People" developed by the Indonesian Forestry Department, the department is now using qualified tree seeds.

The determining of the seed source stand for Cempaka Wasian is the first step in creating a good quality of Cempaka Wasian seed stand, so in the future the needs of good quality Cempaka seed can be fulfilled that in the end the productivity or the quality of the Cempaka wood can compete and can be one of the favourite wood commodity species.

Champac woods, especially Cempaka Wasian (*M. tsiampacca* (L) Figlar & Noot.), is now strived for Minahasan tradisional house, furniture and other purpose materials by small holder and property companies, craftmen and others. Starting from several decade ago, in natural forests, the Wasian tree was decreased in number and in diameter because of overharvesing, even now, it is very rarely to find the trees with diameter larger than 30 cm. That is why since year 1990's, much people started to plant the tree.

Demand of superior and qualified tree seeds is now high enough to supply for self-supporting basis community, community forest, industrial forest, and for greening and land rehabilitation purpose. To produce qualified forest stand, through the program of "Seed for People" developed by the Indonesian Forestry Department, the department is now using qualified tree seeds.

2. Purpose

The purpose is to identify and select the Cempaca Wasian seed source to obtain excellent genetic material on building a provenance seed stand in North Celebes.

3. Output And Outcome

The output is identified locations for Cempaca Wasian seed source in six locations, consist of four locations in North Celebes and two other in South Celebes.

The outcome of this research is the availability of excellent seed source that will be the jumpstart in building an excellent provenance seed stand to support the forestry development especially for superior wood.

4. Identification and Selection Method

The research method was surveying method. The survey was done based on information collected from research reports and information from local people regarding the existing of cempaka wasian trees in every planned area. All gathered information on regency level were then verified on fields and established as chosen stands for seed sources.

Establishing chosen stands of the wasian stands was done by "*Ocular Method*" as on plus tree valuation. This is the simplest method where the valuation is based on tree appearance, performance or phenotypic form of each individual. If a tree looked healthy, straight and has good performance in plain view, then the tree is chosen as candidate tree. Another consideration in using this method is that the heritability value of selected trees to be valued is very low, so the only efficient method for further selected valuation is progeny test. This method can also be used if the trees to be valued has high heritability value, because its phenotype reflects its genotype.

Research steps is as follow:

1. Collecting information regarding distribution areas of Cempaca Wasian on six regencies (four in North Celebes and two in South Celebes). The information are research findings, information from

local people and from literature review. Another information was also gained from relevant government offices and from Forestry Technical Implementer Unit (UPT) of that regency.

2. Verifying collected information regarding the Cempaca Wasian trees that gathered from several relevance sources, and then verified further on fields.
3. Measuring and observing Cempaca stand including tree height, diameter and its general appearance on each determined tree of a population.
4. Observing and measuring environmental factors of each Cempaca habitat.
5. Analyzing all gathered data, and then determining which stand to be establish as seed sources.
6. Mapping the stand distribution based on geographic information system.
7. Describing habitat of each established seed source stand.
8. Drafting and finalizing report regarding the six identified and established locations of Cempaca Wasian seed sources.

B. TECHNIQUE TO MAKE A GOOD QUALITY SEED SOURCE

1. Seed Sources Definition

Seed sources are tree stands inside and outside of forest areas that are managed in order to produce qualified seeds. Seed sources can be chosen and be built according to certain principles that related to knowledge of tree physiology.

Chosen seed sources can be originated from natural forests or from planted trees that in the beginning did not established as seed sources because the qualified seeds of certain species are unavailable or limited when required. Or, it can be from establishing seed sources where the seedlings comes from qualified seeds based on advanced silvicultural treatments.

2. Seed Sources Classifications

Based on Forestry Minister Regulation No. P.72/Menhut-II/2009 revised from No: P.01/Menhut-II/2009 regarding implementation of Forest Tree Seeding, seed sources consist of:

1. Identified Seed Stand

Identified seed stand is a natural tree stand or planted stand with average quality that used for seed production where its location are exactly identified. The established stand is categorized as unplanned seed sources. Its seed provenance is usually unknown. The identified seed stand is generally have old trees. So, if a thinning is needed, then the thinning is done with low intensity.

2. Selected Seed Stand

Selected seed stand is a natural stand or planted stand where its trees have quite high phenotypic quality based on their straight bole, light

branching and with no physical defect. This stand is quite similar to identified seed stand. The only difference is on the selected seed stand has better phenotypic quality.

3. Seed Production Area

Seed production area is a chosen and recommended stand to produce propagation material based on phenotypic criteria. The criteria are growing fastly, good log quality and resistant to disease. The genetic of plant individual is controlling level of certain character and its genetic differentiation is still unknown. Other factors that should be considered is population size, initial density of the population, isolation level of the population, accessibility and possibility to protect the forest.

4. Provenance Seed Stand

Provenance seed stand is a mixed offspring from mother trees from a single population. As it is different from provenance test in establishing this stand, it is no need for an experimental design. Provenance seed stand must be isolated from other stands to avoid cross breeding. The main objective of establishing provenance seed stand is to conserve ex-situ its genetic factors. Provenance seed stand from superior provenance that has been produced fruits, can be used as seed sources for establishing forest plantation.

5. Seedling Seed Orchard

Seedling seed orchard is established to form certain population with the purpose of producing superior seed. In establishing seedling seed orchard, it is not separated from field testing activities, it is however should always be combined with progeny testing from its single parent tree. The combination of the different purpose is known as descendant testing of seedling seed orchard. Tree plant that used for descendant testing is converted to seed orchard after one or several selective

thinnings. After the thinnings, seeds produced can directly be picked up from the seed orchard to develop commercial forest plantation.

6. Clonal Seed Orchard

Clonal seed orchard is developed to produce enormous seeds from restrictive number of superior genotype trees. The trees are cloned, and its copies then be collected in a certain population.

7. Hedge Orchard

Hedge orchard is a plantation that developed for cutting propagation material. Hedge orchard is intensively managed by pruning, bending and fertilizing activities for increasing cutting propagation product. Hedge orchard is developed from seed or vegetative materials that collected from plus tree. Hedge orchard development is done on a certain area that will then be used as the producer for cutting propagations.

3. Important Terminology

Plus Tree or Superior Tree ; is a tree that has a good and clearly seen phenotype. Plus tree is an excellent tree individual with desired characters such as straight stem, grows fast, wide diameter, unconical cylinder stem, tight crown, small branching with flat angle, pest and disease resist, Anonimus, (2006).

Phenotype ; is a tree character that is morphologically seen, and is the product of genetic interaction with the environment.

Genotype ; is a composition of individual inheritance, with or without phenotype expression from one or more character. The genotype is mainly determined by the morphology of its parent.

Base population ; is a tree population where trees will be chosen to be taken care for selecting activity to the next generation. The base population can be natural forest or artificial forest.

Breeding population ; is a part of individual collection from the base population that is selected based on the desired quality to be made as the mother that will be kept for the next generation. This population delivers a species from one generation to the next generation.

Production population ; is a population aimed to produce seed or vegetative material for reforestation operational activity. Is a population that consist of some trees (20-30) chosen from breeding population used to produce seed or vegetative propagul for commercial plant creation.

Genetic Gain ; is the average increase of the generation toward the average mother. The result is acquired by the selection of the mother generation. The increasing degree is according to the selection intensity, mother biodiversity, and heritability.

