16A Factsheet Agroforestry

Characterisation of agroforestry types in the Netherlands

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What is agroforestry?

Agroforestry is referred to when woody crops (trees and shrubs) are deliberately integrated with arable and vegetable crops or grassland on the same plot. The woody crops can be planted for multiple purposes, such as production of fruit, nuts or timber, creating a favourable microclimate, and providing ecosystem services. Each agroforestry system is a tailor-made design. The possible combinations, planting distances and planting densities are almost infinite.

Why this factsheet?

Agroforestry knows a wide variety of types and appearances. This offers many opportunities to realise agroforestry systems that fit a farmer's specific wishes and goals, or that fit certain types of landscape or challenges in a specific area.

However, this wide variety of systems also creates obstacles. In practice, farmers, policymakers and other stakeholders sometimes have different images and ideas about the term agroforestry. As a result, people often talk past each other, which can lead to confusion, misunderstanding and misconceptions. In a conversation about permits for an agroforestry system, do an arable farmer and a policy maker have the same system in mind? Is agroforestry the same for a dairy farmer as for a poultry farmer?

In addition, the diversity of agroforestry systems makes it difficult to make concrete statements about the performance and functions of agroforestry in general. There is much talk about 'the business model' of agroforestry, and about 'the contribution' of agroforestry to societal and ecosystem services, such as biodiversity, water quality and carbon sequestration. But the systems are simply too different to make generic statements about this and quantify them.

The primary purpose of this characterisation is to conduct more targeted research into the opportunities and effects of the various systems, but it may also be used in policy, education and consultancy and to give entrepreneurs more insight into the possibilities of agroforestry.

Characterisation of agroforestry systems

For this characterisation, agroforestry systems that are most common in practice in the Netherlands or for which plans are being made were taken into account. Because most systems are still young, and the practical application and business model have not yet been fully developed, it is not yet possible to say with certainty to what extent the systems can be scaled up. With that being said, this is clearly a first attempt at characterisation, whereby the authors want to emphasise that many intermediate forms and other types of systems are still possible.

First, the agricultural sectors in which agroforestry has developed in recent years was considered. Initially this was mainly in cattle and poultry farming, but in recent years more and more systems have also been established in arable and vegetable farming. In addition, there are developments in fruit and nut cultivation with more interest in crop differentiation, and there is considerable growth in (agricultural) food forests. In other sectors, such as pig farming, agroforestry also has potential, but due to limited practical application these have not been included as yet.

Next, the ways in which agroforestry is applied in each sector and how these systems can be distinguished from each other was considered. A distinction was made in terms of spatial layout, functions of trees and shrubs, tree density, choice of species, scale, mechanisation and management.

Description of eight agroforestry systems

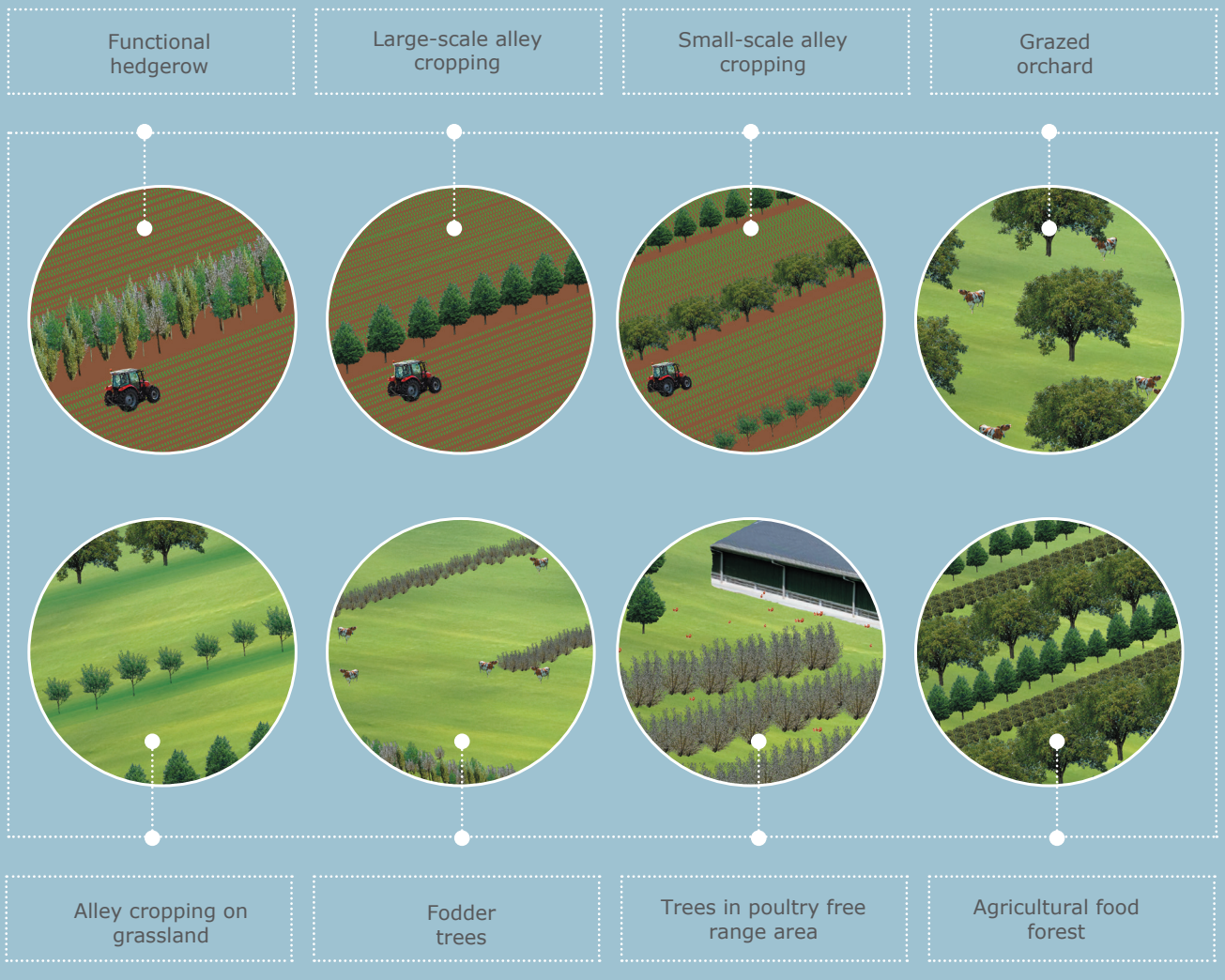
In arable and vegetable cropping systems, trees and shrubs are mostly planted in rows (alleys), so that trees and shrubs do not interfere as much with the management of the (annual) crops. As a result, these systems are spatially similar, but the function and role of trees and shrubs, especially their economic role, can differ substantially. Firstly, we see a category of systems where the woody plants are mainly planted with a supporting role for the crop and biodiversity (functional hedgerow). Second, there are systems where the trees and shrubs play a greater role in the business model by producing nuts, fruit or other products. Here a distinction was made between alley cropping in a large-scale arable system and alley cropping with small-scale arable or vegetable cultivation. Systems of the latter type are often characterised by greater complexity, diversity and a higher tree density.

