The use and management of Baobab (Adansonia digitata) and Tamarind (Tamarindus indica) by three ethnic groups (Peulh, Serer, Wolof) in Senegal-An ethnobotanical study.

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Sarah PREHSLER
Matr-Nr.: 0240257
Stud.-Kennz.: H920 (Diplomstudium Landschaftsplanung und –pflege)

Supervisor: Ao.Univ.Prof. Dipl.-Ing. Dr.nat.techn. Christian Reinhard Vogl
Co-Supervisors: Dr. Dipl.-Ing. Anna Hartl, MSc. Christine Buchmann

Division of Organic Farming
Department of Sustainable Agricultural Systems
University of Natural Resources and Applied Life Sciences, Vienna
Universität der Bodenkultur Wien

Preface

The present work has been written within the framework of the four-year research project "DADOBAT-Domestication and Development of Baobab and Tamarind", an INCO/DEV-project of the European Union. The aim of the DADOBAT project is the development of sustainable production systems of both, baobab and tamarind, in three West-African countries: Senegal, Mali and Benin. The research is based on germplasm characterization, domestication of superior material, development of planting material, development of adapted cropping techniques, eludication of molecular and eco-physiological properties and improved processing techniques of baobab and tamarind. These activities are organized in eight different work packages. Characterized and improved plant material together with documented management practices shall improve traditional cropping systems and furthermore may introduce new agroforestry systems (Anonymous, 2005). The results of this project may improve food security and income situation.

The holistic research approach of the project is guaranteed through multidisciplinary activities of the following participants: University of Ghent, Belgium (Ugent), Centre of Underutilised Crops, UK (ICUC), University of Natural Resources and Applied Life Sciences Vienna, Austria (BOKU), University of Abomey-Calavi, Benin (UAC), Institute of Rural Economy, Mali (IER) and Regional Centre for Studies on the Improvement of Plant Adaptation to Drought, Senegal (CERAAS).

Within this project the Institute of Organic Farming at BOKU collects and analyzes ethnobotanical aspects of baobab and tamarind. Therefore BOKU is involved in the issues of nutritional and medicinal properties, field characterization, domestication, but also adds to information and dissemination. The results of ethnobotanical research should serve as a base for projected further studies on the domestication and development of both trees. Seen in this context, the ethnobotanical research presented here is considered as applied research.

The involvement of BOKU includes detailed ethnobotanical documentation of folk classification (different varieties of baobab and tamarind), as well as different kinds of utilisations of plant parts, traditional plant management (cropping, propagation, and transplanting methods), traditional processing and storage methods. In addition to field research, BOKU is responsible for a literature review of existing ethnobotanical data on baobab and tamarind. Results from field research in all three countries are confronted with existing literature data.

For ethnobotanical research, information has been collected in a consistent manner using the same methods in all three countries (Senegal, Mali and Benin) and study areas to allow comparison and joint presentation of data. In three countries nine different ethnic groups have been investigated. The author of the present study has undertaken field research and data collection in Senegal by investigating three different ethnic groups (Peulh, Serer, Wolof) by factors of local ethnobotanical knowledge on baobab and tamarind. Results have been contributed to the DADOBAT project and are shown in the present work.

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To Umut

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Used abbreviations

BOKU	University of Natural Resources and Applied Life Sciences, Vienna *Universität für Bodenkultur Wien*
CERAAS	Center of regional research for improvement and adaptation to drought *Centre d'étude régionale pour l'amélioration de l'adaptation à la sécheresse*
CIRAD	Center of international cooperation of agronomic research for development *Centre de coopération internationale en recherche agronomique pour le développement*
ENGREF	National school of rural industries of water and forests *Ecole nationale du génie rural des eaux et des forêts*
IRC	Institute of hot regions *Institut des regions chaudes*
CNEARC	National center of agronomic studies in hot regions *Centre national d'études agronomiques des régions chaudes*
SIARC	Section of alimentary industries for hot regions *Section des industries alimentaires pour les régions chaudes*
IAA	Agrarian-alimentary industries *Industries agricoles alimentaires*
AGRO	Polytechnic of agronomics *Ecole Supèrieure d'Agronomie*
INRA	National institute of agronomic research *Institut national de la recherche agronomique*

1. Introduction

The high present population growth, unsustainable overexploitation and scarcity of resources, climate change as well as loss of biodiversity, a lot of problems must be faced. Soil degradation, drought, desertification, water shortage, pest and disease pressure, fragile ecosystems, famine and increasing poverty and hunger are acute global issues (Diallo, 2001; Jama et al., 2007; Sidibé & Williams, 2002).

Although local communities have managed species for many generations, their practices in the last decade were influenced by changes in land and conservation policy, mechanization and intensification of agricultural practices (Dhillion & Gustad, 2004).

In order to cope with the increasing problems new strategies have to be developed, sustainable strategies that are adapted to specific situations. These strategies can be, among others, the diversification of agricultural systems, valorisation and conservation of local resources and biodiversity, as well as access to markets for small farmers. These strategies shall improve income and food security, health care and sustainable development (Assogbadjo et al, 2006; Dhillion & Gustad, 2004; Igboeli et al, 1997; Jama et al, 2007).

One line of approach is the diversification of agricultural systems such as agroforestry systems and introduction of alternative food supplies in times of shortages by introducing and cultivating local trees in existing agricultural systems. Through these systems, local tree resources are valorised and can contribute to new household income (Assogbadjo et al., 2006; Jama et al., 2007). Agroforestry systems are especially applicable to fruit trees, which are not currently domesticated, but well used or already overexploited by local people. With this strategy local people could play an important role in resource management and conservation (Dhillion & Gustad, 2004; Jama et al., 2007).

In the Sahel zone, which is one of the most endangered regions, people are already suffering from climatic changes. This is one of the areas most urgently requiring action in fighting the processes of decreasing ecosystem' stability.

With this background, the present work attempts to contribute towards a strategy for sustainable development by researching and documenting the local knowledge of two common multifunctional used tree species of the semi-arid and arid regions: Baobab (*Adansonia digitata)* and tamarind (*Tamarindus indica).* This work may be considered as a starting point for further research on these trees and dawning sensibilisation process towards resource management and the development of adapted cultivation systems.

Baobab and tamarind are natively used trees: almost no cultivation systems or conservation programs are known (Jama et al., 2007). At the same time high pressure persists on these species, in many regions both trees are overexploited. Therefore a need to develop sustainable ways of utilisation by valorisation and preservation exists- not only for the conservation of biodiversity but also because both trees play an important role in the subsistence of food and vitamin intake of local people in times of shortages and famines, contribute to health status, and finally in a socio-economical sense (Bergeret, 1986; Diallo, 2001).

Before setting out to develop new techniques of cultivation and valorisation of these resources, more in depth knowledge about their potential and their cultural norms is needed. It has to be elucidated how local people use these trees, whether newly developed systems are adaptable to specific regions and whether local people would comply with these ideas. The present work will give an overview of the ethnobotany of baobab and tamarind with the purpose of better understanding local people's way of thinking and acting, as well as their relation to both species in sense of utilisations, values and behaviours.

The study presented here was undertaken in Senegal, one of the most emergent Sahel zone's countries. Data was collected not only in the Sahel zone but also in the Soudanian and Guinea-Congolia/Soudanian zone to illuminate parallels and differences between selected regions and the ethnic groups using these trees. Three ethnic groups were appraised: the Wolof, the Serer and the Peulh.

2. State of the Art

After the definition of technical terms, current knowledge on baobab and tamarind are summarized.

2.1. Definitions

Definition of Ethnoecology and Ethnobotany

Ethnobotany is seen as one of the multidisciplinary subdisciplines of ethnoecology. According to Martin (2004) the terms ethnoecology and ethnobotany are defined as follows: *"The term ethnoecology is increasingly used to encompass all studies which describe local people's interaction with the natural environment, including subdisciplines such as ethnobiology, ethnobotany, ethnoentomolgy and ethnozoology. Ethnobotany refers to the study of the interactions between people and plants"* (Martin, 2004, p.xx-xxi).

Definition of local people

Martin (2004) uses the term local people "*for residents of the region under study who have gained their ecological knowledge from empirical observation of nature and from communication with other people in their culture"* (Martin, 2004, p.xxiii). The author will use this definition for the present thesis.

Definition of local/traditional/indigenous knowledge

In this thesis, local knowledge will be used as a type of empirical knowledge, which is linked to a defined place or site. Indigenous knowledge shall be seen as local knowledge of indigenous people. Haverkort (1995, p.454-455) defines indigenous knowledge as "*actual knowledge of a certain farming population which reflects the experiences based on traditions*". According to Haverkort (1995) indigenous knowledge is not static. "*Such* (indigenous) *knowledge is generated and continues to develop in specific cultural and ecological systems and cannot be seen independent on these systems"* (Haverkort, 1995, p.454-455). Haverkorts definition leads to traditional knowledge. Martin (2004) uses the term traditional knowledge referring to what local people know about the natural environment. Traditional knowledge is focused on historical continuity and transmission of knowledge from one generation to another and used in the present thesis in this sense.

2.2. Baobab *Adansonia digitata*

The scientific name *Adansonia,* was first given in the year 1759 by Linnaeus, to honour the celebrated French botanist Adanson, who lived in Senegal and provided the first technical description and illustration of the tree (Blench & Dendo, 2003).

2.2.1. Origin and distribution

Concerning the origin of the baobab, two theories exist: tropical subsaharian Africa (Diop et al., 2005) or emergence from Madagascar, from where the genus *Adansonia* spread to continental Africa (Baum et al., 1998). Besides its natural habitat the baobab is also found in Cap Verde Islands, the Arabian Peninsula, India and Sri Lanka (Wilson, 1988).

In Africa, the baobab appears from dry tropical to subhumid Africa, the southern Sahara, the Soudano-Sahel Savannah and infrequently in the Guinean wooded Savannah (Arbonnier, 2004; Booth & Wickens, 1988; Burkill, 1985; Diop et al, 2005). The distribution reaches from Senegal to Soudan, and Eastern Africa, from Ethiopia to Mozambique and Natal (Arbonnier,

2004). In Senegal the baobab appears everywhere, sometimes it is found in very dense populations (Berhaut, 1974).

Especially in Sudan and West Africa the baobab grows mostly around villages and old village sites and is therefore closely associated with human population activities (Anon., 1993; Arbonnier, 2004; Burkill, 1985; Diop et al, 2005; Giffard, 1974). A study in Central Western Senegal, in the region of Thiès, points out that all Serer villages are surrounded by a circle of baobabs. These circles of baobab are also an indicator for abandoned, former villages. People are known to have sown the seeds of baobab for its utilisation (Niang, 1981). Assogbadjo et al. (2005) emphasised this statement when they recorded most of the baobabs in Benin around villages or on farms. Nowadays it is still not clear, whether man settled because of the baobab or if man has been responsible for dispersing the seeds around already existing villages.