Heritability ; is the degree where a character is more influenced by generation than influenced by environment. The *narrow heritability* is a fraction from total variation caused by the additive gen, like a comparison between the additive fenotype variation and the fenotype variation.

Family ; is an individual produced sexually from the singular tree.

Genetic Drift ; is a randomly change of alél frequency in a population from one generation to the next generation that is caused by the small population.

Character ; is a real and unchangeable difference showed by individual in a group and can be described in : height and diameter, alignment, shape and appearance. The character of an individual is determined by the genetic composition and environment. The selection is based on the desired characters.

Comparing Tree ; is a tree that has a good quality, grows near plus tree, is even-aged and used as a comparing tree to the plus tree.

Candidate Tree ; is a selected tree based on the fenotype but not tested yet.

Elite tree ; is a tree that have passed a suitable test and is proven for the quality, or a suitable tree for certain environment

Inbreeding ; is a generation production that is relatively homozygote by a fertilization of a near family organism.

4. Steps in Obtaining Seed Source

Seed sources preparation can be suited with seed source status of the species that will be developed. When a certain seed sources is unavailable yet, seed sources preparation could be matched with the timing of requirement, whether it is for short term, middle term and/or long term. If seed sources of a certain species is already available on a certain classification of seed sources, then succeeding step to be done is to increase seed source quality to a higher classification in order to get desired genetic quality.

Other efforts that could be done if needed seed sources is not available yet, such as, Leksono. B (2003):

1. Short Term

- a. Seed source determination on a possible classification Identified Seed Stand (ISS), Selected Seed Stand (SSS) or Seed Production Area (SPA) in natural forest or in forest plantation. Distribution potency information of target species in nature and in plantation is needed for good planning purpose.
- b. Increasing in seed source quality to a step higher classification, for instance from ISS to SSS or from SSS to SPA suited with its stand condition and its surrounding environment. Treatment applied to the stand will increase quality of seed that will be produced.

2. Middle Term

- a. On the middle term, provisioning effort of superior seed should be started to be thought. As superior seed will only be taken from seed source that established through tree breeding program, the breeding tests should be started to be prepared. Breeding test on middle term is to build provenance/race test and progeny test. For efficiency, the two test stages is also can be done simultaneously, depending on genetic diversity information of its initial population.
- b. Information and material taken from the breeding test will then be used to develop Provenance Seed Tree (PST) from provenance test, and Seedling Seed Orchard (SSO) and Clone Seed Orchard (CSO) from progeny test.

3. Long Term

- a. On the long term, clone forestry program could be prepared to develop superior clone based on yield of clone test. Clone can

be originated from plus tree based on yield of clone test on the middle term or yield from crossing over between individual that has superior character, for instance, crossing over between individual that has abundant fruit production and fast growing, and with individual that has high rendement and high oil quality, or between individual that has high increment and fast growing, and with individual that has high wood density and low lignin content.

- b. Yield of clone test that acts as seed source of the highest genetic quality can be used to develop Hedge Orchard (HO), to produce vegetative material in developing forest plantation.

5. The Requirements for The Seed Mother Tree

1. Tree Age

A good quality seed must be farmed from an aged tree or the tree must have bear fruit for three to five times. Generally a tree that has not yet reach three bearing period, often producing seeds with low sprout percentage and also low growth ability. It is because the tree that just started to learn on how to bear fruit, the balance of photosynthesis product dividing (food) from the tree, usually dominated by the vegetative growth, so the gereative growth (flower and fruit) just received less food supply. This condition also cause many fertilization failure because the anthers and stamens fall before fertilization occur.

2. The Growing Size of The Tree

The tree growth size means the tree diameter, bole height, and the tree crown size. By the vertical tree dividing criteria in a forest, there will be four growth steps (by the diameters), they are seedling (0 – 1,9 cm), sapling (2-9 cm), pole (10 – 19 cm), and tree (20 cm and above). If we use the tree diameter approach like explained above, there will be so many tree species that grow flowers and bear fruits not just in

the tree growing process, but there are also some of them grow flowers and bear fruits in the sapling and pole growing process. This is because every tree has its own genetic age to grow flowers and bear fruits, and is not depending on the tree diameter. So the use of diameter criteria in determining the mother tree of the seed usually does not use an absolute size, but uses the largest diameter from the group of related trees on the field. For example: If we want to search for Cempaca seed and when we are in the forest area, there are 10 cempacas with the diameter of each tree of 25, 50, 43, 67, 96, 130, 29, 84, 91, and 78 in cm, so the one we must choose is the largest one, that is 130 cm.

But we must notice that the diameter is not the only criteria, yet it must be synchronized or compared with the other growth criteria like the bole height of the tree and the crown size of the tree.

3. Tree Health

The tree health criteria is usually related with the pest or disease attack. The assessment is often based symptoms showed by the tree, like on the leaves, stem, root, and other parts. The symptoms is whether the leaves have shown the trace after being attacked by pest or have been attacked by termites. And whether there were symptoms of disease like fungus, spots on the leaves, and other symptoms. Theoretically, an unhealthy tree often uses the energy produced by the photosynthesis more to the healing process of the tree, therefore the tree just got less energy for growth and generative development. Besides, the tree cells and tissues are damaged so they are inactive to operate in a tree growth control system. This means if the pest and/or disease attack were serious, it is very affecting to the seed quality produced by the tree.

4. Tree Growth Performance

There are so much tree in the forest with bad growth appearances. For example, crooked stem and imperfect crown condition. As the tree genetic theory explained, the crooked tree stem character is a dominant effect from the genetic factor, so it is better not to be used to mother tree of the seed because the generations produced will have a bad stem growth.

5. The Position of Tree Growth

The position requirements or the seed's mother tree location is more focused on the position towards the sunshine in the morning. In the forest there are so much tree that have not receive enough sunshine in the morning because the sunshine is being blocked by the other tree or by the mountain, or the trees are in a deep valley. The sunshine in the morning is effective for the photosynthesis process because it just contains few heat energy so it is effective to be used. In the afternoon, mainly at 12.00 AM and above, the sunshine is having higher heat energy so the plants are anticipating by closing their stomata to prevent damage on the stomata cells and excessive transpiration. Therefore, it is advised for the tree that receives enough sunshine in the morning, must be the choice for the seed's mother tree. And it is even advised for the seed to be collected from the tree crown that receives enough morning sunshine.

6. Seed Source Management

The seed source includes : 1) Provenance Seed Tree (PST), 2) Seedling Seed Orchard (SSO), 3) Clone Seed Orchard (CSO), and 4) Hedge Orchard (HO), Leksono B. (2003).

1. Provenance Seed Tree (PST)

PSS is a seed source that created from a seed which excellence of the provenance has been known. A provenance test is a test that compares the natural seed source (geographic race) and occasionally involves land race (plant) from a plant to gather information about the best provenance or land race in the development area.

The PST creating is for the seed production so the area election, silviculture treatment, selection thinning and the seed handling that will be done are prepared better and well.