In cattle farming, three systems are distinguished on grassland. One type realised mainly for animal welfare (fodder trees) and two types with more focus on wood, nut and fruit production. Within these two types, a distinction is made between a grazed orchard, with trees in a square or diamond pattern, and alley cropping, with woody plants in rows on grassland, which is mowed or grazed.

For poultry farming, one type of system is included, with the planting of trees in free range chicken runs, containing two variants of spatial layout and production function (fruit, nuts, biomass).

In addition, a system that consists (almost) entirely of woody plants is included. This type of system is here referred to as an agricultural food forest (food forest in rows), but a spatially similar system could also arise when diversifying existing fruit and nut cropping systems.

The eight types of agroforestry systems described in this factsheet are:



Functional hedgerow for arable cropping

In this type of agroforestry, trees and shrubs are planted with the main purpose of supporting crop production. In Dutch arable farming a windbreak can be very relevant. Reducing wind speed can reduce wind damage to crops, evaporation and wind erosion, which can help create a more robust cropping system. Other benefits include increasing (functional) biodiversity, improving soil and water quality, and carbon sequestration.

In this type of agroforestry, rows of woody plants are planted quite far apart. The negative effects of woody plants on the crop (competition for light and water) occur close to the tree rows, while the aforementioned positive effects reach further into the field. This way, positive effects of trees on the crops are obtained and maximum space is given to the crops.

This type of agroforestry suits a large-scale arable farm, as the maintenance of the woody plants is minimal and crop production remains basically unchanged. Depending on design and species choice, this type of agroforestry can also produce wood or biomass.

Characteristics of the system

Most important functions of trees

- Windbreak
- (Functional) biodiversity and ecological corridors

Spatial design

- Hedgerows on field edges and/or in field
- Row distance >100m
- Hedgerow max 10m high, max 6m wide
- Hedgegrow porosity important for optimal windbreak

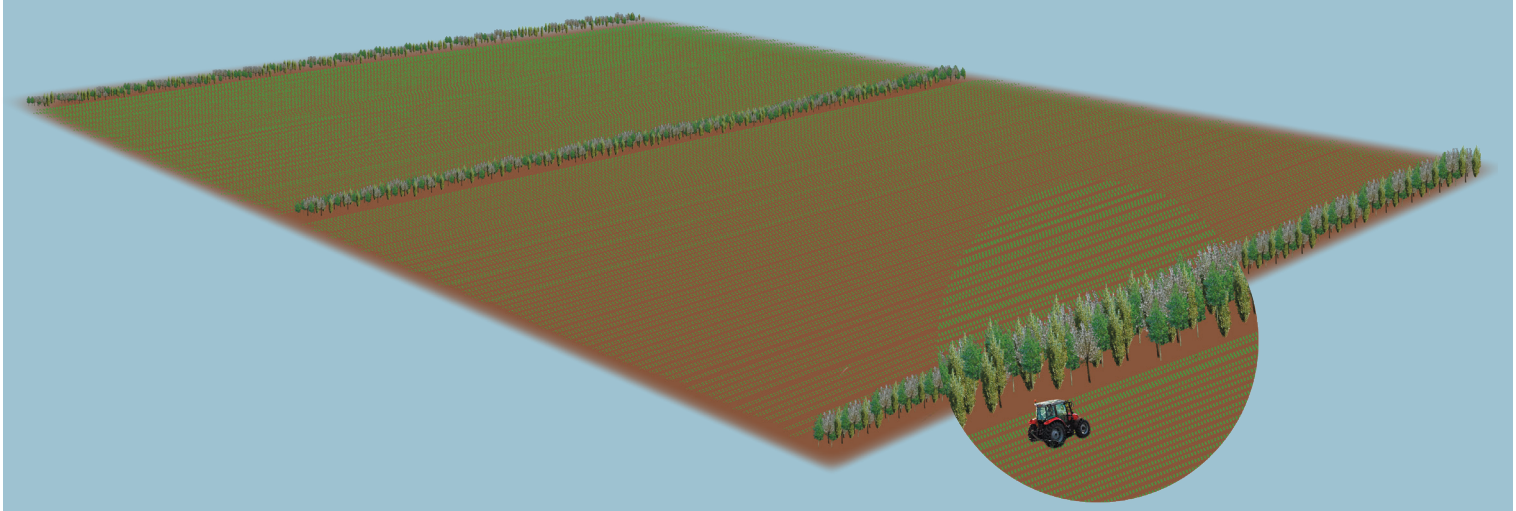
Tree species

- Row can consist of multiple species of trees and shrubs
- Mix of native species can offer most benefits for biodiversity

Management

- Simple; annual pruning to keep hedgerow in desired shape
- Potentially cutting down completely or partly once in a few years

Functional hedgerow



Large-scale alley cropping

This system provides space for large-scale crop cultivation, but explicitly integrates trees and shrubs that provide production themselves. Production from the trees (e.g. nuts, fruit, wood) complements the business model, but arable farming remains the economic carrier of the system. The tree rows are spaced at such a distance from each other that the positive effects on crops (such as windbreak) are optimised, and competition (for water and light) is limited. The undergrowth of the tree row can be managed ecologically to increase (functional) biodiversity, although this should not complicate nut or fruit harvesting too much.