The baobab fruit is a food source and was often carried by pastoralists, which explains the existence of baobabs along former cattle-trails. When pastoralists cracked the shell and ate the seeds, trees sprouted along the passages they ventured (Blench & Dendo, 2003). Across West Africa, even today discarded baobab fruits can be found along the line of Fulbe migration routes and the presence of baobab marks the lines of such routes, even after the use of trees was discontinued (Blench, 2001). Besides Fulbe, Arab merchants scattered baobab seeds on their routes as far as India (Maheshwari, 1971).

2.2.2. Ecology and habitat

The baobab has broad ecological tolerances (Blench & Dendo, 2003). It grows on very variable soils (Arbonnier, 2004), but prefers deep, full draining soils and thriving on sandy or limy topsoils (Anon., 1993; Booth & Wickens, 1998). It does not grow in deep sands (Booth & Wickens, 1988) and does not tolerate temporary inundations on heavy, loamy soils (Maydell, 1990).

Adansonia grows from open thorn shrub to wooded savannah, from rocky to sandy coastal environments and sometimes along river valleys (Booth & Wickens, 1988; Sidibe & Williams, 2002). The baobab can be found ranging from a single isolated tree to dense clumps with a closed or almost closed canopy (Wilson, 1988).

The baobab requires mean annual temperatures from 20 to 30°C (Booth & Wickens, 1988) and appears at sea level from 0 to 1.500m, given sufficient heat. The optimal sea level is from 450 to 600m (Booth & Wickens, 1988, Diop et al, 2005).

Adansonia digitata appears from 90 to 1.500mm mean annual rainfall (Booth & Wickens, 1988; Schütt & Wolf, 2006). The greater part of the distribution is below 800mm; under 400mm the population decreases (Jama et al., 2007). The baobab is one of the most effective trees in controlling its water loss. The lateral growing roots are relatively shallow-down to 1.8m, but are spread out to a distance greater than the heights of the trees, which is a strategy of adaptation to low annual rainfalls and long drought periods. In addition, the baobab is known to have a very effective stomatal and/or cuticular control of water loss, which is probably controlled by rapid stomatal closure. Loss of water during dry season causes the circumference to decrease by some centimetres (Fenner, 1980).

Young baobab trees grow very fast with an annual maximum growth of 80 to 100cm (Maydell, 1990). Young baobab trees require high exposure to light and are therefore vulnerable to competiting ground vegetation. Other risk factors for young trees are drought, fire and damages caused by animals and agriculture (Schütt & Wolf, 2006). Because of high land pressure and wide dispersion of agriculture and pasture, natural regeneration is nowadays only possible in exceptional cases, causing obsolescent of populations (Wilson, 1988).

The question of baobab age used to be subject to debate. Previously the baobab was assumed to live for thousands of years because of its enormous trunk. Nowadays, carbon dating allows age estimation at around 1.000 +/- 100 years (Wilson, 1988).

2.2.3. Biology and botanical description

The genus *Adansonia,* member of the *Bombacacae* family*,* counts six species in Madagascar, one in Australia and one in sub-Saharan Africa- *Adansonia digitata* (Giffard, 1974).

The baobab is a tree about 10m high but may grow up to 30m (Anon.,1993; Berhaut, 1974; Booth & Wickens, 1988). It has an enormously stout trunk, ranging from 2m up to 10m in diameter (Anon., 1993; Arbonnier, 2004; Booth & Wickens, 1988; Diop et al, 2005) and 20m girth or more (Burkill, 1985). The trunk is often hollow (Arbonnier, 2004). The branches are short and broad, and frequently irregular (Diop et al, 2005).

The outer bark is hard and smooth internally, it is silver grey to purple, thick and very fibrous (Arbonnier, 2004; Booth & Wickens, 1988; Diop et al, 2005; Schütt & Wolf, 2006). The wood is soft, spongy and saturated with water (Diop et al, 2005; Schütt & Wolf, 2006) explaining the high resistance to drought and fire. The quantity of stored water is estimated at around 120m³ (Diop et al, 2005). A layer of green cells directly beneath the bark allows photosynthesis during the leafless time (Fenner, 1980). The wood is extremely vulnerable to fungi and little durable (Schütt & Wolf, 2006).

The leaves are simple when young, becoming alternate, digitate and compound, 5-9 almost sessile leaflets. The leaves reach 20cm in diameter (Booth & Wickens, 1988, Diop et al, 2005). The tree is leafless between December and June (Giffard, 1974) correlating with the dry season (Maydell, 1990).

The flowers are solitary or in pairs, hanging 15cm to 1m on a peduncle , 8 to 20cm in diameter, large and white with 5 petalouses (Arbonnier, 2004; Booth & Wickens, 1988; Diop et al, 2005; Schütt & Wolf, 2006). The tree blooms at the end of dry season or just before rain season, normally before the first leaves appear (Arbonnier, 2004; Berhaut, 1974; Booth & Wickens, 1988). In Senegal, the baobab begins to flourish in June with the beginning of the rain season. The leaves appear at the same time as the flowers and persist until October (Diop et al., 2005). The flowers open in late afternoon or early evening and remain open for 16 to 20 hours (Booth & Wickens, 1988; Diop et al, 2005). Flowers are pollinated by fruit bats and bush babies, which are attracted by the carrion smell given off by the flower (Booth & Wickens, 1988; Schütt & Wolf, 2006). The development of the fruit takes 5 to 6 months (Diop et al, 2005). In Senegal, the fruit develops from August to October and mature from November to January.

The fruit, called Monkey Bread or Pain de Singe, is of variable shape: oval, elongated globose or clubbed; 15 to 40cm long and 7 to 15cm in diameter (Arbonnier, 2004; Burkill, 1985; Diop et al, 2005). The pod is woody, bronze-green to brown, and covered by a layer of tomentose hair. The pulp is white to creamy and generally dry and mealy. It contains a large number of brown to black seeds (Arbonnier, 2004; Booth & Wickens, 1988; Diop et al, 2005; Schütt & Wolf, 2006). The name baobab, given by Alpini in the year 1591, has its origin from the Arabic *Bu hibab* which means *Fruit with many seeds* (Burkill, 1985; Diop et al., 2005). The seeds are dispersed by monkeys, squirrels, rats, elephants, birds and humans (Booth & Wickens, 1988). The natural germ inhibition is broken by the passing of the intestinal tract (Schütt & Wolf, 2006).

Fruit production begins with 8 to 10 years of age. Seeds take 8 months to mature, normally during rain season (Jama et al., 2007; Schütt & Wolf, 2006).The fruit falls late in the rain season. The fractured pods allow termites to obtain the seeds (Booth & Wickens, 1988). The

quantity of fruit production can alternate; in some years the tree does not produce any fruit (Diop et al, 2005). The baobab fruit is the food of preference for baboons, explaining the origin of the name Monkey Bread or Pain de Singe (Dellatola, 1984).

2.2.4. Utilisation

Klein (1961) describes the baobab in the year 1961 as a tree without any commercial value, as well as a tree with an unusable wood, which only hinders the cultivation of crop plants and therefore should be destroyed chemically. However, the baobab is used by local communities in multifunctional ways. The main benefits of the tree are alimentation, forage, domestic utilisations and its medicinal properties (Billand & Diallo, 1991). Only the wood is rarely or not used (Giffard, 1974). Local populations have developed traditional ways of processing baobab products for auto-consumption, marketing and preservation (Assogbadjo et al., 2006).

Food uses and processing

Baobab consumption increases in situations of cereal crop failures and thus the tree can serve as crucial source of nutrition during catastrophic events, (Dhillion & Gustad, 2004), although leaves and fruit of baobab are also consumed regularly throughout the whole year. Therefore, *Adansonia* serves either as food substitute in times of crisis or, when there is no famine it plays an important role in nutritional balance (Chastanet, 1991). Notably however, the time of fruiting and harvest also corresponds to the usual season of food shortage (Assogbadjo et al., 2005).

Flowers are eaten raw (Bosch & Asafa, 2004; Maydell, 1990). The pulp is chewed by children and animals. Mixed with water it gives a cloudy liquid which is taken as milk-substitute (Burkill, 1985) or used to thicken milk in dry season when yields are low (Blench, 2001). In Senegal, a drink consisting of pulp mixed with sugar and water is known as *ndiambdne* (Wickens & Lowe, 2008). The baobab pulp, mixed with the flour made of the fruit of the Néré (*Parka biglobosa),* is consumed in the form of ice-cream. To obtain ice-cream the juice of both fruits is frozen. In Guinea, a traditional meal called *souloukoubada* is prepared by piercing a hole into the baobab fruit, filling it with water, adding groundnut paste and sugar or honey and blending it with a *baguette*, which gives a semi-liquid paste (N'Diaye et al., 2003). For storage purposes, the fruit pulp is sundried or fermented (Bosch & Asafa, 2004). The dry pulp is rich in calcium, magnesium, phosphor and, when eaten raw, in vitamins B1 and C (Anon., 1993; Booth & Wickens, 1988; Burkill, 1985). The vitamins deteriorate when stocked (Diop et al, 2005). Furthermore, the pulp is a good source of pectin, tartars and rich in mucilage (Booth & Wickens, 1988; Dweck, 1996). The presence of tartars gives rise to the name "Cream of Tartar tree" (Dweck, 1996).

In times of famine seeds are eaten roasted (Berhaut, 1974). Seeds are used as a coffee substitute (Booth & Wickens, 1988; Dellatola, 1984; Diop et al, 2005; Dweck, 1996). The thick seed shell is difficult to separate from the kernel, which might limit its utilisation. Traditionally, seeds are sundried, roasted or fermented for conserving (Bosch & Asafa, 2004). They are high in protein-about 30%- and thiamine, calcium, magnesium, phosphor and iron (Booth & Wickens, 1988; Burkill, 1985; Diop et al, 2005 Igboeli et al., 1997). The kernel contains 68% oil, which can be boiled off or won by pounding seeds is used for gala occasions in Senegal (Burkill, 1985; Kerharo 1974). The oil is semi-fluid, golden yellow, gently scented, non-drying and has a long shelf life. It is used for cooking and in the cosmetics industry (Bosch & Asafa, 2004).

Leaves, especially young leaves, can be eaten raw or cooked as spinach or used to make soups and sauces (Booth & Wickens, 1988; Burkill, 1985). In Senegal, glabrous leaves are preferred (Dhillion & Gustad, 2004). The leaves are often sundried, pounded and sieved to

powder for conserving. This powder is known in West Africa as *lalo* and used as thickening and flavouring agent for couscous preparations or sauces (Anon., 1993; Assogbadjo et al., 2005; Berhaut, 1974; Burkill, 1985; Dhillion & Gustad, 2004; Wickens & Lowe, 2008). Drying leaves in the shade decreases the loss of vitamin A, as opposed to sundrying (Bosch & Asafa, 2004). Furthermore, leaves serve as livestock fodder in times of food shortages during dry season (Schütt & Wolf, 2006), although the high tannin content of the leaves has a marked negative effect on digestibility (Bosch & Asafa, 2004).