The PST building steps are :

1. The seed collection as the PST building material is from the best provenance from the previous provenance test result. The seed is collected in a minimal of 25 mother tree from the best provenance stand.
2. The PST is built by planting the best provenance seed with the nearer beginning planting range so that after the thinning, we could obtain the optimal range between the trees to produce fruit.
3. The thinning is done after the crowns are overlapping each other by cutting the poor quality and the low fruit-producing trees, to manage the optimal planting range for the increasing of fruit production.
4. The isolation lane is made according to Seed Production Area

2. Seedling Seed Orchard (SSO)

The SSO is a seed Orchard that is created by using seeds from selected mothers that is managed and isolated to prevent or decrease the unwanted fertilization of the pollen. Because the SSO is created with the purpose to produce seeds, so the SSO is basically similar to SPA, but the intensity of mother tree selection that is applied is more careful.

We must notice that the SSO building must be identified for every family that will be used.

The SSO building steps are :

1. Seed collection as the material for the SSO building is from the mother tree in a natural forest or artificial forest, or from the plus tree produced by the previous progeny test. The seed is collected in a minimal of 25 mother tree.
2. The progeny test is built from certain design by planting seeds from each family with shorter beginning planting range. The identity of each family must be kept until the selection is done.
3. The selection thinning is held by cutting the tree that has low quality and low fruit production. The selection is held in a family, or among family if needed, so there will be left the best family of trees that can produce many fruit.
4. The isolation lane is made according to the PST
5. To increase the fruit production, a silviculture action is done according to the PST.
6. The seeds from the creating mother tree is collected for the artificial forest program.

3. Clone Seed Orchard (CSO)

The CSO is a seed orchard that is built with a vegetative material, such as branch and bud from the mother tree that is the result from the progeny test to produce generative material. The CSO is basically similar to the

SSO, the difference is in the material used to build both seed orchard, that is from the generative part (SSO) and from the vegetative part (CSO).

The CSO building steps are :

1. The seed collection as the building material for CSO is from the plus tree that passed the previous progeny test. The vegetative material is collected in a minimal of 25 plus trees.
2. The CSO built by the half-sib progeny test is built with a systematic design, with the same planting range as planting seed from each clone by the optimal planting range for fruit production.
3. The CSO built by the full-sib progeny test is built with the same planting range in a cluster (optimal planting range) and wider range between the clusters.
4. The top pruning can be applied to widen the crown and increase fruit production, but it must be done carefully to avoid them being damaged or dead.
5. The isolation lane is made according to the SSO.
6. To increase the fruit production, the silviculture treatment is done according to the SSO.
7. The seed from the creating clone is collected for the artificial forest program.

4. Hedge Orchard (HO)

The HO is the highest quality seed source built from tested materials by clone test to produce vegetative material like vegetative propagation, bud, root, leaf, and plant tissue to propagation good quality seed. The clone used in the test can be from the plus tree that have passed the progeny test or from the nature stand/plant. The HO is built with a purpose to produce vegetative material, so it is built using good quality plant and clone that have a high ability to be vegetatively propagated. This made the HO has the highest genetic quality because it is obtained from the result of clone test and developed by a vegetative propagation

to keep the quality of clone in its generations

The HO building steps are :

1. The genetic material collection to the HO building can be from the plus tree that have passed the previous progeny test to build the clone test or from the natural forest or artificial forest that has a certain quality.
2. The clone test can be built by using some clone to compare the selected clones so that we can see the growing and adaptating ability in their growing area.
3. The good quality clone evaluated from the clone test, is used as the Hedge Orchard building material.

C. TECHNIQUE TO SELECT MOTHER TREE

1. Selection From the Artificial Forest

An individual selection is better done to the even-aged stand or monocultural forest with the comparing tree method. So far the tree individual selection method is the most used. There are some benefits in doing the tree individual selection in an even-aged forest than in an unevenaged forest, or in a mixed forest. First, the breeder can be sure that the age is not in a big difference between the trees, and therefore the age has no effect to the growth difference, shape, disease endurance, and other aspects. Second, the trees grow in the same competition and in the same age, making it easier to determine the comparing tree to decide which tree will be chosen as the plus tree candidate.

In an even-aged forest there is no age difference, while in a natural forest there is. This age difference makes a difference in competition that causing a big difference in the stand volume.

The following are the guides in selecting tree individual, that is generally used on the first generation in a tree breeding program.

1. The search is focused on a stand that has growth above average, high pruning ability, straight, better branch angle, and is better in other character than other stand. The search on a stand population that has good growth is more efficient in finding plus tree candidate. A tree that grows more dominant than the other is one character that can be used to choose as a plus tree candidate.
2. The stand that has plus tree candidate must have similar growing site, because the difference on growing site can affect fenotype.
3. When the selection is held to the artificial forest, information on the suitability of the seed source must be known for consideration on a new seed source creation.
4. On an old stand (end of cycle), the effort in searching the tree must not more than ten to fifteen years from young trees or must not older than the cutting cycle.
5. Selection is held on a low composition stand. The difference in growth speed between species can complicate the selection by competition difference when the stand consists of two or more species.
6. Avoid choosing tree in pole level or has imperfect crown.
7. There is no limit in minimum range for selection area of plus tree candidate, the important thing is the stand has good appearance and the comparing one is available.
8. It is better to choose just one tree to prevent possibility on taking inbreeding tree.
9. Do not choose a tree that is solitary because the probability of inbreeding is very high.
10. Even if a plus tree candidate has a character with many flowers, the character is not used as a main emphasize. A tree can grow

less flower if they receive less sun shine but can grow a lot of flowers if planted on an open area that receives more sun shine.

11. In deciding a plus tree candidate that will be occupied, the trees must be watched generally with a detailed inspection. Therefore, an experienced grader will be needed.

12. The comparing tree method must be used if possible, to choose a plus tree. This method is more efficient in choosing a plus tree candidate because has considered the environmental impact.

The comparing tree method is the most suitable to be used in the plus tree selection on the artificial forest. Principally, this method compares the characters that will be graded among the comparing tree with the plus tree candidate.

The plus tree choosing procedure with the comparing tree method is as follows :

1. Do a quick tour toward a stand in a desired area. The stand that will be selected from the artificial forest must have minimally aged for half cycle.
2. Choose six best tree by the appearance, such as : tall, straight, and healthy. The best tree will be chosen as a plus tree candidate, while the other five is used as a comparing tree. The requirement for a comparing tree is a good growth quality that is similar with the plus tree. A comparing tree must have a dominant crown or a codominant crown. Then measure the parameter that will be graded from the trees.
3. Do a scoring toward the graded characters.
4. Mark the plus tree with a paint and give it tree number and other information such as the tree age. If possible, provide fence to the plus tree for safety.

The scoring method is comparing the grade of measuring result (actual data) with the average grade of the comparing tree, explained as follows :

1. Height

The height comparison result of the plus tree candidate is :

< 10%	scored 0
10-11%	scored 1
12-13%	scored 2
14-15%	scored 3
16-17%	scored 4
18-19%	scored 5
20%	scored 6
> 20%	scored 7

2. Volume

Score is given every 10% increase from the comparison result of the plus tree candidate volume with the comparing tree volume.

3. Crown

Scored subjectively, with a minimal score of 0 and a maximal score of 5, according to the crown appearance of the plus tree candidate compared to the comparing tree.

4. Straightness

Scored subjectively, the score is among 0 to 5, not compared to the comparing tree.

5. Natural pruning

Compared to the comparing tree, if equal is scored 1, and if better is scored 2 or 3 according to scoring.

6. Branch Diameter

Compared to the comparing tree, if equal is scored 0, and if smaller is scored 1 or 2 according to scoring.