Characteristics of the system

Most important functions of trees

- Production of food from woody crops
- Windbreak and biodiversity

Spatial design

- Tree rows in alleys
- Row distance 40-100m
- Height and width of tree row dependent on tree species

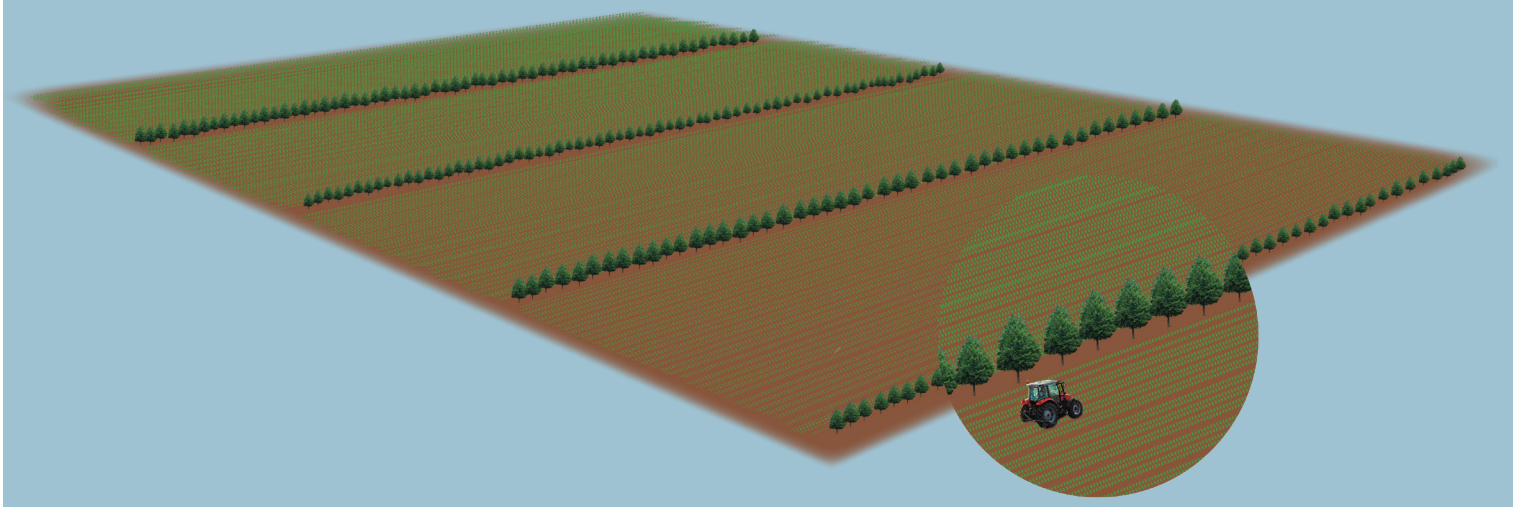
Tree species

- Nut, fruit or wood producing trees or shrubs
- Robust species (to cope with wind and other extreme circumstances)
- Often one species per tree row

Management

- Quite intensive; to optimise for productive trees and crops

Large-scale alley cropping



Small-scale alley cropping with arable or vegetable cultivation

In this type of agroforestry, arable crops are cultivated in between rows of trees. Compared to the previous systems, the tree rows here are closer together. This gives the system a higher tree density, making the production of nuts, fruit and/or wood an important economic carrier of the system (in the long run). Because the woody plants need time to age and come into production, this system goes through some phases of succession. In the first 10 years after planting, the emphasis will be on crop production, but the production of woody plants will become increasingly important, both ecologically and economically. This may also influence crop choice, as the annuals will increasingly face competition (light and water) in addition to shelter from the wind by the woody plants. In this type of agroforestry, the rows of woody plants are spaced far enough apart to leave space for arable or vegetable cultivation. This type also includes systems where annual crops are integrated into (existing) fruit or nut cropping systems.