Baobab leaves are rich in calcium and fresh leaves in vitamin A and C, which degrade during drying for the production of *lalo* (Burkill, 1985). Also, high quantities of vitamin B1, B2 and B3 are found in the leaves (Diop et al, 2005), making them an important complimentary source of nourishment and often the principal source of calcium for local communities. This is especially true for people who do rarely consume milk and meat and depend on millet. Furthermore, the leaves have a high iron content and are an excellent source of magnesium and potassium (Billand & Diallo, 1991; Diop et al, 2005; Jama et al., 2007).

In Western Africa baobab roots are cooked and eaten as a food in times of famine (Arbonnier, 2004; Booth & Wickens, 1988; Bosch & Asafa, 2004; Burkill, 1985).

Therapeutic and medicinal utilisations

All parts of the plant are rich in mucilage and are medicinally used as emollient (Berhaut, 1974).

Flowers are applied against asthma and cough (Kerharo, 1974). Water, which is filtered through the ash of burnt fruit, can be added to soup, as this is believed to kill germs and cure stomach ailments (Burkill, 1985). The pulp is used against diarrhoea and dysentery (Berhaut, 1974, Dweck, 1996; Kerharo, 1974). This treatment is held in great esteem by the Wolof of Senegal, but Peulh and Toucouleur have little faith in its efficacy Kerharo & Adam, 1964 in Wickens & Lowe, 2008). The pulp also serves as febrifuge which is drunk as infusion (Kerharo, 1974). Baobab fruit pulp improves iron status of children with low iron levels in their blood (Nnam, 2004 in Wickens & Lowe, 2008).

Seeds are used as a febrifuge and as an eye-instillation (Booth & Wickens, 1988). The extracted oil, traditionally won by pounding the seeds, is used to relieve aches, pain and rheumatism as well as for treating skin complaints. Compresses of roasted seed paste have an anti-inflammatory effect (Kerharo, 1974). Roasted seeds are crushed to a paste which is used for teeth troubles (Arbonnier, 2004; Berhaut, 1974; Burkill, 1985). A decoction of the roasted and pounded seeds is useful in cases of diarrhoea and dysentery (Dweck, 1996; Kerharo, 1974; Wickens & Lowe, 2008). A decoction of the fruit shell's fibres is given for amenorrhea (Dweck, 1996).

The leaves are generally used for kidney and bladder diseases, asthma, fatigue, blood-cleanser, diarrhoea, dysentery, anaemia, fever, malaria, insect bites, expulsion of guinea-worm, internal pains, inflammations, inflammatory diseases of the urinary tract, ear troubles, backache, rachitis, wounds and tumours (Arbonnier 2004; Berhaut, 1974; Booth & Wickens, 1988; Burkill, 1985; Dweck, 1996; Kerharo, 1974). Asthma, sedation, colic, fevers, inflammations, diseases of the urinary tract, ear troubles, backache, wounds and tumours, respiratory difficulty etc. are treated by lalo by mouth or as external application by liquid preparations as decoctions (Dweck, 1996). Absorbed lalo from the leaves protects from asthma attacks. Leaves are diaphoretic and promote sweating. A hip bath with *lalo* helps against dysentery; hot lotions of cooked leaves, fumigation of leaves or compresses of *lalo* are used as an anti-inflammatory and compresses of lalo decoctions are applied in cases of wounds (Kerharo, 1974). In Senegal, leaves are prepared as tea, serving as emollient and calmative, against fever. A hip bath helps against dysentery and illnesses of urinary passage

(Berhaut, 1974). The leaves are component of several salve preparations (Berhaut, 1974). They have hypotensive and antihistaminic properties (Dweck, 1996).

The bark is medicinally used as a febrifuge, malaria prophylactic, against tooth decay, anorexia and menorrhalgia (Arbonnier, 2004; Berhaut, 1974; Booth & Wickens, 1988; Burkill, 1985; Kerharo, 1974). For toothaches a bark decoction is gargled in Senegal (Irvine, 1961 & N'Diaye 1962 in Wickens & Lowe, 2008). It is diaphoretic and anti-periodic, which means that it prevents the return of recurring diseases such as malaria (Booth & Wickens, 1988; Dweck, 1996). Children with rachitis bathe in decoction of bark (Berhaut, 1974).

The root, dried and powdered, is taken to treat acute malaria (Arbonnier, 2004; Booth & Wickens, 1988; Burkill, 1985). The root of baobab is used for therapy of mental disorders in the Toucouleur region of Senegal (Kerharo & Adam, 1964a in Wickens & Lowe, 2008; Kerharo, 1974). Wounds are cleaned with baobab resin (Kerharo, 1974) and the resin soothes teeth problems (Maydell, 1990).

Other uses of baobab

Hollowed out, the baobab trunk is used as tomb, shelter, loft, dwelling, store, prison or water cistern (Anon., 1993; Arbonnier, 2004; Booth & Wickens, 1988; Burkill, 1985) and by several animals as shelter (Berhaut, 1974). In dry rangelands of Northern Africa and the Sahel baobab is used as living fence to keep out animals, protect houses, cropland and gardens or to mark property lines and dividing lines between plots (Rocheleau et al., 1988).

The acrid smoke of burning fruits is used to drive off stinging insects (Booth & Wickens, 1988; Burkill, 1985). The ashes of burnt husk give potash-rich vegetable salt, which are used for the fabrication of soap. The ashes of the husk, the peduncle and bark are rich in potash and give force to tobacco. It may even serve as a tobacco substitute (Berhaut, 1974; Bosch & Asafa, 2004). The powdered husk can also be smoked (Booth & Wickens, 1988; Burkill, 1985). Pollen mixed with water is used as glue (Blench & Dendo, 2003; Booth & Wickens, 1988). The fruit pulp, especially of lower quality, as well as the leaves, serves as additional revenue by selling it on local markets. Fruit pulp and leaves are strongly commercialized in Western Senegal (Bergeret, 1986, Giffard, 1974) and at least the dried pulp is available throughout the whole year (N'Diaye et al., 2003). This new source of income has led to the development of new habits. Women from the Soninke ethnic group in Senegal are reported to buy more and more the baobab leaves from Peulh women, which come from other villages (Chastanet, 1991). This relatively new value of baobab could lead to overexploitation, which might no longer guarantee the natural reproduction of baobab (Bergeret, 1986).

The light, spongy and delicate wood, which is easily attacked by fungi, is hardly used. However, the most common uses are fabrication of canoes, floats, wooden plates, trays etc. It gives poor firewood and poor quality charcoal. The low value humans place on this wood must be a favourable characteristic for survival of tree species in areas with increasing demands for wood. Wild animals chew the wood (Booth & Wickens, 1988; Burkill, 1985; Dhillion & Gustad, 2004; Diop et al, 2005).

Local people use the strong and durable fibre from the inner bark to fabricate ropes and cordages, belts, strings for musical instruments, fishing nets, baskets, mats, nets, hammocks, fishing-lines, cloths (Arbonnier, 2004; Booth & Wickens, 1988; Burkill, 1985). Nevertheless, Dhillion & Gustad (2004) observed that the arrival of stronger synthetic alternatives leads to decreasing exploitation of baobab bark for rope production. The bark is used for tanning (Booth & Wickens, 1988). Soap lye can be made from the bark ash (Dweck, 1996), which is also used as fertilizer (Burkill, 1985).

In times of fodder shortages, towards end of dry season, the bark is eaten by horses and donkeys (Arbonnier, 2004). Because of its high water content there are several legends about the baobab having saved the life of more than one traveller (Dellatola, 1984). In times of famine, men and animals chew the bark to slake their thirst (Maydell, 1990). It is said that men have planted the tree to use it as water storage (Burkill, 1985). One can even cut a hole into the trunk and take the desired quantity of water before reclosing the hole (Dellatola, 1984). Because of the high quantity of stored water in the trunk, the baobab is very drought-resistant and resistant to fire (Anon., 1993; Burkill, 1985).

The root, dried and powdered, is used as red dye (Arbonnier, 2004; Booth & Wickens, 1988; Maydell, 1990). The root bark is used as string for nets, socks, mats, etc. (Booth & Wickens, 1988; Burkill, 1985).

Dead trees and processing residues such as branches, fruit shells and the outer, coarse layer of the bark can be burnt to produce potash (Dhillion & Gustad, 2004).

2.2.5. Symbolic and cultural value

Adansonia digitata has a place in numerous cultures and beliefs in magical and superstitious stories and traditions (Burkill, 1985; Diop, 2005). It is often chosen as regional emblem (Diop et al, 2005). In Western Africa the baobab tree is often called “the mother of Sahel” (Maydell, 1990).

Because of its strange and gigantic shape the baobab tree is often associated with many legends. Some ethnic groups believe that God was in anger and that is why he tossed the baobab into a dry part of Africa. The tree landed upside down with its roots in the air. Other ethnic groups say that God distributed the seeds to men and animals and because of their stupidity, some of them planted the baobab the wrong way round (Dellatola, 1984).

The baobab tree is considered as a symbol of fertility, sacred tree, fetish tree and associated with some taboos (Assogbadjo et al., 2005; Burkill, 1985). The Serer used to gather under the baobab for rainmaking ceremonies when the dry season drew near (Anonymous, 2005a in Wickens & Lowe, 2008). Senegalese often presented offerings to their ancestral spirits under the baobab tree, such as eggs, kola nuts or millet porridge, called *lakh* (Wickens & Lowe, 2008). In Benin, some individual baobabs are inhabited by evil spirits, others are said to be divine trees, which are objects of rituals and ceremonials held around the trees (Assogbadjo et al., 2005). The presence of a baobab tree near homesteads is interdicted in some regions of Mali while in other regions people plant the baobab for protection. The penetration of its roots into the room is said to evoke a misfortune, but, at the same time, it is told that if the roots of a baobab tree cross the way of a walker, it will bring good fortune and power to him. Besides Mali, mythologies of baobab are also spread throughout in Senegal, Mali, Burkina Faso, Benin and Niger (Sidibé & Williams, 2002).

In Senegal, the Serer and Wolof cultures used to mummify and “bury” the bodies of so-called *griots* in a hollow baobab. Griots are people of low rank in Serer and Wolof societies, often “praise singers”, musicians, poets, society’s historians and so on. Such people, as well as their wives and children, could not be buried in the soil, because it was said that the millet crop would fail. Neither could the bodies of these *griots* be thrown into the sea or rivers, because they would pollute the water. Therefore, people chose hollow baobabs, which are between the earth and sky. Today, the practice of burying *griots* in hollow baobabs has diminished (Gillet, 1986; Wickens & Lowe, 2008).

Beside cultural and symbolic values of the tree as a whole, baobab pulp and leaves are often used to prepare meals served to guests during wedding and baptism ceremonials (Assogbadjo et al., 2005). The Wolof of Senegal concoct a dish known as *ngalakh*, which is prepared from baobab pulp mixed with millet and groundnuts and eaten by Catholics on

Good Friday. Moslem families are said to eat a similar preparation at the end of Ramadan and Catholic families at the end of fasting. Again in Senegal, parents protect their babies from evil by bathing them in water containing flour made from baobab seeds (Owen, 1970 in Wickens & Lowe, 2008).