7. Branch angles

Compared to the comparing tree, if equal is scored 0, if bigger (flatter) is scored 1 or 2 according to scoring.

2. Selection From Natural Forest

The selection with the comparing tree method is not suitable to be used on the selection in a uneven-aged or mixed forest. This is caused by some reasons, they are :

1. The age of trees are different.
2. The tree spreading is too dispersed so it is difficult to find a comparing tree,
3. There are so many seedlings that grow naturally, so it is possible for the tree that grows near the plus tree candidate has the same genotype, and
4. The stand consists of mixed species.

Generally, the growth of species with broad leaves in a mixed forest is occasionally growing in groups on a specific area, but is spread randomly. If the spreading is too wide will cause a very high environmental difference. Therefore, the choosing of comparing tree is hard to do in a mixed forest or uneven-aged forest. The growth curve in relationship with age is more various, so it is hard to compare the growth characteristic among trees in a mixed stand. The stem shape often significantly different because of the difference in tree age.

1. Regression Selection System

The generally used method in scoring the tree quality of a mixed stand or uneven-aged stand is a regression system. The regression shows the relationship between the scored character with the tree age. Based on the regression method, character quality is often determined according to the fenotype character of the plus tree candidate, without a comparing tree.

2. The Mother Tree System

This system requires a long time, because the chosen mother tree must have passed some test, where the length is minimally half cycle. The first step is obtaining seed from the mother tree, even if it is not as good as the plus tree is a comparing tree system or regression system. Then examine it in a progeny test.

The second step is to propagation vegetatively or generatively to create seed orchard from the best individuals or best family in a previous progeny test. Considering the long time, this system is just suitable when the seed needs is not urgent.

3. The Subjective Grading System

Some people that is familiar with a species think that the selection can just be done by a grader that has a good knowledge about a good quality tree. The requirement is the grader should know the species he or she will grade. This method is usually used for the species with broad leaves, but the success is according to the grader's experience in choosing a good quality tree.

4. Scoring System

The scoring system is the scoring of plus tree candidate by giving points for important characters that will be scored. This system is a modification from an ocular system and grading system. A plus tree candidate is scored by a visual inspection then is given point in every character that is scored. The character that will be scored is measured with a measuring tools, so even if the grader are different, they can do the measurement with the same method. Thus, the score is more measured and is objective because they are using the same measuring tools.

3. Plus Tree Selection Technique

The plus tree selection technique that will be used in a tree breeding program is according to the species and the purpose. The character needed to crafting purpose will be different with the paper making purpose (pulp and paper). Some technique often used in choosing a plus tree are :

1. Ocular Method

This method is the simplest. The choosing of a plus tree is not based on the measurement or the scoring of the character, but is only based on the performance of the tree. If the tree looks healthy, straight, and good with bare eye, then it will be chosen as a plus tree candidate. This method can be used with a consideration that the selected character heritability score is very low, that the selection progress will just be efficient by a progeny test. This method can also used when the heritability score is very high, that the phenotype reflects the genotype.

2. Comparing Tree Method

This method uses the comparing tree as the base determination of plus tree candidate. The comparing tree that is usually used is a good quality tree, has a similar species and age with the plus tree candidate that will be scored. This method will be efficient on a stand with similar age than the different one or a mixed one. This method is usually used with a score combination for a qualitative result.

3. Base Line System

This method is based on the dependent variable and independent variable, for example the height and age of 10-20 dominant or codominant trees in a stand; then the regression line is made. If

the plus tree candidate passes the average score or is located above the regression line, then the tree will be determined as a plus tree. This method will be suitable for uneven-aged stand and mixed stand.

4. Absolute Standard Method

A character, for example the diameter or height, compared to the volume table on the certain bonita. A plus tree must pass the determined standard. A plus tree must also fit the qualitative character of the other, like the stem, branch, and other characters.

4. Important Variables in A Tree Selection

Research variable are tree height (total and free branching heights), diameter, tree age, tree appearance and ecological condition of each habitat. Measured variable in form of quantitatives and qualitatives. Criteria of each variable are as follow:

Stem diameter ; is midst line that measured on 130 cm in height from soil surface or at breast height.

Total height ; is tree height that measured from its soil surface to the tip of its canopy.

Height of free branching ; is tree height that measured fro its soil surface to its first branching.

Criteria applied for qualitative variable are:

Stem form ; is condition of stem whether the stem is globular straight or inglobular bent (globular straight/bent).

Canopy form ; is a condition of branching pattern on canopy whether it is spread evenly or just spereading on certain side of the tree (spread evenly/unevenly).

Stem physical defect ; is a condition of stem and its bark whether there is a scar, hole or rotten (presence/none).

Canopy condition ; is a condition where the canopy are evenly spread and has good branching pattern with dense twigs and foliages (good/average/bad).

Leaf condition ; is a condition of leaf whether it is attacked by pest and or disease (good/bad).

D. TECHNIQUE TO IDENTIFY CEMPACA WASIAN

1. Taxonomy

Based on the taxonomy and the history of Cempaka species naming where Cempaka Wasian is classified under the Order of *Magnoliales*, *Family : Magnoliaceae*, and *Genus : Magnolia*.

M tsiampacca (L) Figlar & Noot., has several synonym names including:

- *Elmerrillia celebica* (Koord.) Dandy
- *Elmerrillia mollis* Dandy
- *Elmerrillia papuana* (Schltr.) Dandy
- *Elmerrillia papuana* var. *adpressa* Dandy
- *Elmerrillia papuana* var. *glaberrima* Dandy
- *Elmerrillia sericea* C.T.White
- *Elmerrillia tsiampacca* (L) Figlar & Noot.,
- *Michelia arfakiana* Agostini
- *Michelia celebica* Koord.
- *Michelia forbesii* Baker
- *Michelia mollis* (Dandy) Mc Laughlin
- *Michelia tsiampacca* L.
- *Sampacca sylvestris* Rumph.
- *Talauma papuana* Schltr.

For the time being, the taxonomy experts publicate Cempaka species by genus *Elmerrillia*, *Talauma*, *Micellia*, *Kmeria*, *Manglietia* and *Magnolia*. Based on the latest update in Cempaka species taxonomy, which was published by F. Brambach, *et al.*, (2013) in a journal “*Blumea*”, state that the change in taxonomy for all species included in Order *Magnoliales*, Family *Magnoliaceae* by only using one Genus, that is Genus *Magnolia*. Currently, 36 species of *Magnolia* are known to occur in Malesia, 25 of which are endemic to the region (WCSP 2013). There are 10 species of *Magnolia* in Celebes Island, and two species among them are a type of cempaka wasian. Both of them are : *M Celebesana* (L) Figlar & Noot., and *M tsiampacca* (L) Figlar & Noot.,

2. Botany

Morphological features of Cempaca Wasian is as follow:

Trunk ; globular cylinder in form with smooth bark, white spots evenly scattered on all stem surface.



Picture 1. Trunk of *M. tsiampacca* (L) Figlar & Noot., (Photos: Kinho *et al.*, 2012).