Characteristics of the system

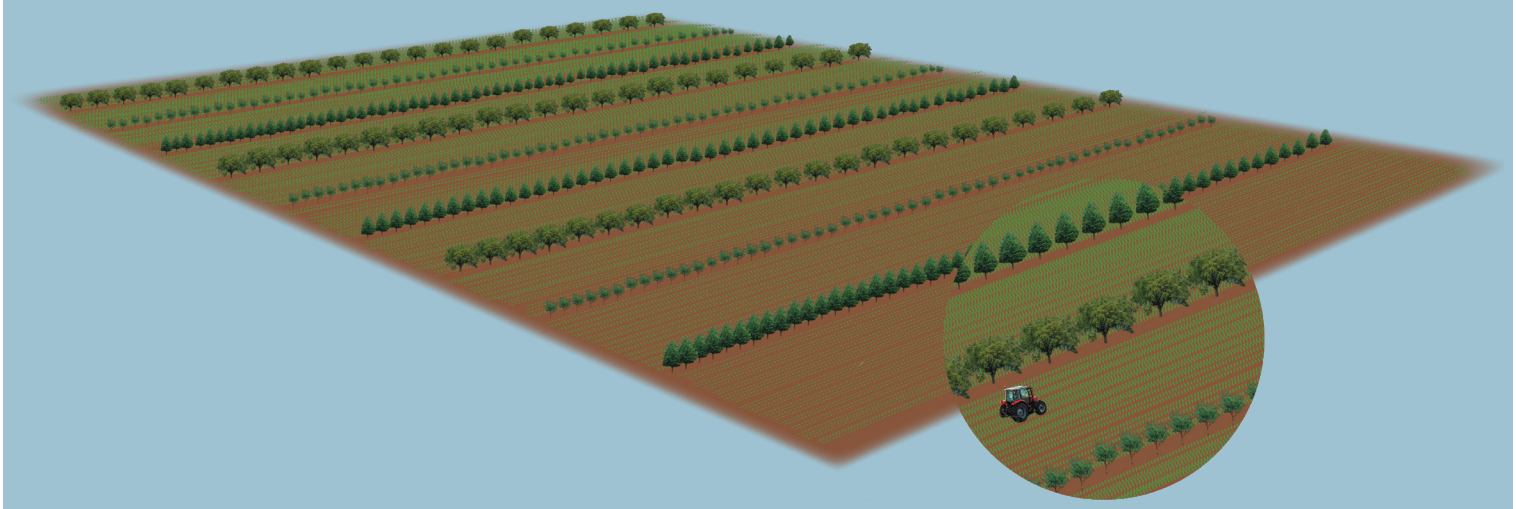
Most important functions of trees
- (Diverse) production of food (nuts, fruit)
- Biodiversity, soil and water quality

Spatial design
- Row distance 5-40m
- Height and with of tree row dependent on woody species
- One or more tree rows per tree line

Tree species
- Possibility of a highly diverse system
- One or more species per tree row (trees and shrubs)
- Trees for nut, fruit and/or wood production

Management
- Intensive when focus on high production from woody crops
- In highly diverse design: each (tree) crop has its own management and harvesting moments

Small-scale alley cropping



Grazed orchard

Grazed orchards with high-stem trees have long been part of the Dutch agricultural landscape. With the introduction of low-stem fruit trees, this came to an end. The orchards that have remained intact are highly valued for their cultural and biodiversity value. Today, in addition to fruit trees, nut and chestnut trees are planted on grassland in grazed orchards. Wood production (poplar, chestnut, etc.) can also be used in a grazed orchard.

A grazed orchard offers the livestock farmer alternative forms of income and provides numerous valuable ecosystem services including an improved microclimate and hence animal welfare for livestock. In this type of agroforestry, the grass can be both mowed and grazed. In principle, both are possible, but in mature systems with high tree density, livestock grazing is more practical.

Characteristics of the system

Most important functions of trees

- Production of food and wood
- Shadow and shelter for livestock
- Biodiversity and cultural heritage

Spatial design

- Trees planted in square or diamond pattern
- Tree spacing between 6 and 12 meter, dependent on tree species

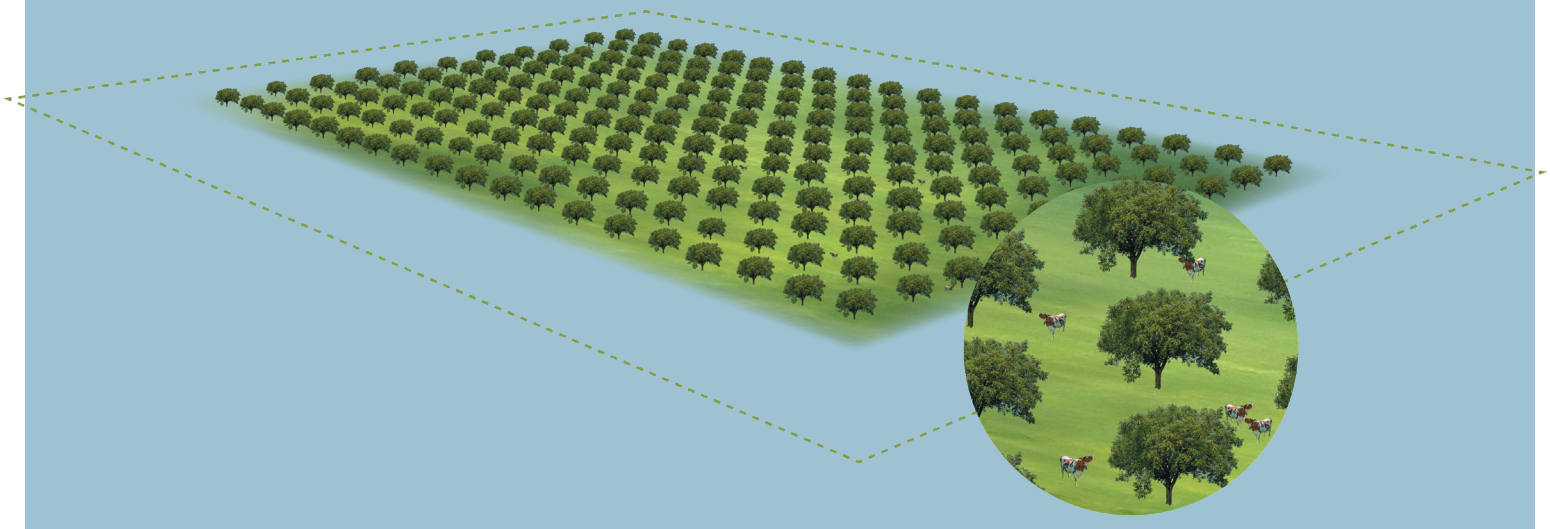
Tree species

- Productive high-stem trees for food or wood production
- One species or a mix of species

Management

- Quite intensive, but dependent on the desired production

Grazed orchard



Alley cropping on grassland

In alley cropping with productive trees on grassland, trees and shrubs are planted in rows, with pasture in between to mow or graze. When grazing, cattle must be fenced out to prevent damage to trees and shrubs. This is therefore different from the grazed orchard where cattle walk under the tree crown. The undergrowth in these strips, especially with extensive management, has great added value for biodiversity. Since cattle do not walk under the trees, shrubs can also be used in these rows of woody plants. Besides diversity in production (of fruit and nuts for instance) and increasing biodiversity, this system is also applied to improve animal welfare by creating shade and shelter in the lee.