2.2.6. Harvest and storage management

The time of fruiting and harvest takes place mainly from January to February (Diop et al, 2005). Fruits in Senegal are ripe from January to April. An average mature tree produces about 200kg of fruit per year (Bosch & Asafa, 2004). Fruit harvesting has an impact on dispersal and establishment, while foliage harvesting causes mutilation that reduces the number of fruit on each tree and thus affects fruit production (Dhillion & Gustad, 2004). Trees that are harvested for their leaves produce hardly any fruit because of the drastic pollarding during leaf harvest (Bergeret, 1986).

Main harvesting time of leaves in Senegal is from September to October (Bergeret, 1986). Leaves are harvested either by women or boys. Women and boys gather leaves either by climbing the tree and cutting branches or using a sickle mounted on a long stick, which enables harvesting without having to mount the tree (Bergeret, 1986; Dhillion & Gustad, 2004). A study in Senegal highlights, that food gathering is normally a labour performed by womenfolk, while in the special case of baobab fruit and leaf harvest, men participate in the harvesting procedure (Chastanet, 1991). Another study in Mali points out that fresh leaves, soon after their development at around May, are harvested by women for daily consumption, whereas men are responsible for bulk harvesting for storage purposes through the dry season. This harvest by men is conducted right after work in the fields, from September to October. Men climb up the tree and harvest leaves by cutting with a regular sickle, while women prefer not to ascend (Dhillion & Gustad, 2004). Shepherds also climb trees and cut branches for animal fodder (Maydell, 1990).

The trunks of the baobabs are often damaged up to 1 or 1.50m because of man using the fibrous bark (Berhaut, 1974). However, the species appears to be able to tolerate rough treatment and to regenerate bark tissue (Blench & Dendo, 2003; Burkill, 1985; Dhillion & Gustad, 2004). Bark can be collected at any time of the year, but according to local communities in Mali it should only be done once a year (Dhillion & Gustad, 2004).

2.2.7. Propagation and cultivation systems and conservation management

Studies in Benin point out the scant recruitment of young baobab trees and conclude a natural regeneration problem of baobab, due to bush fires and other anthropogenic activities, such as land clearing and browsing (Assogbadjo et al., 2005). Other theories reach from long-term changes in land use to climate changes. Long-term drought and increasing human populations lead to an expansion of cultivation and heavier grazing pressure by domestic animals (Wilson, 1988). Another study reports that some farmers have to buy the baobab fruits because the baobabs of their region do not produce enough fruit (Bergeret, 1986). To fight this process, Senegal is undertaking some protection, domestication and valorisation programs (Soloviev et al., 2003). In Mali, ICRAF (2007) and IER (l'Institut d'économie rurale) have already developed some systems. Gardening systems with tiny baobab trees have been tested. Trees at the age of four weeks could already be harvested, which again promoted production of new leaves. Farmers reported that they harvested three kilograms of foliage every two weeks. These systems could increase fruit production of wild baobab trees, as they would not be damaged by leaf harvest (ICRAF, 2007).

An essential part of baobab trees is exploited by wild individuals: in most of the cases the baobab is not cultivated, (Diop et al, 2005) although, because of its multiple uses,

propagated and protected (Anon., 1993; Jama et al., 2007). Even if not planted, baobabs are not cut for firewood as they are believed to harbour spirits (Blench, 2001). Farmers sometimes care for baobab seedlings in their courtyard until they are two or three meters tall, when baobabs are transplanted to the borders of their fields (Bosch & Asafa, 2004). Studies in central Senegal showed that Serer farmers commonly care for baobab seedlings that germinate in the garbage, but, on the other hand, deliberate planting of baobab trees is not practised (Pélissier, 1966). Young baobabs receive a lot of attention in Peulh communities, while they seem to be absent in Wolof fields (Bergeret, 1986).

Some ethnic groups in western Africa make a distinction between wild and domestic plants. Domestic plants are plants that grow near the habitations, in contrast to wild plants in the bush. Planting is seen as a cultivation practice, reserved for domestic plants, such as millet, while baobab trees can be transplanted from the bush to cropland near habitations (Bergeret & Ribot 1990). Throughout most of Africa, wild, indigenous trees “belong” to the “bush” and should therefore not be planted, whereas exotic trees, such as mangoes and neems are acceptable domestic plants. It is said that misfortune will befall anyone who plants trees that already grow in the bush (Blench, 2001).

In Mali, however, baobab is grown as a crop by local people (Wilson, 1988); although studies have found that local people do not consider the resource of the baobab tree as insufficient. A study in Mali has found out that one of the main reasons for local people to plant baobab trees is the availability of fresh leaves during dry season. At the same time the cultivation simplifies the harvesting process and eliminates the risk of falling off the tree during harvesting (Savard et al, 2006). Further motives for local people for caring for young baobab trees are the future value of leaf-, fruit-, seed- and bark products and sometimes also potash, social and cultural values (Dhillion & Gustad, 2004).

Again in Mali, people also believe that demons house in big baobab trees. These demons are responsible for the accidents that happen while people harvest leaves and fall. Planting a few small baobab trees could protect people from these demons because demons only live in the biggest trees. Studies in Mali, however, have shown that these taboos and beliefs do not greatly affect the employment of these practices. Local people seem to make a difference between the big trees, which grow wild in the bush, and the planted individuals, which remain small and are therefore not as much associated with taboos and beliefs (Savard et al, 2006).

A study in Central Western Senegal, in the region of Thiès, reports that Serer sow sorghum (*Sorghum bicolor*) around baobab trees because of the quantity of organic matter, which results from the decomposition of the aerial plant parts. This cultivation system can be seen as an agroforestry system (Niang, 1981).

Its large size and the long period between germination and first fructation of the baobab is a limitating factor. The latter problem, however, could be solved by vegetative multiplication, by grafting after selection of varieties (Diop et al, 2005). Furthermore, the poor and slow germination of the baobab tree and its relatively slow reproduction is seen as constraint (Booth & Wickens, 1988; Dhillion & Gustad, 2004; Diop et al, 2005). Baobab can be propagated from seeds (Jama et al., 2007). In nature, the dormancy is broken by the transit through the digestive tract of large mammals (Maydell, 1990). To artificially break the dormancy the seeds are boiled in water for 5 to 15 minutes or soaked for 1 to 2 days in cold water which is done traditionally by local people (Booth & Wickens, 1988; Diop et al, 2005). Dipping seeds into a nitric or sulphuric acid solution would augment the germination rate to 86% while soaking in water has a germination rate of fewer than 10% (Diop et al, 2005). Transplanting is recommended at the beginning of the rains, leaving intervals of 20 to 30m (Booth & Wickens, 1988). Demanded management strategies protect young plants against fire and livestock, because sprouts are devoured by cattle (Anon., 1993; Booth & Wickens,

1988; Diop et al, 2005). Beside sowing, stem cuttings can be easily rooted (Bosch & Asafa, 2004).

2.2.8. Folk classification and selection criteria

Billand and Diallo (1991) found that local communities choose the trees by the taste of leaves. People's sense of taste and preferences changes with regions and ethnic group. Furthermore, preferential selection for leaf quality and intentional protection for fruit production explain why some trees are practically untouched (Dhillion & Gustad, 2004).

Sidibé and Williams (2002) report four types of baobab in the Sahel, which are recognized physically, but not genetically. Farmers in Mali distinguish several types of baobab by taking into account bark colour, pulp and leaf taste, or height and width of the tree (Sidibé & Williams, 2002). Bark colour is connected with the taste of the pulp. Baobabs with black bark are supposed to produce moderately sweet pulp, baobabs with red bark have a very sweet pulp and baobabs with gray bark produce small good quality fruits and are more used for fibres and cord production, whereas dark-leaf baobabs are preferred as a leafy vegetable (Assogbadjo et al., 2005; Leakey, 1999 in Jama et al., 2007; Sidibe & Williams, 2002). In Mali, local people call trees with tasty leaves *molons*. These trees are regularly cut (Dhillion & Gustad, 2004).

A study in Benin reports that farmers use several criteria to differentiate between individual baobabs, which are related by the characteristics of the fruit such as colour and seed size, precocity in maturity, trees' productivity, capsule shape and taste of the pulp; the bark such as colour and structure and the leaves such as colour, taste and shape. The most frequently used criteria are the shape of the capsules, the taste of the pulp and leaves, the bark colour and the precocity in fruit maturity. Focusing on the bark, farmers distinguish between three types: baobab with pink and smooth bark, with rough and grey bark and with smooth and grey bark. For the different shapes of the fruit there are four types: baobab with small size capsules, with middle size and long shape, with middle size and round shape and with big size capsules. In addition, there are two different types of baobab discriminating between leaves: baobab with bitter leaves and delicious leaves. Again, the fruit pulp is distinguished by its taste: sweet and sour tasting pulp (Assogbadjo et al., 2005).

2.3. Tamarind *Tamarindus indica*

The Senegalese Wolof' name "Dakkar" originates from the Sudanese Arabic word for the male date-palm (*Phoenix dactylifera* Linn.) (Burkill, 1995). The capital of Senegal has the Wolof name Dakkar and is said to be named for the tree (Grovel, 1993; ICRAF, 2007).

2.3.1. Origin and distribution

The area of origin of *Tamarindus indica* is unclear; most theories place its origin in Africa. Theories reach from the drier savannahs in the central Soudanian region of Mali, Burkina Faso and Niger (Burkill, 1995; ICRAF, 2007) to oriental Africa, in the Nile valley, where it was known and cultivated in ancient Egypt as early as 400 B.C. (Diallo, 2001; Giffard, 1974; Grovel, 1993). Another theory places the tamarind's origin in Eastern Africa, where it was introduced from Madagascar and is most common today (Diallo, 2001; Grovel, 1993). Finally, India, as original habitat is also discussed. The origin of the name from the Arabic "Tamar hindi", which means *date of India,* comes from India and is associated with the dry pulp (Diallo, 2001).

Today the tree mainly appears in central, south-central and eastern Africa, but has been and is still dispersed by man worldwide and is cultivated in all tropical countries (Arbonnier, 2004;

Burkill, 1995; Diallo, 2001; ICRAF, 2007). Its distribution reaches from Senegal to Aritrea, from Sierra Leone to Cameroon, from Ethiopia and Somalia to Mozambique, Madagascar, India, United States and Australia (Arbonnier, 2004). It was introduced probably by Arabian traders and naturalized in tropical Asia (ICRAF, 2007). The tamarind often grows around villages and inhabited areas (Burkill, 1995; Giffard, 1974; Grovel, 1993).

2.3.2. Ecology and habitat

The tamarind, an evergreen legume, mostly grows in the tropical and semi-dry central Soudanian region (rainfall ranging between 400 and 1.500mm), in low-altitude woodlands, savannahs and bush lands. In the Sahel zone it grows along watercourses, permanent water sources, rivers, lakes and on sites with high groundwater level (Giffard, 1974; Grovel, 1993; ICRAF, 2007; Weber & Hoskins, 1988). It tolerates fog and saline air in coastal districts and even monsoon-climates (ICRAF, 2007). It appears in scattered formations and never builds closed forests (Schütt et al., 2006).