Leaf ; Leaves spaced along branches, spiral leaves occurring singly at a node and arranged spirally up the branchlet, simple a leaf composed of a single blade; petiole present, not winged, attached to base of leaf blade, not swollen or slightly swollen; leaves broadest above middle, rarely broadest at or near middle, or broadest below middle, 8.0-31.0 cm, 3.0-12.0 cm; rarely very asymmetric or symmetric, entire, not dissected or lobed, acute, acuminate, or long-tapering, venation pinnate, secondary veins open, prominent, intramarginal veins absent; leaves lower surface blue-green (slightly purplish-grey) or pale green (slightly silvery green), upper surface dark green, indumentum (hairs) present, indumentum (hairs) dense; absent; domatia absent; stipules present, free, laterally placed, encircling the twig, leafy, not fringed, large, not persistent.



Picture 2. Leaf Upper and Under Surfaces of *M. tsiampacca* (L) Figlar & Noot., (Photos:Kinho *et al.*, 2012).

Flowers ; Inflorescence axillary, flowers single (sometimes in pairs), cones absent; flowers bisexual, stalked, flowers with many planes of symmetry, 15.0-20.0 mm long, diameter large (more than 10 mm diam.); perianth present, with all sepals and/or petals (hence tepals)

similar, inner perianth white; 12-18, free; stamens 25-30, present, free of each other, free of the perianth; ovary superior, carpels separate (when more than one), locules 1; styles free, 100. Yellow and white in color



Picture 3. Flower of *M. tsiampacca* (L) Figlar & Noot.,

Fruit ; Infrutescence single, fruit 40.0-100.0 mm long, green, not spiny, non-fleshy, aggregate (consisting of free carpels spirally arranged around the receptacle), dehiscent, follicle (split on ventral side); seeds 100 (red or orange), to about 5 mm long, not winged, broad (as wide as long), seed 1-10 mm diam.



Picture 4. Fruit of *M. tsiampaka* (L) Figlar & Noot., (Photos:Kinho *et al.*, 2012).

E. THE IDENTIFICATION AND SELECTION RESULT OF CEMPACA WASIAN MOTHER TREE

1. Locations of Cempaka Wasian Stands in North Celebes Province: Location I

Administratively, this area is located on Minahasa Regency, Subdistrict Tondano Timur, political district of Kinar administrered by the lurah at "Toulumuten" plantation. The area located on 1°27'28.69564" N and 124°9'48.7669" E, west slope aspect, 30 % - 60 % slope angle, 655 m asl, with stony and gravel soil substrate. Picture 1 is location map of seed source stand of selected cempaka in Minahasa Regency.

Based on survey, it was found 31 individual cempaka wasian tree that distributed on about 2 ha of mixed stand. The stand age is 21 year old with tree diameter ranging from 20 - 45 cm, tree height reaches to 26 m, tree free branching reaches to 19 m. Another information gathered

regarding fruiting time period is that this tree fruited twice a year i.e. in May and in November.

Physical appearances of each individual tree are as follow:

Tabel 1. Cempaca Wasian Tree Appearance at Toulumuten Plantation

No of Tree	Ø (cm)	Ht (m)	Ht of Free Branch (m)	Stem Form	Stem Defect	Stem Cond.	Buttress Root (m)	Canopy Form	Canopy Cond.	Foliage Cond.	Tree Cond.
1	27	22	15	Globular Straight	None	Good	None	Evenly	Average	Good	Good
2	38	25	12	Globular Straight	None	Good	None	seimbang	Average	Good	Average
3	40	26	11	Globular Straight	None	Good	None	Evenly	Good	Good	Good
4	21	18	12	Globular Straight	None	Good	None	Evenly	Good	Good	Good
5	21	25	19	Globular Straight	None	Good	None	Evenly	Good	Good	Good
6	20	25	18	Globular Straight	None	Good	None	Evenly	Good	Good	Good
7	24	25	17	Globular Straight	None	Good	None	Evenly	Good	Good	Good
8	28	25	15	Globular Straight	None	Good	None	Evenly	Good	Good	Good
9	28	25	18	Globular Straight	None	Good	None	Evenly	Good	Good	Good
10	34	22	12	Globular Straight	None	Good	None	Evenly	Good	Good	Good
11	27	16	8	Globular Straight	None	Good	None	Evenly	Good	Good	Good
12	23	24	17	Globular Straight	None	Good	None	seimbang	Average	Good	Average
13	26	20	12	Globular Straight	None	Good	None	seimbang	Average	Good	Good
14	29	16	10	Globular Straight	None	Good	None	seimbang	Average	Good	Good
15	29	19	11	Globular Straight	None	Good	None	Evenly	Good	Good	Good
16	28	22	14	Globular Straight	None	Good	None	Evenly	Good	Good	Good
17	30	24	18	Globular Straight	None	Good	None	seimbang	Average	Good	Average

18	27	25	19	Globular Straight	None	Good	None	Evenly	Good	Good	Good
19	30	20	12	Globular Straight	None	Good	None	Evenly	Good	Good	Good
20	45	22	14	Globular Straight	None	Good	None	Evenly	Good	Good	Good
21	28	18	13	Globular Straight	None	Good	None	Evenly	Good	Good	Good
22	29	19	11	Globular Straight	None	Good	None	Evenly	Good	Good	Good
23	27	18	12	Globular Straight	None	Good	None	Evenly	Good	Good	Good
24	29	20	13	Globular Straight	None	Good	None	Evenly	Good	Good	Good
25	30	17	9	Globular Straight	None	Good	None	Evenly	Good	Good	Good
26	30	16	12	Globular Straight	None	Good	None	Evenly	Good	Good	Good
27	29	17	11	Globular Straight	None	Good	None	Evenly	Good	Good	Good
28	30	16	9	Globular Straight	None	Good	None	Evenly	Good	Good	Good
29	31	16	9	Globular Straight	None	Good	None	Evenly	Good	Good	Good
30	30	18	10	Globular Straight	None	Good	None	Evenly	Good	Good	Good
31	32	19	12	Globular Straight	None	Good	None	Evenly	Good	Good	Good

Location II

Administratively, this area is located on Tomohon City, Subdistrict Tomohon Timur, political district of Pinaras administered by the lurah at "Yayasan Masarang" plantation. The area located on 1'297574444" N and 124'7824519" E, west slope aspect, 15 % slope angle, 640 m asl, with soil substrate.

Based on survey, it was found 26 individual cempaka wasian tree that distributed on about 1 ha of mixed stand. The stand age is 20 year old with tree diameter ranging from 20 - 38 cm, tree height reaches to 28 m,

tree free branching reaches to 20 m. Another information gathered regarding fruiting time period is that this tree fruited twice a year i.e. in May and in November.