Characteristics of the system

Most important functions of trees

- Production of food and/or wood
- Shadow and shelter for livestock (when grazed)
- Biodiversity

Spatial design

- Trees planted in rows
- Row distance of 12-40m, dependent on the objectives and height of the trees

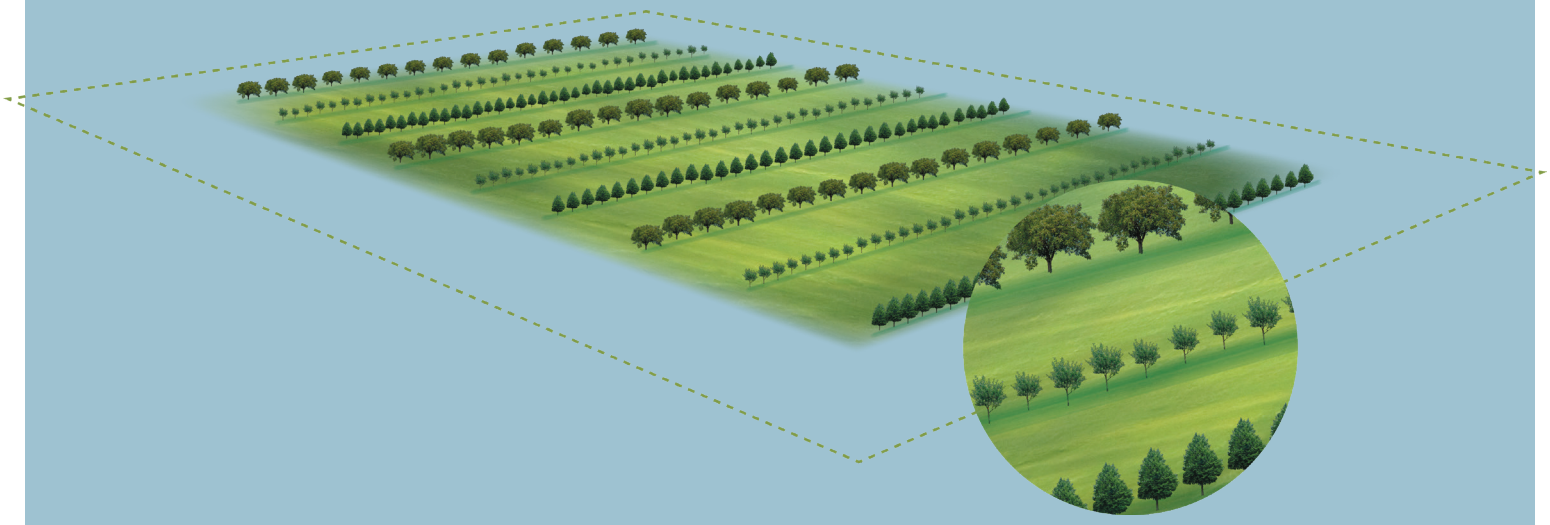
Tree species

- Row can consist of trees and shrubs, whether or not mixed
- Productive species for nut, fruit and/or wood

Management

- Quite intensive, but dependent on the desired production

Alley cropping on grassland



Fodder trees

There is a fair amount of experience with fodder trees and hedges in the Netherlands. Fodder trees can be planted at the edges of fields, but can also be planted across the field or in small groups. Livestock farmers choose to work with fodder trees because of the many animal welfare benefits it can provide. The leaves and twigs can contain micronutrients and secondary plant substances that can supplement the supply in the cattle's rations. Cattle are given the opportunity to exhibit more natural behaviour by browsing and seek shade on hot days and shelter in windy days. In addition, these systems have a strong positive impact on biodiversity and carbon sequestration.

Characteristics of the system

Most important functions of trees

- Animal welfare and natural behaviour
- Biodiversity, cultural heritage, carbon sequestration

Spatial design

- Within the field or on field edges
- Trees planted in rows, often 1.5-4.5 meter wide
- Height of 1.5-6 meter