Tamarindus grows on a wide range of soils (Jama et al., 2007) but prefers deep, heavy but well-drained, humid, alluvium soils and tolerates rocky conditions (Arbonnier, 2004; Burkill, 1995, Diallo, 2001; Grovel, 1993). It does not grow on soils where water is stagnant (Grovel, 1993). The optimum pH should be around 5.5 (Arbonnier, 2004; Burkill, 1995, Diallo, 2001; Grovel, 1993).

Its natural range goes from 0 to 1.600m above mean sea level (Jama et al.,2007) with a mean annual temperature of 20 to 33°C and main annual rainfall of 350 to 2.700mm (ICRAF, 2007). It can also appear in mountains, up to 5.000m if the climate is warm enough (Grovel, 1993).

The tamarind tree's extensive root system contributes to its drought and wind-tolerance and –resistance. The tamarind needs a dry season during the period of flowering; otherwise it does not set fruits (Burkill, 1995, Diallo, 2001; Grovel, 1993; ICRAF, 2007).

Seedlings are often found on large termite hills and in association with baobab (Arbonnier, 2004; Burkill, 1995, Diallo, 2001; Grovel, 1993). The seeds are eaten by birds or monkeys, which drop them under baobab trees (Grovel, 1993). *Tamarindus indica* grows slowly (Burkill, 1995; Giffard, 1974). Young trees are killed by the slightest frost, but older trees are more resistant to cold (ICRAF, 2007).

2.3.3. Biology and botanical description

Tamarindus indica, from the *Caesalpiniacées* family, is a tree of 10 to 30m height and 65cm to 1m in diameter (Arbonnier, 2004; Burkill, 1995, Diallo, 2001; Grovel, 1993). The short trunk is usually divided in several trunks. The tree is low-branching with a dense, dark and evergreen crown (Arbonnier, 2004; Burkill, 1995).

Leaves are alternate, 7 to 15cm long, becoming glabrous with 8 to 15 pairs of opposite leaflets, 2 to 3cm long and 0.6 to 1cm across (Arbonnier, 2004, Diallo, 2001). Except for semi-arid regions the tree is evergreen (Diallo, 2001).

The flowers, pale yellow or pinkish with red stripes, are to 5 to 10 flowers together in a 5 to 15cm long raceme (Arbonnier, 2004; ICRAF, 2007). Flowering begins from the 7^{th} to 14^{th} year and continues for more than 60 years (Burkill, 1995; Grollier et al, 1998). The tree normally flowers at the end of dry season, in synchrony with new leaf growth (Arbonnier, 2004; ICRAF, 2007), in Senegal from December to May (Giffard, 1974). The flowers are probably pollinated by insects, namely bees and waps (Diallo, 2001; ICRAF, 2007). Beside sexual reproduction, the tamarind sometimes reproduces vegetatively by suckers (Diallo, 2001).

The fruit, indehiscent, a pod, 10 to 18cm long and 1.5 to 2.5cm across, straight or curved, velvety and rusty-brown, counts about 3 to 12 seeds, which are embedded in a gelatinous pulp. The seeds take 5 to 8 months to mature (ICRAF, 2007; Jama et al., 2007).The fresh edible fruit-pulp is light brown and darkens later to black (Arbonnier, 2004; Burkill, 1995). The fruit contains 30% pulp, 40% seeds and 30% husk. The pulp has a low water content which is about 38% but it contains the highest protein, carbohydrate and mineral values of all fruits (Grollier et al, 1998). The fruit is adapted to dispersal by ruminants (ICRAF, 2007).

2.3.4. Utilisations

The tamarind is a multifunctional tree; every part of the tree is locally used (Burkill, 1995).

Food uses and processing

Because of its drought-resistance, the tamarind is an important food source during dry seasons and famine (Burkill, 1995), but also features in daily diets (Slingerland & Kiema, 2001). It has a high content of tartaric acid and is often used as acid-forming (Bougouma, 1981).

Flowers are eaten fresh as salad or made into a sauce (Berhaut, 1975; Billand & Diallo, 1991; Burkill, 1995). The nectar produces excellent honey (Diallo, 2001; Grovel, 1993).

The fruit of tamarind is acidic and sweet at the same time, containing up to 98% tartaric acid and soluble sugar (Grollier et al, 1998; Soloviev et al., 2003). Fruits in Senegal tend to be sour to very acidic (Soloviev et al., 2003). It is rich in pectin, organic acids (Grollier et al, 1998), full of energy, vitamin B and minerals, and also has small amounts of carotene and vitamin C (ICRAF, 2007; Jama et al., 2007). Tamarind fruits are a potential source of protein but are not very well digested (Grollier et al, 1998; Jama et al., 2007) and are rich in oil (Jama et al., 2007).

The main product is the fruit-pod, which is sold in form of cakes or balls still containing the seeds, or prepared into a paste (Billand & Diallo, 1991; Burkill, 1995; Grovel, 1993). It is often added to meals as seasoning (N'Diaye et al., 2003). The crushed fruit is used for a nourishing soup, mixed with cereal for making gruel, and, if fermented it is consumed as an alcoholic drink. In some regions in Senegal people prepare a drink called *sangle* in which they add milk and millet flour. It is drunk as a laxative and is rich in vitamin C (Arbonnier, 2004; Burkill, 1995). The pods are used in local cuisine as a digestive and as a cold infusion, standing over sugar or honey for a few days and then drunk as refreshing beverage (Arbonnier, 2004; Berhaut, 1975; Billand & Diallo, 1991; Burkill, 1995, Diallo, 2001). The fruit juice, mixed with ginger, serves as ice-cream (N'Diaye et al., 2003). The fruit pods are fed to cattle (Burkill, 1995). Seeds can be eaten roasted or cooked, or mixed with dishes in form of flour (Maydell, 1990). Prepared with meal and mixed with cereal, the seeds serve as famine-food (Burkill, 1995).

Leaves, rich in tannin (ICRAF, 2007) are locally used as an addition to sauces or as tea (Billand & Diallo, 1991), in soups or as a salad (Giffard, 1974; Grollier et al, 1998). Young tamarind leaves are steamed and formed to bowls and later sundried: this product is sold on local markets (Bergeret, 1986). Leaves are appreciated by cattle and hence used as forage (Arbonnier, 2004).

Therapeutic and medicinal utilisations

In Senegal, the tamarind is found in numerous medico-magical preparations against mental disorders, which is explained by the fact that the tamarind is said to be the preferred shelter for genies. Therefore it is applied in cases of madness, impotence and sterility (Kerharo, 1974).

Flowers are used to treat liver infections (Berhaut, 1975). The pulp, mixed with millet, is given as a fortifier to children, old people and voyagers (Berhaut, 1975; Giffard, 1974). As tea and cold beverage, the pulp is used against fever and as a laxative (Berhaut, 1975; Kerharo, 1974). In Senegal, the unripe fruit is made into a sweet-meat with millet called *bengal* or *bêgal* and consumed as laxative and febrifuge (Arbonnier, 2004; Burkill, 1995; Kerharo, 1974). The pulp also helps against intestinal troubles. It strengthens the heart, reduces blood glucose and is applied against scurvy (Maydell, 1990). The seeds are used against diarrhoea (Berhaut, 1975).

Leaves are used against diarrhoea, breast abscesses, malaria, coughs, illnesses of the eye etc. (Arbonnier, 2004).

The stem is used for liver failure, cold, fever and bronchitis (Arbonnier, 2004). Because of its astringent properties, the stem or bark is used for the treatment of diarrhoea, for hepatitis, coughs, wounds, etc. (Arbonnier, 2004; Berhaut, 1975; Burkill, 1995). Twig-bark, processed to a powder and mixed with water, is used to treat snakebites by drinking and washing the wound with the mixture (Burkill, 1995). The ash of the bark is applied against digestive trouble (Maydell, 1990). The roots are given to babies, who refuse to suckle (Arbonnier, 2004). A tea with tamarind roots is used against respiratory diseases (Maydell, 1990).

Other uses of tamarind

Because of the dense crown there is no ground-cover under the tree (Arbonnier, 2004; Burkill, 1995; Grovel, 1993). The tamarind is used as a fire-break, shelter-belt and wind-break to prevent soil-erosion (Arbonnier, 2004; Burkill, 1995; Grovel, 1993).

The nectar is used as a yellow dye (Grollier et al, 1998). In Senegal, powdered seeds are added to gunpowder, this is said to enforce the explosion (Arbonnier, 2004; Berhaut, 1975; Burkill, 1995). Seeds are used for tanning leather (Bougouma, 1981). The kernel, boiled in water, is used as glue. The kernel oil is burnt as an illuminant (Burkill, 1995). Leaves are used as red dye (Arbonnier, 2004).

The fruit is very common and can be found at every market (Billand & Diallo, 1991; Burkill, 1995). Some societies in Senegal, Mali and Burkina Faso have commercialized the pasteurized tamarind juice (Grollier at al, 1998). Products, such as beverages, honey, leaves, agricultural tools and traditional pharmacopoeia are frequently sold on local markets (Diallo, 2001). Tamarind juice is not only known in Africa but also in Europe and the US (Weber & Hoskins, 1988). In Asia, uses are more numerous than in Africa, including tamarind jam, syrup, candy, sauces, sweets etc. (Grollier et al., 1998; Jama et al., 2007). The juice of tamarind fruit is an ingredient of Worcestershire Sauce (ICRAF, 2007).

The wood is heavy and therefore difficult to work with, but still appreciated (Billand & Diallo, 1991; Burkill, 1995; Grovel, 1993). It is moderately durable and resistant against insect and fungal attacks (Billand & Diallo, 1991; Burkill, 1995) although it is sensitive to termites (Grovel, 1993). Uses as construction-timber are common: furniture-making and other carpentry, door frames, housetops, household utensils such as pestles and mashers, agricultural tools and other tool handles (Arbonnier, 2004; Berhaut, 1975; Burkill, 1995; Grovel, 1993; N'Diaye et al., 2003). Furthermore it is elastic and resilient and makes good charcoal (Arbonnier, 2004; Burkill, 1995; Grovel, 1993) although in Soudano-Sahelian Africa it is considered as bad fuel (Diallo, 2001). Nevertheless, Bergeret (1986) reports that tamarind is sometimes absent in the Sine-Saloum of Senegal because of overexploitation for charcoal. In the Sahel zone the ash is used for depilating and tanning the skin of goats (Grovel, 1993). In North America, tamarind wood has been traded under the name of "Madeira mahogany" (ICRAF, 2007). The bark is locally used for tanning (Arbonnier, 2004; Berhaut, 1975; Burkill, 1995).

2.3.5. Symbolic and cultural value

The tamarind is commonly used as shade- and avenue-tree (Arbonnier, 2004) and for community meetings (Rocheleau et al., 1988). In villages, in Oriental Africa, it is planted as “arbre à palabres” (Giffard, 1974).