Physical appearances of each individual tree are as follow:

Tabel 2. Cempaca Wasian Tree Appearance at “Yayasan Masarang” Plantation

No of Tree	Ø (cm)	Ht (m)	Ht of Free Branch (m)	Stem Form	Stem Defect	Stem Cond.	Buttress Root (m)	Canopy Form	Canopy Cond.	Foliage Cond.	Tree Cond.
1	33	24	14	Globular Straight	None	Good	None	Evenly	Average	Good	Average
2	30	21	11	Globular Straight	None	Good	None	Evenly	Good	Good	Good
3	20	21	15	Globular Straight	None	Good	None	Evenly	Good	Average	Good
4	27	19	13	Globular Straight	None	Good	None	Evenly	Good	Good	Average
5	30	19	11	Globular Straight	None	Good	None	Evenly	Good	Good	Average
6	35	21	12	Globular Straight	None	Good	None	Evenly	Good	Good	Good
7	35	23	14	Globular Straight	None	Good	None	Evenly	Good	Good	Good
8	30	25	20	Globular Straight	None	Good	None	Evenly	Good	Good	Good
9	35	28	20	Globular Straight	None	Good	None	Evenly	Good	Good	Good
10	30	26	12	Globular Straight	None	Good	None	Evenly	Good	Good	Good
11	38	25	17	Globular Straight	None	Good	None	Evenly	Good	Good	Good
12	38	24	16	Globular Straight	None	Good	None	Evenly	Good	Good	Good
13	36	26	20	Globular Straight	None	Good	None	Evenly	Good	Good	Good
14	35	21	17	Globular Straight	None	Good	None	Evenly	Not Good	Average	Average
15	28	25	18	Globular Straight	None	Good	None	Evenly	Good	Good	Good
16	21	21	14	Globular Straight	None	Good	None	Evenly	Average	Holed	Good

17	28	23	15	Globular Straight	None	Good	None	Evenly	Good	Good	Good
18	25	23	11	Globular Straight	None	Good	None	Evenly	Good	Good	Good
19	38	27	18	Globular Straight	None	Good	None	Evenly	Good	Good	Good
20	32	25	16	Globular Straight	None	Good	None	Evenly	Good	Good	Good
21	33	24	16	Globular Straight	None	Good	None	Evenly	Average	Average	Average
22	20	17	10	Globular Straight	None	Average	None	Evenly	Good	Good	Good
23	28	26	18	Globular Straight	None	Good	None	Evenly	Good	Good	Good
24	30	22	15	Globular Straight	None	Good	None	Evenly	Good	Good	Good
25	35	10	12	Globular Straight	None	Good	None	Evenly	Good	Good	Good
26	30	23	15	Globular Straight	None	Good	None	Evenly	Good	Good	Good

Location III

Administratively, this area is located on South Minahasa Regency, Subdistrict Tareran, Rumoong Atas II Village at "*Raruman*" plantation. The area located on 1'224144074" N and 124'7214283" E, west slope aspect, 40 % slope angle, 575 m asl, with soil substrate.

Based on survey, it was found 29 individual cempaka wasian tree that distributed on about 1 ha of mixed stand. The stand ages have wide variety of ages with tree diameter ranging from 20 - 60 cm, tree height reaches to 30 m, tree free branching reaches to 20 m. Another information gathered regarding fruiting time period is that this tree fruited twice a year i.e. in May and in November.

Physical appearances of each individual tree are as follow:

Table 3. Cempaca Wasian Tree Appearance at Raruman Plantation

No of Tree	Ø (cm)	Ht (m)	Ht of Free Branch	Stem Form	Stem Defect	Stem Cond.	Buttress Root (m)	Canopy Form	Canopy Cond.	Foliage Cond.	Tree Cond.
1	73	33	13	Globular Straight	None	Good	Present	Evenly	Good	Good	Good
2	70	29	15	Globular Straight	None	Good	Present	Evenly	Good	Good	Good
3	30	21	13	Globular Straight	None	Good	None	Evenly	Good	Good	Good
4	28	19	12	Globular Straight	None	Good	None	Evenly	Good	Good	Good
5	30	17	10	Globular Straight	None	Good	None	Evenly	Good	Good	Average
6	30	16	6	Globular Straight	None	Good	None	Evenly	Good	Good	Good
7	20	14	10	Globular Straight	None	Good	None	Evenly	Good	Good	Good
8	20	14	10	Globular Straight	None	Good	None	Evenly	Good	Good	Good
9	30	20	12	Globular Straight	None	Good	None	Evenly	Good	Good	Good
10	30	16	10	Globular Straight	None	Good	None	Evenly	Good	Good	Good
11	30	17	11	Globular Straight	None	Good	None	Evenly	Good	Good	Good
12	30	18	10	Globular Straight	None	Good	None	Evenly	Good	Good	Good
13	25	18	12	Globular Straight	None	Good	None	Evenly	Good	Good	Good
14	30	20	12	Globular Straight	None	Good	None	Evenly	Good	Good	Good
15	35	20	10	Globular Straight	None	Good	None	Evenly	Good	Good	Good
16	30	18	10	Globular Straight	None	Good	None	Evenly	Good	Good	Good
17	30	30	20	Globular Straight	None	Good	None	Evenly	Good	Good	Good
18	18	19	12	Globular Straight	None	Good	None	Evenly	Good	Good	Good
19	31	18	12	Globular Straight	None	Good	None	Evenly	Good	Good	Good
20	32	23	15	Globular Straight	None	Good	None	Evenly	Good	Good	Good

21	35	21	15	Globular Straight	None	Good	None	Evenly	Good	Good	Good
22	30	23	11	Globular Straight	None	Good	None	Evenly	Good	Good	Good
23	30	20	12	Globular Straight	None	Good	None	Evenly	Good	Good	Good
24	35	20	12	Globular Straight	None	Good	None	Evenly	Good	Good	Good
25	40	20	12	Globular Straight	None	Good	None	Evenly	Good	Good	Good
26	35	30	20	Globular Straight	None	Good	None	Evenly	Good	Good	Good
27	60	30	20	Globular Straight	None	Good	None	Evenly	Good	Good	Good
28	35	22	12	Globular Straight	None	Good	None	Evenly	Good	Good	Good
29	35	20	10	Globular Straight	None	Good	None	Evenly	Good	Good	Good

Location IV

Administratively, this area is located on South East Minahasa, Subdistrict Tombatu, Tonsawang Village at "Lesung" plantation. The area located on 100'38.214" N and 124040'43.326" E, west slope aspect, 60 % slope angle, 550 m asl, with soil substrate.

Based on survey, it was found 25 individual cempaka wasian tree that distributed on about 1 ha of mixed stand. The stand ages have wide variety of ages with tree diameter ranging from 20 - 80 cm, tree height reaches to 35 m, tree free branching reaches to 20 m. Another information gathered regarding fruiting time period is that this tree fruited twice a year i.e. in May and in November.

Physical appearances of each individual tree are as follow:

Tabel.4. Cempaca Wasian Tree Appearance at Lesung Plantation

No of Tree	Ø (cm)	Ht (m)	Ht of Free Branch (m)	Stem Form	Stem Defect	Stem Cond.	Buttress Root (m)	Canopy Form	Canopy Cond.	Foliage Cond.	Tree Cond.
1	45	24	15	Globular Straight	None	Good	None	Evenly	Good	Good	Good
2	20	20	15	Globular Straight	None	Good	None	Evenly	Good	Good	Good
3	25	22	19	Globular Straight	None	Good	None	Evenly	Good	Good	Good
4	40	32	15	Globular Straight	None	Good	None	Evenly	Good	Good	Good
5	28	20	16	Globular Straight	None	Good	None	Evenly	Good	Good	Good
6	60	35	20	Globular Straight	None	Good	None	Evenly	Good	Good	Good
7	60	34	16	Globular Straight	None	Good	None	Evenly	Good	Good	Good
8	45	23	16	Globular Straight	None	Good	None	Evenly	Good	Good	Good
9	40	20	14	Globular Straight	None	Good	None	Evenly	Good	Good	Good
10	35	12	10	Globular Straight	None	Good	None	Evenly	Good	Good	Good
11	40	23	15	Globular Straight	None	Good	None	Evenly	Good	Good	Good
12	36	20	12	Globular Straight	None	Good	None	Evenly	Good	Good	Good
13	42	20	14	Globular Straight	None	Good	None	Evenly	Good	Good	Good
14	35	13	10	Globular Straight	None	Good	None	Evenly	Good	Good	Good
15	80	12	12	Globular Straight	None	Good	None	Evenly	Good	Good	Good
16	28	25	18	Globular Straight	None	Good	None	Evenly	Good	Good	Good
17	33	26	17	Globular Straight	None	Good	None	Evenly	Good	Good	Good
18	33	25	18	Globular Straight	None	Good	None	Evenly	Good	Good	Good
19	32	18	14	Globular Straight	None	Good	None	Evenly	Good	Good	Good
20	28	19	13	Globular Straight	None	Good	None	Evenly	Good	Good	Good