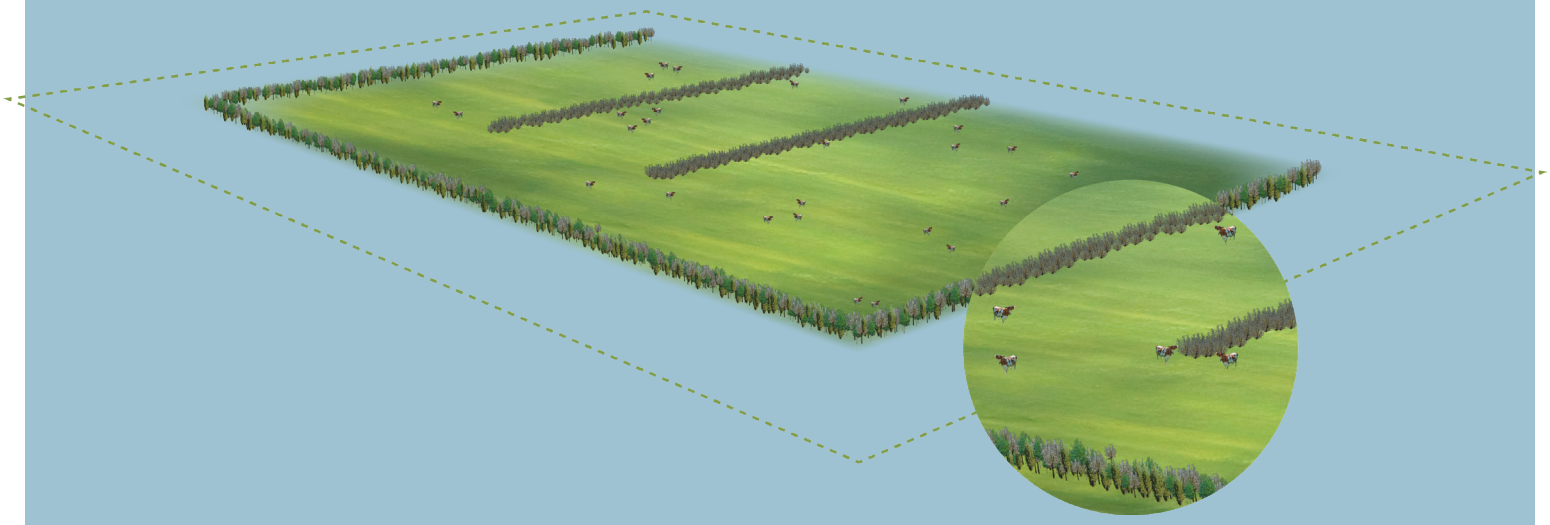
Tree species

- Often native species that cattle likes to eat
- Species that are beneficial for biodiversity

Management

- Simple, but depends on species and objectives
- Cut back or cut down every once in a few years

Fodder trees



Trees in poultry free range area

In poultry farming, trees and shrubs are planted in the free range areas to promote animal welfare. The woody plants provide chickens with a more natural environment. The shelter from the trees and shrubs encourages chickens to make better use of the entire enclosure. By placing the rows no further than 20m apart, they can seek protection in case of predation by birds of prey. In addition, woody plants provide opportunities for additional income derived from the sale of wood chips, fruit or nuts.

Characteristics of the system

Most important functions of trees

- Animal welfare and natural behaviour
- Production of food and/or biomass

Spatial design

- Trees and shrubs in strips (max 20m apart) or in square pattern

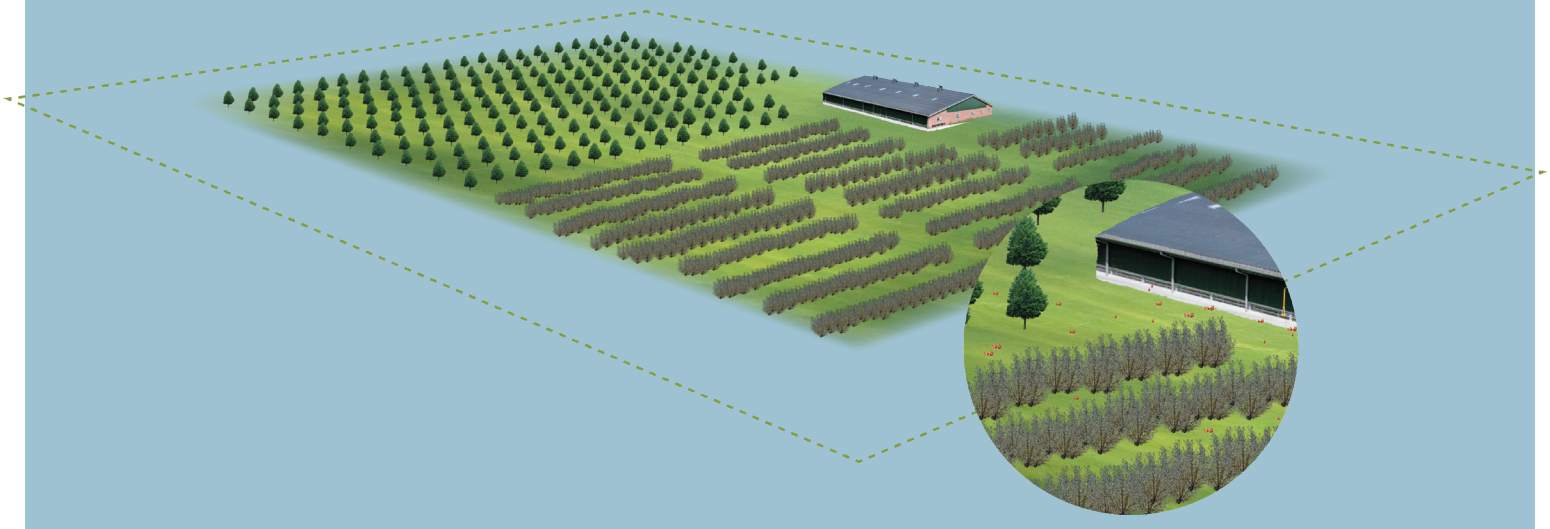
Tree species

- Fruit and nut trees or trees for biomass production

Management

- Quite intensive, but dependent on the function and objectives of the woody plants

Trees in poultry free range area



Agricultural food forest

This type includes systems in which only woody plants are grown. These systems fall outside of the international definition of agroforestry, as it does not combine with arable or livestock farming. In the Netherlands, however, because of the similarity in terms of high complexity, diversity and presence of woody plants, these systems often do fall under the definition of agroforestry. In an agricultural food forest, the production of edible trees and shrubs is the main objective, in addition to providing other ecosystem services. The principles from food forestry are followed to achieve a resilient system. For instance, there are at least three vegetation layers and succession is taken into account. To enable mechanisation and thus scaling up of such systems, trees and shrubs are grown in rows, sometimes with the same or similar species next to each other. To register a food forest in the Netherlands under the current crop code 'Food forest', no fertiliser or chemicals are allowed.

Species-diverse systems using only woody plants are also being considered from a very different angle. There are major sustainability challenges in current fruit cropping systems. Diversification of existing fruit and nut orchards (now mostly monocultures) could be a way to make these systems more sustainable. This could be expressed by constantly replacing one or more rows of trees with a different species. To put this kind of system into practice, some practical obstacles still need to be removed.