In some areas the tree is said to have magical properties. It is used in medico-magical treatment practices for mental disorders, folly, insanity, impotence and sterility (Arbonnier, 2004; Berhaut, 1975; Burkill, 1995). In Africa, the tamarind is said to be the dwelling for genies of the forest (Diallo, 2001). In Senegal, people believe that the tamarind serves as housing for *djinns* (genies) - a type of demon in Islamic mythology (Burkill, 1995). By most tribes the tamarind is considered a sacred tree. The Peulh confide in the sacred tree during their migrations. Young animals are led under the tree for resting. The tree protects the herders and their animals; therefore it receives organic manure. It is forbidden to burn the wood at the risk of having bad luck. In some regions of Sahelian Africa there is a myth, which says that the planter of a tamarind tree will die before the first fructation (Diallo, 2001).

2.3.6. Harvest and storage management

In Senegal, green fruits are harvested from October to November, and ripe fruits are collected in January (Bergeret, 1986). The fruits should be collected from the ground, after they have fallen from the tree, when they are really mature, because there is no more maturation during the storage (Arbonnier, 2004; Burkill, 1995; Grovel, 1993; Maydell, 1990). Fruits are difficult to harvest because they break easily if harvested by hand (Maydell, 1990). The acidity does not diminish with maturation (Grollier at al, 1998). The fruit is subject to attack by weevils, which can be a limit to preservation (N’Diaye et al., 2003). To conserve the pulp for several months without any deficit of quality it is either sundried or mixed with sugar (Grollier et al, 1998). It is also recommended to treat the fruit with steam and then deposit it in a well closing vessel (N’Diaye et al., 2003). Normally it can be stored at room temperature for over 6 months without spoilage (Jama et al., 2007).

In Senegal, leaves are usually harvested from May to July (Bergeret, 1986).

2.3.7. Propagation and cultivation systems and conservation management

The tamarind in the Sahel zone is rarely domesticated, sown, planted or transplanted and it is hardly a part of any treatment (fertilization, irrigation) or selection processes to increase a more regulated production. The traditional management is limited to harvest, which is mainly done by women and children (Billand & Diallo, 1991; Diallo, 2001; Grovel, 1993; Maydell, 1990) unlike southern and central America and Asia where the tamarind has been established in plantations (Jama et al.,2007).

Traditional multiplication by seeds is common, although propagation is also easy with cuttings or by budding (Burkill, 1995). The seed has to be stored properly to avoid damage by weevils (Jama et al., 2007). Tamarind germinates easily from seeds by soaking in warm water for 24h or by scarifying the seed (ICRAF, 2007; Jama et al., 2007). Germination is optimal when seeds are covered with 1.5 cm loose, sandy loam or a mixture of loam and sand. Trees generally require minimal care (ICRAF, 2007; Maydell, 1990), but should be planted in shade until they are 25cm tall (Maydell, 1990). Seedlings have to be protected from cattle (Grovel, 1993) and are very sensitive to cold (Bougouma, 1981). The tamarind is very sensitive to denudation and mutilation of roots (Maydell, 1990). Young tamarinds should be transplanted when they are about 80cm tall, just before the beginning of the rainy season (Maydell, 1990). Beside sowing, branches can easily be rooted (Maydell, 1990).

Limits of cultivation could be the slow growth of tamarind (Diallo, 2001; ICRAF, 2007). A huge problem of using tamarind is the irregularity of its fructation. After two or three years of fruit production a year of near-zero harvest follows (Billand & Diallo, 1991). The yield is about 150 to 200kg per tree, which is about 15t/ha for up to 50-60 years (Bougouma, 1981; Jama et al., 2007). It should be considered that *Tamarindus indica* is not very compatible with other plants because of its dense shade, broad spreading crown and allelopathic effects (ICRAF, 2007). No vegetation can grow under a tamarind tree (Maydell, 1990).

Senegal, however, has started some programs for protection, amelioration, development, domestication and valorisation of the most important and appreciated tree species including the tamarind. Subject of these programs are selection and cloning of varieties of high quality (Danthu, 2001; Soloviev et al., 2003).

2.3.8. Folk classification and selection criteria

It is reported that local people generally select their plants by seed size, size and taste (sugar content) of the fruit, time of maturation (precocious maturity), the regularity of production and the length of branches (Diallo, 2001). People in Senegal seem to select their preferred trees, among other criteria such as taste of fruit, by the productivity and resistance to pests and diseases (Soloviev et al., 2003).

There are four types of tamarind concerning the fruit form: straight with contractions, bent with contractions, bent and flat, and fruit with red pulp (Schütt et al., 2006).

2.4. Research Objectives

The following goals shall be achieved within the thesis:

- The local knowledge about ethnobotanical characteristics of baobab and tamarind in Senegal shall be presented.
- The differences in local knowledge of three ethnic groups in Senegal shall be compared.
- The importance of baobab and tamarind for local people shall be described by showing their multifunctional uses.
- The cultural and symbolic value of baobab and tamarind shall be highlighted.
- The traditional processing methods of baobab and tamarind plant parts shall be demonstrated.
- The existing traditional propagation and cultivation systems and management practices shall be pointed out.
- The folk classification and selection criteria shall be described.
- The traditional conservation management shall be presented.

2.5. Research Topics and Questions

In the present study the author's aim is to document and conserve traditional ethnobotanical knowledge of local people on baobab and tamarind. The research has taken place in Senegal and the following focuses on regions of Senegal. The topic includes the following questions:

- How do local people use baobab and tamarind plant parts?
    - Which plant part is used for what purpose?
    - How do local people process plant parts and prepare products?
    - How frequently do local people use different plant parts?
- What is the symbolic and cultural value of baobab and tamarind for local people?
    - What kinds of ceremonies are connected with baobab and tamarind?
    - Are baobab and tamarind connected or inhabited by spirits?
    - By which kind of spirits are baobab and tamarind inhabited?
    - Do traditions and beliefs have an influence on the utilisation or harvest of baobab and tamarind?
    - What kind of influence do they have?
- How do local people harvest and store baobab and tamarind plant parts?
    - In how far is the harvest and storage identified with gender and age?
    - At what time of the year do local people harvest baobab and tamarind?
    - Are there problems or limitations concerning harvest?
- How do local people propagate or cultivate baobab and tamarind?

- Why or why not do local people propagate and cultivate baobab and tamarind?

- How do local people choose their own selection criteria on baobab and tamarind?
  - Do local people define different types of baobab and tamarind?
- How do local people protect baobab and tamarind?
  - Why or why not do local people protect baobab and tamarind?
  - Do local people recognize regeneration problems of baobab and tamarind?
- What is the difference in local knowledge between different ethnic groups?
  - In how far does local knowledge between different ethnic groups vary?

2.6. Hypotheses

From the above-stated theoretical considerations, the following hypotheses for this study are formulated as follows:

Hypothesis 1: Baobab and tamarind play an important role for local communities.

This hypothesis has been devised due to the numerous utilisations cited in literature by Assogbadjo et al (2005), Assogbadjo et al (2006), Berhaut (1974), Billand & Diallo (1991), Booth & Wickens (1988), Burkill (1985), Chastanet (1991), Dhillion & Gustad (2004), Diop et al (2005), Grollier et al (1998), Jama et al (2007), Wickens & Lowe (2008) and many others. Both, baobab and tamarind are described in those works as trees, which are commonly used by local communities and play an important part in their daily life.

- *Sub-Hypothesis 1.1: All plant parts of baobab and tamarind are used in a multifunctional way.*

  Again, on the basis of the literature mentioned above, both baobab and tamarind are used for nutritional, medicinal, therapeutical, and domestic purpose. In the literature cited, used plant parts are flowers, fruit, pulp, husk, leaves, bark, wood, roots and resin.

- *Sub-Hypothesis 1.2: There is an existing local market for baobab and tamarind plant parts.*

  Bergeret (1986), Chastanet (1991), Giffard (1974) and N'Diaye et al (2003) report on the strongly commercialized baobab pulp and leaves in Western Africa, which is assumed to be still ongoing.

  In the case of tamarind, the fruit can be found at every market, sold in form of balls or prepared into a paste, as cited by Billand & Diallo (1991), Burkill (1995) and Grovel (1993). Grollier et al (1998) and Diallo (2001) even report of tamarind products, such as pasteurized juice or agricultural tools, which are sold on markets.

Hypothesis 2: Baobab and tamarind plant parts are not only used in a nutritional and medicinal context, but also in social and cultural life.

The baobab is often chosen as a regional emblem and is part of stories, traditions and legends, as mentioned by Burkill (1985), Dellatola (1984) and Diop (2005). Assogbadjo et al (2005) and Burkill (1985) cite that the baobab is considered as sacred and fetish tree. Ceremonies are often held under baobab trees, as described by Anonymous (2005a) and Wickens & Lowe (2008). Gillet (1986) and Wickens & Lowe (2008) report of the baobab

being used as gravesite for so called *griots*. Dishes prepared with baobab pulp and leaves are often served during ceremonial events, as mentioned by Assogbadjo et al (2005) and Owen (1970) in Wickens & Lowe (2008).

Arbonnier (2004), Giffard (1974) and Rocheleau et al (1988) describe the tamarind as a shade and avenue-tree, which serves for community meetings. The tamarind is often considered as sacred tree with a protective function, but also as a tree, which serves as housings for genies, as cited in Burkill (1995) and Diallo (2001).

On the basis of all these statements, the author assumes that baobab and tamarind play an important role in social and cultural life.

- *Sub-Hypothesis 2.1: There are some local traditions or beliefs that could hinder plantations of baobab or tamarind.*

  According to Sidibé & Williams (2002) it is forbidden in some regions of Mali to have baobab trees near housings, since it is said that the penetration of roots into the room would evoke misfortune. Again in Mali, it is said that demons live in big baobabs, which are responsible for the accidents happen during harvesting, as described by Savard et al (2006). However Savard et al (2006) also report that this mean of explaining accidents does not have any effect on cultivation techniques since demons are only associated with tall baobabs. Still, the belief of demons being responsible for accidents during harvest could nevertheless be a hindrance in Senegal, since ethnic groups have different traditions.

  Diallo (2001) reports that in some regions of Sahelian Africa people believe in a myth which says that the planter will die before the first fructation of tamarind. In Senegal, the tamarind shelters demons, as cited by Burkill (1995). It is not clear which impact these beliefs could have on cultivation and plantation systems, but it is not excluded that these beliefs could hinder such practices.

Hypothesis 3: There are almost no traditional cultivation systems and local people are harvesting unsustainably from wild baobab and tamarind trees.

According to Anon. (1993), Diop et al (2005) and Jama et al (2007) the baobab tree is rarely cultivated, but wild individuals are exploited. Bergeret (1986) describes that baobabs, harvested for their leaves, produce hardly any fruits because of the drastic pollarding during leaf harvest, while Berhaut (1974) mentions that the trunks of baobabs are often damaged because of man using the fibrous bark. Although Dhillion & Gustad (2004), Niang (1981), Savard et al (2006) and Wilson (1988) mainly report of cultivation systems in Mali and in one region of Senegal, the author suspects that the baobab is hardly cultivated in most regions of Senegal.

What has been said about of the baobab can be assumed to hold true for the tamarind, since Billand & Diallo (1991), Diallo (2001), Grovel (1993) and Maydell (1990) describe the tamarind in the Sahel zone as a species that is rarely domesticated.