21	28	18	12	Globular Straight	None	Good	None	Evenly	Good	Good	Good
22	35	19	16	Globular Straight	None	Good	None	Evenly	Good	Good	Good
23	36	18	11	Globular Straight	None	Good	None	Evenly	Good	Good	Good
24	40	24	16	Globular Straight	None	Good	None	Evenly	Good	Good	Good
25	40	18	12	Globular Straight	None	Good	None	Evenly	Good	Good	Good

2. Locations of Cempaka Wasian Stands in South Celebes Province:

Location V

Administratively, this area is located on Tana Toraja Regency, Subdistrict Sa'dan Balusu, Sangkaropi Village at "Tondok" plantation. The area located on 2° 00' 07.6" N and 119° 56' 37.2" E, west slope aspect, 30 - 60 % slope angle, 946 m asl, with soil substrate.

Based on survey, it was found 27 individual cempaka wasian tree that distributed on quite large area of mixed stand. The stand ages have wide variety of ages with tree diameter ranging from 29 - 95.5 cm, tree height reaches to 38 m, tree free branching reaches to 21 m. Another information gathered regarding fruiting time period is that this tree fruited twice a year i.e. in May and in November.

Physical appearances of each individual tree are as follow:

Tabel.5.Cempaca Wasian Tree Appearance at Tondok Plantation

No of Tree	Ø (cm)	Ht (m)	Ht of Free Branch (m)	Stem Form	Stem Defect	Stem Cond.	Buttress Root (m)	Canopy Form	Canopy Cond.	Foliage Cond.	Tree Cond.
1	66,8	26	12	Globular Straight	None	Good	None	Evenly	Good	Good	Good
2	57,3	22	10	Globular Straight	None	Good	None	Evenly	Good	Good	Good
3	49,3	25	16	Globular Straight	None	Good	None	Evenly	Good	Good	Good
4	60,5	29	14	Globular Straight	None	Good	None	Evenly	Good	Good	Good
5	76,4	32	13	Globular Straight	None	Good	None	Evenly	Good	Good	Good
6	50,9	31	18	Globular Straight	None	Good	None	Evenly	Good	Good	Good
7	47,7	28	11	Globular Straight	None	Good	None	Evenly	Good	Good	Good
8	60,5	29	10	Globular Straight	None	Good	None	Evenly	Good	Good	Good
9	79,5	32	18	Globular Straight	None	Good	None	Evenly	Good	Good	Good
10	78,0	30	15	Globular Straight	None	Good	None	Evenly	Good	Good	Good
11	66,8	35	21	Globular Straight	None	Good	None	Evenly	Good	Good	Good
12	95,5	32	14	Globular Straight	None	Good	None	Evenly	Good	Good	Good
13	64,3	28	16	Globular Straight	None	Good	None	Evenly	Good	Good	Good
14	63,6	30	15	Globular Straight	None	Good	None	Evenly	Good	Good	Good
15	54,1	27	13	Globular Straight	None	Good	None	Evenly	Good	Good	Good
16	55,7	26	14	Globular Straight	None	Good	None	Evenly	Good	Good	Good
17	61,7	31	16	Globular Straight	None	Good	None	Evenly	Good	Good	Good
18	64,6	35	18	Globular Straight	None	Good	None	Evenly	Good	Good	Good
19	56,3	36	20	Globular Straight	None	Good	None	Evenly	Good	Good	Good
20	87,5	34	17	Globular Straight	None	Good	None	Evenly	Good	Good	Good

21	86,2	38	21	Globular Straight	None	Good	None	Evenly	Good	Good	Good
22	71,9	32	18	Globular Straight	None	Good	None	Evenly	Good	Good	Good
23	68,7	28	13	Globular Straight	None	Good	None	Evenly	Good	Good	Good
24	37,2	26	15	Globular Straight	None	Good	None	Evenly	Good	Good	Good
25	57,6	25	12	Globular Straight	None	Good	None	Evenly	Good	Good	Good
26	29,0	20	10	Globular Straight	None	Good	None	Evenly	Good	Good	Good
27	40,4	22	15	Globular Straight	None	Good	None	Evenly	Good	Good	Good

Location VI

Administratively, this area is located on Tana Toraja Regency, Subdistrict Kapalapitu, Lolai Village at "*Lempe*" plantation. The area located on 2° 00' 07.6" N and 119° 56' 37.2" E, west slope aspect, 30 - 60 % slope angle, 890 m asl, with soil substrate.

Based on survey, it was found 27 individual cempaka wasian tree that distributed on about 1 ha of mixed stand. The stand ages have wide variety of ages with tree diameter ranging from 36.9 - 52.5 cm, tree height reaches to 35 m, tree free branching reaches to 13 m. Another information gathered regarding fruiting time period is that this tree fruited twice a year i.e. in May and in November.

Physical appearances of each individual tree are as follow:

Tabel 6. Cempaca Wasian Tree Appearance at Lempe Plantation

No of Tree	Ø (cm)	Ht (m)	Ht of Free Branch (m)	Stem Form	Stem Defect	Stem Cond.	Buttress Root (m)	Canopy Form	Canopy Cond.	Foliage Cond.	Tree Cond.
1	46,5	28	10	Globular Straight	None	Good	None	Evenly	Good	Good	Good
2	41,1	25	11	Globular Straight	None	Good	None	Evenly	Good	Good	Good
3	45,5	27	9	Globular Straight	None	Good	None	Evenly	Good	Good	Good
4	49,4	25	12	Globular Straight	None	Good	None	Evenly	Good	Good	Good
5	51,6	30	12	Globular Straight	None	Good	None	Evenly	Good	Good	Good
6	37,6	21	8	Globular Straight	None	Good	None	Evenly	Good	Good	Good
7	42,0	24	10	Globular Straight	None	Good	None	Evenly	Good	Good	Good
8	40,4	20	9	Globular Straight	None	Good	None	Evenly	Good	Good	Good
9	52,5	35	12	Globular Straight	None	Good	None	Evenly	Good	Good	Good
10	43,6	23	10	Globular Straight	None	Good	None	Evenly	Good	Good	Good
11	47,5	24	9	Globular Straight	None	Good	None	Evenly	Good	Good	Good
12	41,1	22	9	Globular Straight	None	Good	None	Evenly	Good	Good	Good
13	42,0	20	10	Globular Straight	None	Good	None	Evenly	Good	Good	Good
14	38,5	20	8	Globular Straight	None	Good	None	Evenly	Good	Good	Good
15	36,9	27	9	Globular Straight	None	Good	None	Evenly	Good	Good	Good
16	39,5	25	8	Globular Straight	None	Good	None	Evenly	Good	Good	Good
17	52,5	28	13	Globular Straight	None	Good	None	Evenly	Good	Good	Good
18	51,3	28	11	Globular Straight	None	Good	None	Evenly	Good	Good	Good
19	50,0	30	12	Globular Straight	None	Good	None	Evenly	Good	Good	Good
20	46,2	25	9	Globular Straight	None	Good	None	Evenly	Good	Good	Good
21	47,8	27	8	Globular Straight	None	Good	None	Evenly	Good	Good	Good
22	45,5	22	10	Globular Straight	None	Good	None	Evenly	Good	Good	Good
23	41,1	24	8	Globular Straight	None	Good	None	Evenly	Good	Good	Good