Another system that could move towards an agricultural food forest is 'forest edge agriculture', which repeatedly mimics a forest edge by allowing low, medium and high woody plants to follow each other, as seen at the edge of a forest. These systems also offer opportunities to integrate crops such as mushrooms, flowers and herbs.

Characteristics of the system

Most important functions of trees

- Diverse production of food
- Multiple ecosystem services (e.g. water retention, biodiversity, carbon sequestration)

Spatial design

- Trees and shrubs planted in rows
- Layering of the rows (high-middle-low)

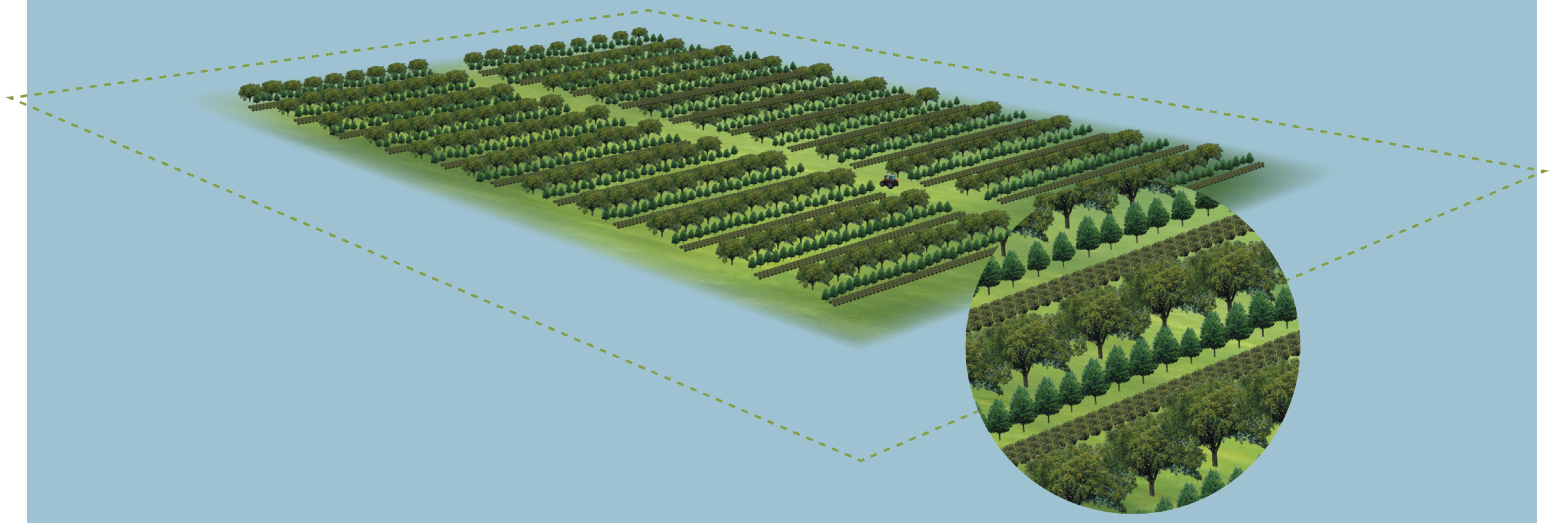
Tree species

- Large diversity of edible species
- Per row the same or similar species
- In totality very diverse

Management

- Management can vary from very intensive to more extensive, depending on the objectives and complexity of the system

Agricultural food forest



What can this characterisation be used for?

This characterisation is intended to describe the development of agroforestry in the Netherlands and provide an overview of the diversity of Dutch agroforestry systems. The main reason to characterise agroforestry systems is to structure and facilitate research.

Researcher

- This characterisation can help to better delineate research and conduct targeted research on one type of system to draw more informed and specific conclusions.
- The characterisation helps to structure research and can thus be a stepping stone for a national research programme.
- Data obtained from different studies within the same type of agroforestry system are easier to compare.
- Cultivation manuals can be developed for each type of agroforestry.

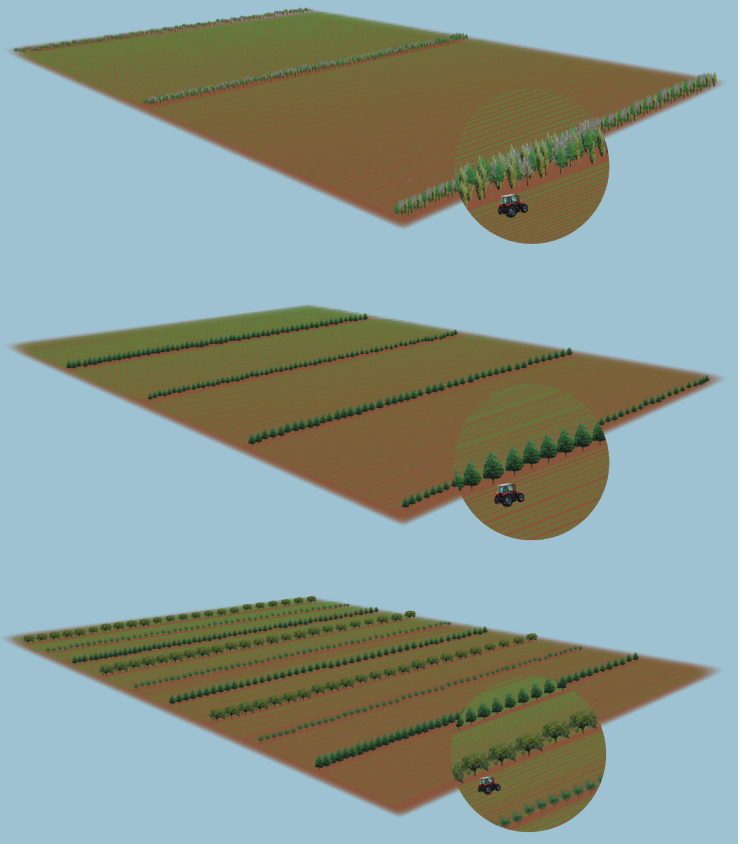
This characterisation can also be used by other relevant parties.