- *Sub-Hypothesis 3.1: Baobab and tamarind are not or rarely planted, but protected by local communities.*

  Although it is not cultivated, the baobab is often protected by local communities, as mentioned by Anon. (1993), Jama et al (2007). According to Blench (2001) the baobab is not cut for firewood. Bosch & Asafa (2004) and Pélissier (1966) describe that farmers sometimes care for baobab seedlings. These references lead to the assumption that the baobab tree is a protected species by local communities. Like

the baobab, the tamarind is not cultivated-, but appreciated and commonly used, therefore the author suspects that local communities also protect the tamarind.

- *Sub-Hypothesis 3.2: Local people are already feeling some shortage of baobab and tamarind.*

  Bergeret (1986) reports in her study that local people have to buy baobab and tamarind fruits because the trees of their own region did not suffice. In addition, Senegal has initiated some protection, domestication and valorisation programs of both, baobab and tamarind, as mentioned by Danthu (2001) and Soloviev et al (2003). Although another study in Mali, undertaken by Savard et al (2006), has pointed out that local people do not consider the resource of the baobab tree as insufficient, the author assumes, according to the observation of Bergeret (1986) that local people are aware of the shortage of baobab and tamarind, since local people already experience the consequences of shortages.

Hypothesis 4: Baobab is an indicator of former settlements and accompanies actual human settlements.

The baobab tree is often cited in literature (Anon., 1993; Arbonnier, 2004; Assogbadjo et al, 2005; Blench, 2001; Blench & Dendo, 2003; Burkill, 1985; Diop et al, 2005; Giffard, 1974; Niang 1981) as tree, which grows around villages and abandoned village sites. As the tree is described in the literature to be associated with human presence due to people throwing away seeds and therefore dispersing the tree, it also indicates former human settlements and migration routes. For these reasons it can be concluded that the baobab still indicates former human habitations.

Hypothesis 5: Local people do have own selection criteria and concepts of classifications for varieties of baobab and tamarind.

Billand & Diallo (1991) and Dhillion & Gustad (2004) report of preferential selection of baobab concerning leaf and fruit quality. Furthermore, according to Assogbadjo et al (2005) and Sidibé & Williams (2002) farmers in Mali and Benin distinguish several types of baobab by different criteria of bark, pulp and leaf. Schütt et al (2006) report four different types of tamarind, which are identified by different fruit shapes. Due to these statements the author assumes that local people in Senegal will have their own selection criteria and classification systems, even if they are dissimilar to those of Mali and Benin. Since Diallo (2002) cites that local people generally select their plants, amongst others, by seed size, size and taste of fruit and time of maturation, the author concludes that these classification systems do also exist in the case of baobab and tamarind.

- *Sub-Hypothesis 5.1: The varieties have different values or importance for local people.*

  According to Assogbadjo et al (2005), Dhillion & Gustad (2004) and Sidibé & Williams (2002) people select some baobab trees for leaf harvest, while others are preferred for their fruit and others again for cord production. These selections would mean that the trees used for leaf harvest have other qualities and therefore other values than trees harvested for fruit. A similar example for the tamarind could not found in the literature, but it is suspected that local people consider the tamarind in a way similar to the baobab.

3. Methodology

Methods used for this Master thesis have been elaborated by Christine Buchmann and Christian Vogl from the Boku DADOBAT team. Since the Master thesis is in the frame of DADOBAT, the author uses these elaborated methods in her study to enable comparisons between different research regions and ethnic groups. The methods, if not marked specifically, are taken from Bernard (Bernard, 2002).

3.1. Research Sites

3.1.1. The case of Senegal

The Republic of Senegal lies at the westernmost point of Africa. It covers an area of 196.722km² and is bordered in the north by Mauritania, in the east by Mali, in the south by Guinea and Guinea-Bissau, and in the west by the Atlantic Ocean. Gambia lies in between Senegal-it forms a long corridor of 40km width and 370km length, from west to east in the southern half of the Senegal. This corridor isolates the Casamance region in the south from the rest of the country (CIA, 2008; FAO, 2008).

Senegal is located between latitudes 12°18' and 16°41' N. Nearly the whole of Senegal falls within the tropical Sudanian zone. The wetter southern part has Guinean influence and the region around the Senegal-Mauritania border, as well as the Ferlo "desert" have Sahelian character with low, irregular rainfall. Tropical scrublands and tropical dry forests cover the country. In the south, tropical moist deciduous forests dominate the landscape. Thus the vegetation of Senegal covers a large part of the range of tropical vegetation from closed forest to sub-desert steppe (FAO, 2008). The country's landscape is generally one of low plains, normally not higher than 200m, only in the south-east does it rise up to 500m. The Senegambian basin is drained by three rivers, the Senegal, Gambia and Casamance, which flow through wide, flat valleys (FAO, 2008).

Senegal has a wet summer season from July to October and a dry season from November to June. Temperatures can reach from 14°C in January or, December to 43°C in April, Mai or June (AFRISTAT, 2008). The average temperature on the coast is 22°C in January and 28°C in July. The harmattan blows in the dry season in inland areas, raising the temperature and drying the air (FAO, 2008).

3.1.2. Phytogeographic regions

The classification below is chosen after White, 1983.

Soudanian zone

The Sudanian region is a relatively narrow band across Africa, which extends from the coast of Senegal to the foothills of the Ethiopian Highlands. It is mostly between 500 and 700km wide (White, 1983). In Senegal, the Soudanian zone covers almost two-thirds of the country (FAO, 2008).

Nearly everywhere the level is below 750m altitude. Large areas are covered with superficial deposits of Pleistocene age. Consolidated dunes of wind-blown sand occur towards the northern fringes of the zone (White, 1983).

Mean annual temperature is around 24°-28°C and because of the harmattan wind, the dry season is more severe. There are three main seasons: one wet and two dry. Frost is unheard of. Rainfall is between 500 and 1.400mm per year (White, 1983).

Of the surviving stands of natural and semi-natural vegetation the most numerous and characteristic belong to various types of woodland. Apart from some exceptions there is virtually no primary forest. Some authors have suggested that dry forest was the original climax over extensive areas before the region became densely populated (White, 1983).

In most places where cultivation is possible, the natural vegetation has been profoundly modified. In the less densely populated areas most land is bush fallow, that is, woodland in various stages of regeneration following a period of cultivation. Where the fallow period is short and fires are frequent, trees are often represented only by coppice shoots and mature trees of specially preserved species of economic importance; sometimes trees are eliminated completely. Around large towns, cultivation is permanent or semi-permanent up to a distance of tens of kilometres, but valuable trees are protected and the landscape is one of wooded farmland. Common trees are *Adansonia digitata* and *Tamarindus* indica among others (White, 1983).

Guinea-Congolia/Soudanian zone

The main area of the Guineo-Congolian Region extends as a broad band north and south of the equator from the Atlantic seaboard eastwards to Congo. Nearly everywhere the altitude is less than 1.000m. In West Africa almost the whole Guineo-Congolian region is underlain by Precambrian rocks (White, 1983).

Most of the Guineo-Congolian region is relatively dry with rainfall between 1.600 and 2.000mm per year. The rainfall is, in general, lower and its distribution throughout the year is less than in rain-forest regions. The mean monthly rainfall is never higher than 100mm throughout the year. Further away form the equator, but also towards the Atlantic coast at equatorial latitudes, the length and severity of the dry period increases. Further west, the rainfall becomes increasingly concentrated in a single season. Throughout the Guineo-Congolian region mean monthly temperature is almost constant throughout the year (White, 1983).

The greater part of the Guineo-Congolian region was formerly covered with rain forest on well-drained sites and swamp forest on hydromorphic soils. Today, little undisturbed rain forest remains and secondary grassland and various stages of forest regrowth are extensive. Much of the rain forest at the northern and southern limits of the Guineo-Congolian region has been destroyed by cultivation and fire and was replaced by secondary grassland. These secondary grasslands often occur in mosaic with small, usually severely degraded, patches of the original forest, and small patches of secondary thicket and secondary forest. The grassland is often 2m or more tall and usually contains an admixture of fire-hardy and, often fire-trimmed trees. These grasslands are usually burned at least once a year (White, 1983).

Sahelian zone

The Sahel zone occupies a relatively narrow band, mostly about 400km wide, which extends across North Africa from the Atlantic coast to the Red Sea. Because of its geographical position on the southern fringes of the largest desert of the world, rainfall in the Sahel zone is insufficient for permanent agriculture based on rain-fed crops. Permanent agriculture is only possible in the few places where permanent rivers, which originate in wetter regions, leave water for irrigation available (White, 1983).

Most of the Sahel region forms are more or less flat, below 600m. Large areas are covered with Pleistocene clays, or sand sheets which where distributed by wind action (White, 1983).

Rainfall is erratic and mostly between 150 and 500mm per year. Most rain falls in three to four summer months and the dry season is long and severe. Except for coastal regions, the

mean annual temperature is between 26° and 30°C. Light frosts occur occasionally in some places (White, 1983).

Rainfall in the Sahel zone shows pronounced fluctuations of a cyclical nature. During the dry phase of the cycle prolonged and severe drought can result in the death of large numbers of people and livestock, and in grave degradation of vegetation. In the years 1968-73 the Great Drought was subject to world-wide news coverage (White, 1983).

In most parts of the Sahel, livestock-breeding in the form of pastoralism is the main source of livelihood and the basis of the economy. Nearly everywhere, pastoralism involves common ownership of grazing lands, and people are nomadic or semi-nomadic (White, 1983).

The extensive sand sheets of the Sahel support wooded grassland in the south and semi-desert grassland in the north. The density of larger woody plants varies greatly, especially in relation to water supply and the amount of human interference (White, 1983).

3.1.3. Ethnic groups

Senegal is dominated by five main ethnic groups, which represent more than 90% of the senegalese population: the Wolof, the Serer, the Haal Pulaaren (Peulh, Tukuleer), the Joolas and the Mandings or Mandinkas. In Senegal, ethnic groups are mainly identified by their common language. Because of the high migration tendencies of peoples, the identification by region or original locality for ethnic groups is quite difficult. Even the identification by patronymic names is complicated because of multiples intermixtures. Today, almost all Senegalese speak two or three languages. People learn the dominant language of the region (mostly wolof) to facilitate communication. The languages of the Wolof, Serer and Peulh have a common origin (Diouf, 1994).

The Wolof

The Wolof, the principal and most dominant ethnic group in Senegal, are defined by their mother tongue wolof. The language wolof is also widely spoken in other ethnic groups to facilitate contact, therefore wolof serves as instrument of communication. This tendency of wolof expansion is called *wolofisation.* The Wolof are predominant in five regions of the Senegal: Louga, Diourbel, Sine Saloum, Thiès and Cap Vert (Diouf, 1994). The religion of the Wolof is Islam (Kerharo, 1974).

The Serer

The Serer are principally settled in the Sine (region of Fatick) and are sedentary. There are several sub-groups with two main regions: the Serer of the Bas Saloum and the Serer of the region of Thiès. The sub-groups speak different languages (Diouf, 1994). Serer practice two religions: Islam and Catholicism (Kerharo, 1974).