24	39,8	20	12	Globular Straight	None	Good	None	Evenly	Good	Good	Good
25	42,0	21	11	Globular Straight	None	Good	None	Evenly	Good	Good	Good
26	46,5	28	10	Globular Straight	None	Good	None	Evenly	Good	Good	Good
27	41,1	25	11	Globular Straight	None	Good	None	Evenly	Good	Good	Good

F. CONCLUSIONS

Based on research finding, stand location of Wasian (*M tsiampacca* (L) Figlar & Noot., that established for seed sources in Celebes (North and South Celebes) are:

1. Toulumuten plantation.

Administratively, this area is located on Minahasa Regency, Subdistrict Tondano Timur, political district of Kinar administrered by the lurah. The area located on 1'272869564" N and 124'9487669" E, west slope aspect, 30 % - 60 % slope angle, 655 m asl, with stony and gravel soil substrate. (North Celebes),

2. Yayasan Masarang plantation.

Administratively, this area is located on Tomohon City, Subdistrict Tomohon Timur, political district of Pinaras administrered by the lurah. The area located on 1'297574444" N and 124'7824519" E, west slope aspect, 15 % slope angle, 640 m asl, with soil substrate (North Celebes).

3. Raruman plantation.

Administratively, this area is located on South Minahasa Regency, Subdistrict Tareran, Rumoong Atas II Village. The area located on 1'224144074" N and 124'7214283" E, west slope aspect, 40 % slope angle, 575 m asl, with soil substrate (North Celebes),

4. Lesung plantation,

Administratively, this area is located on South East Minahasa, Subdistrict Tombatu, Tonsawang Village. The area located on 100'38.214" N and 124'040'43.326" E, west slope aspect, 60 % slope angle, 550 m asl, with soil substrate (North Celebes),

5. Tondok plantation.

Administratively, this area is located on Tana Toraja Regency, Subdistrict Sa'dan Balusu, Sangkaropi Village . The area located on 2° 00' 07.6" N and 119° 56' 37.2" E, west slope aspect, 30 - 60 % slope angle, 946 m asl, with soil substrate (South Celebes), and

6. Lempe plantation.

Administratively, this area is located on Tana Toraja Regency, Subdistrict Kapalapitu, Lolai Village. The area located on 2° 00' 07.6" N and 119° 56' 37.2" E, west slope aspect, 30 - 60 % slope angle, 890 m asl, with soil substrate (South Celebes).

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APPENDIX

Appendix 1: Stands of *M. tsiampacca* (L) Figlar & Noot., Location, Minahasa Regency, political district of Kinar administrered by the lurah.



Photos : Thomas. A and H. Polo., (2016)

Appendix 2: Stands of *M. tsiampacca* (L) Figlar & Noot., Location, Tomohon City, political district of Pinaras administrered by the lurah.



Photos : Thomas. A and H. Polo., (2016)

Appendix 3: Stands of *M. tsiampacca* (L) Figlar & Noot., Location, South Minahasa Regency, Rumoong Atas II Village.



Photos : Thomas. A and H. Polo., (2016)

Appendix 4: Stands of *M. tsiampacca* (L) Figlar & Noot., Location, South East Minahasa Regency, Tonsawang Village.



Photos : Thomas. A and H. Polo., (2016)

Appendix 5: Stands of *M. tsiampacca* (L) Figlar & Noot., Location, Tana Toraja Regency, Lolai Village.



Photos : Abidin. M and K. Mairi.,(2016)

Appendix 6: Stands of *M. tsiampacca* (L) Figlar & Noot., Location, Tana Toraja Regency, Sangkaropi Village.



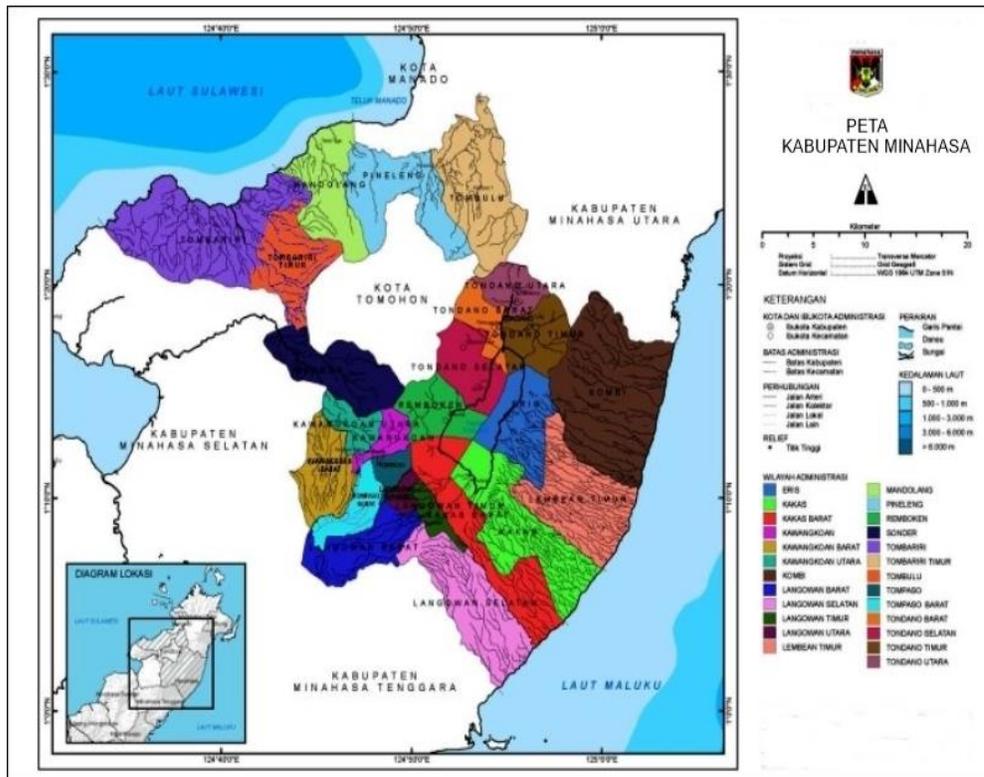
Photos : Abidin. M and K. Mairi.,(2016)

Appendix 7: Fruit of *M. tsiampacca* (L) Figlar & Noot., The Dried 2 Months After The Fall.



Photos : Kristian Mairi.,(2016)

Appendix 8. Map Location of Cempaca Wasian Stand Selected at Minahasa Regency.



Appendix 12. Map Location of Cempaca Wasian Stand Selected at Tana Toraja Regency.