Farmer and farm consultant

- Partly due to the visualisations, this characterisation quickly gives an overview of the variety of agroforestry systems for Dutch agriculture. This can help farmers find a system that suits their farm and business.
- National or regional study groups can be set up for farmers with the same type of agroforestry system so that knowledge and experience can be exchanged in a targeted way. Because different opportunities and challenges arise with each type of agroforestry system. This already happens with fodder trees.

Policy maker

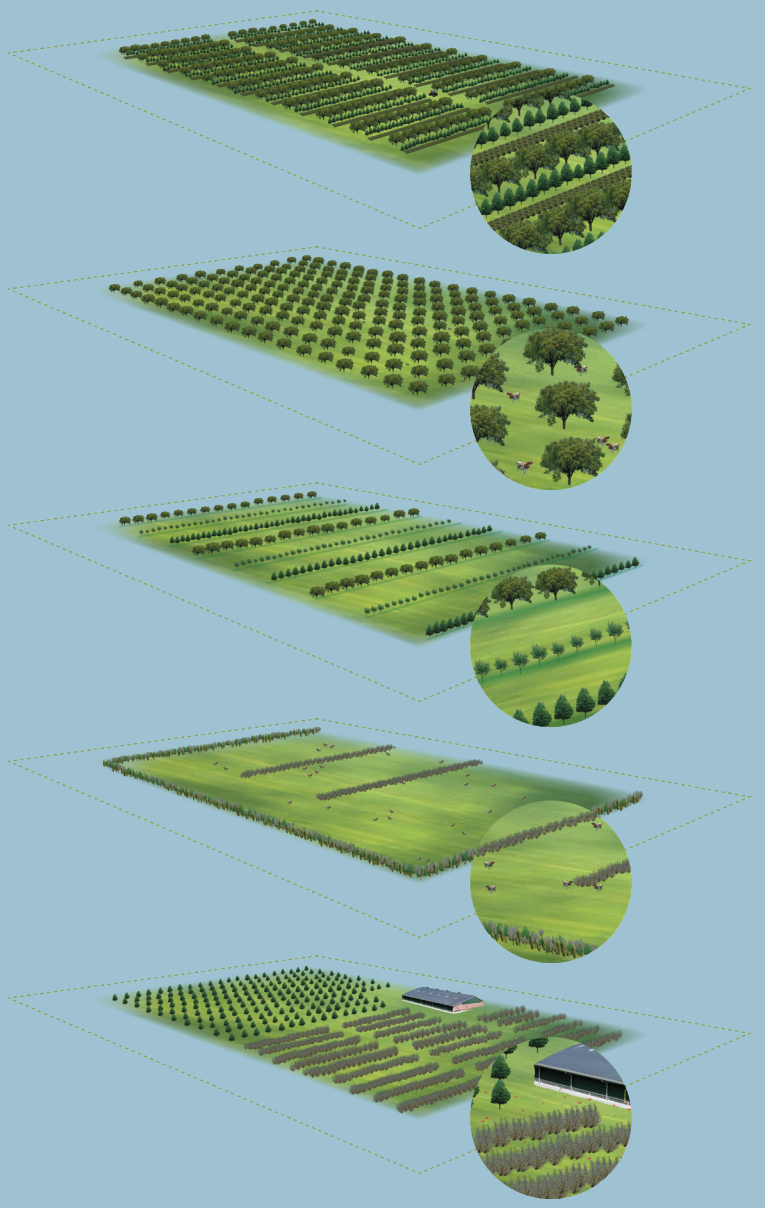
- The characterisation and visualisations can help policymakers visualise the different types of agroforestry systems and make the term agroforestry less abstract. It can thus serve as a conversation starter to engage in dialogue about agroforestry.
- The Netherlands aims to realise 25,000 hectares of agroforestry by 2030. This characterisation may help monitor whether this target is met, by showing the number of hectares realised per type. The advantage of the characterisation is that it can also provide a conservative estimation of its performance on carbon sequestration, biodiversity and other ecosystem services that are important in the context of national policy goals for nature, water and climate.
- Possibly, this characterisation can be used in some way to help with plot registration, providing an accurate picture of what kind of systems are planted in the Netherlands.
- Each of the eight types has a different effect on the environment due to differences in tree density and spatial structure. Possibly some types may be desirable in one region and undesirable in another due to ecological or landscape goals, or certain types of systems may help solve region-specific challenges. This characterisation can help to realise the right system in the right place. For example, by including it in regional plans or by providing of not providing (planting) subsidies for certain types.



Considerations

In this factsheet, the characteristics of agroforestry systems have been described in fairly general terms. Within each type, specific choices can still be made in tree species, tree density and row spacing to match the design with the local context and wishes of the farmer. In practice, all kinds of intermediate forms and spin-offs of the mentioned types will also exist and arise. Thus, within the same type of system, a high or low degree of complexity and variety of trees and shrubs can still be chosen. The characterisation in this factsheet is therefore explicitly intended as a guide and is not meant to be a blueprint for practice.

It can be said that the eight types of agroforestry systems described cover most of the current practice. Of course, other interesting forms may arise in the future that are not yet in the picture or seem promising. As agroforestry is still relatively new in the Netherlands, the characterisation can and will change over the years. This document should therefore be regarded as a living document, which can, for example, be updated before the start of each new CAP period. This characterisation should be used carefully (in policy, for example), not to hinder the development of agroforestry and the entrepreneurship of farmers.



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