The Peulh

The Peulh are part of the ethnic group of Pulaar or Haal pulaar, which speak pulaar as their mother tongue. The Peulh are principally present in the *Sénégal Oriental* and highly present in the regions of Louga. Since the Peulh do not have a recognized territorial base and are characterized by their nomadism and, they are well represented in all regions of Senegal (Diouf, 1994). Peulh dominant religion is Islam (Kerharo, 1974).

3.1.4. Researched Sites

Fieldwork was undertaken in Senegal, West Africa. Research sites have been identified in collaboration with the DADOBAT team partners and leaders. As the research project concerns both, baobab and tamarind, sites have been chosen for the presence of both trees. In order to gain a broad image of Senegal, all three phytogeographical zones (Guineo-Congolian, Sudanian and Sahelian zone), as well as the three main ethnic groups of Senegal (Peulh, Serer, Wolof) were covered by the chosen sites. The chosen villages were the same as researched by the partners of the DADOBAT project. This consistence should enable later comparisons. Research has been undertaken in the following regions and villages:

- Boarder of Guineo-Congolian/Sudanian and Sudanian zone

Ibel (Peulh)

Velingara (Peulh)

Foua 1 (Serer)

- Soudanian zone

M'Bassis (Serer)

Mont Rolland (Serer)

Niakhoul (Wolof)

N'Dande (Wolof)

- Sahelian zone

Sakal (Wolof)

Coki (Wolof)

3.2. Research Partnerships

During the author's stay in Montpellier, France, the author was supported and facilitated by all research institutions (CIRAD, ENGREF, IRC, CNEARC, SIARC, IAA, AGRO/INRA) and their library staff.

For the author's stay in Senegal, the author was supported and facilitated by the research institution CERAAS (Centre d'étude regional pour l'amélioration de l'adaptation à la sécheresse). CERAAS facilitated the author's transport, arriving at and leaving the villages. A driver and car have been at the author's disposal when needed.

Between the stays of the author in the villages, the author could prepare and organize her next travel at the institution of CERAAS. There the author had Internet access and the possibility of making copies for her interviews.

3.3. Data Collection

3.3.1. Literature research

Literature research was supported by Dr. Anna Hartl, who developed the first keyword list which was actualised according to the author's concerns by herself.

An extensive literature research was undertaken in July 2007 in Montpellier, France. Analog and digital sources were searched in the libraries of the local research institutions:

- CIRAD Baillarguet: Centre de coopération international en recherche agronomique pour le développement"
- CIRAD Lavalette
- ENGREF: Ecole nationale du génie rural des eaux et des forêts
- IRC: Institut des regions chaudes (including CNEARC and SIARC)

  CNEARC: Centre national d'études agronomiques des régions chaudes

  SIARC: Section des industries alimentaires pour les regions chaudes
- IAA: Institut agro-alimentaire
- AGRO/INRA: Ecole Supèrieure d'Agronomie, Institut national de la recherche agronomique (one library together)

Selected sources, found through online catalogues in the libraries of each research institution, were printed or copied.

English and French literature was searched and selected by the following criteria:

- Trees: baobab and tamarind
- Region: Senegal, West Africa, Sahel zone, Africa
- Topic: ethnobotany, ethnobiology, ethnology, agroforestry, traditional/local/indigenous knowledge, traditions, mythology, religion, beliefs, folk classification
- Ethnic group: Wolof, Serer, Peulh

The following key words have been used in English and French: baobab (Adansonia digitata, pain de singe, calebassier), tamarind (Tamarindus indica, tamarinier, tamarinde); Senegal/Sénégal, West Africa/Afrique de l'ouest, Sahel zone/sahel, Africa/Afrique; ethnobotany/ethnobotanique, ethnobiology/ethnobiologie, ethnology/ethnologie, agroforestry/agro-foresterie, traditional/local/indigenous knowledge/savoir/connaissance traditionnel/local/indigène, traditions/traditions, mythology/mythologie, religion/religion, beliefs/croyances, folk classification/classification; Wolof, Serer, Peulh.

None or little literature was found at the AGRO/INRA and the IAA libraries. AGRO/INRA is not specialised in tropical and subtropical regions and IAA with its focus on topics of alimentation, had little literature concerning baobab and tamarind linked with alimentation.

Additional literature from Dr. Anna Hartl completed the data. This additional literature from Anna Hartl included literature from online catalogues of relevant institutions and e-journal consortia.

The research process of written data has been documented in an excel file including name of database/library/institution, keyword, number of hits as well as extra comments and remarks. This documentation was useful for finding the best-working keywords and to avoid searching the same place twice for the same keywords.

During the process of literature analysis new useful literature sources were discovered in the reference-lists of articles, searched and, when found, added to the previously obtained literature.

With the collected literature a literature review was compiled to summarize the state of art before going to the field (chapter state of the art).

3.3.2. Methods overview

For each of the three ethnic groups the following methods were used:

- 20 individual interviews: 10 men and 10 women
- 1 village introduction interview per visited village
- 1 group discussion per visited village
- 1 community exercise mapping per village
- Key informant interview/s if local experts (traditional healer, religious head, old wise woman or man) were present in the village
- Additional documentation: field diary, photographs, voice recorder

The order of methods varied with the time made available by the interview partners and the organisational possibilities of each village (especially for group discussions and mapping exercise). Only the village introduction interview was done at the beginning if possible (which was not always the case since the village chief was not always on site or available at the beginning of the author's journey in the village). Furthermore, the key informant interviews were done towards the end, because informants gave names of local "experts" during the individual interviews.

To cross-check the acquired data and verify information, some questions were asked multiple times in individual and key informant interviews, group discussions, mapping exercise and village introduction interview.

Initial phase

When arriving in a village the author attempt to find the village chief. Normally the village chief was the author's first contact in the village. The author explained the purpose of her stay, the DADOBAT project, some background information about herself (name, nationality, studies, age) and asked to accept her stay in the village.

The author asked for accommodation, a local translator and other support from the village chief such as communicating to his villagers the purpose of the author's stay and the form of cooperation needed.

The author could always stay in the village itself, which had the advantage of getting closer contact with the local population other than during interviews, and to observe daily routine life.

Village introduction questionnaire

Normally the starting point was a questionnaire to gather general information about the village. The village introduction interview had the dual function of gaining some idea of the village and to present again the author herself, her work and the purpose of the author's journey. The village introduction interview also served as a demonstration for the way of working.

The author had no influence on the choice and number of participants during village introduction questionnaire, so the selection of contributants happened by chance. Sometimes people were asked to come, sometimes people who just passed by, participated, sometimes even the village chief was not present and his son replaced him.

Questions were asked about administrative data (region, circle, community, village), data about village access meaning transport infrastructure, kinds of water sources, educational- and socio-sanitarian infrastructure, existence of administrative services, electricity, markets,

all kinds of shops and telephone access, active institutions and projects in the village. In addition, questions concerning property and access rights to baobab and tamarind were asked since normally the village chief was one of the participants of the village introduction questionnaire and knew the rules of property rights in his village. The questions regarding property and access rights were partly cross-checked in individual interviews.

Group discussion

In every village one organised structured group discussion of normally five (two men and three women) sometimes six persons (three men and three women) of mixed age, was held. The reason for choosing only two men and three women was to attempt to balance the men and women relations since it was observed that men were more dominant in such discussions.

The first group discussion did not really work out in the sense of equal participation since both men but none of the women spoke French. Therefore the author asked a question and the men answered without translating for the women. After this, the author wanted the translator to translate her question but again, the men answered while the translator was still translating the question to the women. Afterwards the women only agreed to the answers already given although they did not even understand the French answer, as it is custom that the women do not have the right to contradict the men.

There was also an acoustic problem since the group discussion was held outside and the women were seated too far to hear the author's questions. This did not make much of a difference as the women did not understand French anyway, but it was very important to demonstrate empathy by showing that the question also concerned the women and gave them a feeling of being a valuable part of the discussion.

To encourage the women to participate freely in the interview, women were normally placed in front of the men, sometimes, if possible, a little bit higher seated than men and, directly beside the interviewer (the author) or the translator.

Furthermore the combination of participants was chosen in such a way, that either no one spoke French, or half the female and half the male participants could speak French, making the conditions equal. These strategies were developed after the first group discussion.

During the group discussions, questions sometimes precipitated major discussions which have been noted beside. The questions included topics of folk classification and selection criteria, local nomenclature of the different plant parts of baobab and tamarind, ecology and an agricultural calendar.

The calendar allowed an overview of the ecological and economical situation of each village since questions about the different seasons, times of shortages and illnesses, harvest-, storage- and consumption periods about baobab and tamarind, but also food crops, were asked.

Finally the informants of the group discussion were asked whether there were any individual baobab or tamarind trees that are preferred by the whole village, a district of the village or a group of people, or if there was a baobab or tamarind which is known by everybody because of some special characteristics for utilisation (preferred leaves, fruits or bark). If the participants mentioned some preferred trees the author walked with the informants to these trees. Then she was taking pictures, identifying the trees' location by writing down the owner of the tree or the field it was standing in, as well as the village. Finally the author was noting the special characteristics which made up the preferred *plus tree,* as well as the preferred use of the individual trees.

Agricultural calendar

The agricultural calendar was used during group discussions and allowed an overview over the ecological and economical situation of each village. The participants were asked to name the period of rainy and dry season, pests, insect attacks and illnesses, times of harvest and storage period of millet and other food crops; period of harvest, storage, utilisation and sale of baobab and tamarind plant parts.

Normally local people did not use the Julian calendar system and could not name months. Definition of months happened in collaboration with the translator because students are taught the Julian calendar system in French class.

In addition, calculation was done by counting the number of months passing after the month of Ramadan or after seeding. Another orientation were rainy and dry seasons. Once the months of rainy and dry season were defined, people could compare this time system with their activities, for example harvest of that crop or plant part happens at the beginning or the end of rainy or dry season.

Community mapping exercise

One community mapping exercise was conducted in each village. A group of three or four people, men and women, of different ages, was asked to draw a map containing some orientation elements such as the main street, the house of the village chief, the mosque or church, the school etc. Afterwards the houses of the participants, the baobab and tamarind trees used by the participants and the route participants use to reach the tree were added. Each informant used a different colour pen.

After choosing colours, every informant was individually asked some questions about distances to the used trees, utilisation frequencies and seasons, property and access rights related to gender issues and other additional information linked to the map. Questions were asked in semi-structured interviews (Bernard, 2002).

The informants had the choice between drawing in the sand or on paper. Only one group chose sand. The resulting map was reproduced on paper by the author.

After the first time the author drew the map, participants always drew it themselves. It often took some time to convince them of the merits of a pen. After a while one “secretary” was selected and whilst he/she drew the others discussed how and where to place the different elements of the design required by the interviewer.

Individual questionnaires

The French structured questionnaire (Bernard, 2002) was developed, tested and adapted according to the experiences and results during the pre-test performed by Christine Buchmann in the field before it was used for the main data collection. The questionnaire was split into several sections according to topic: socio-economical data, “general knowledge” on trees and transmission of knowledge, utilisations of different plant parts (harvesting, processing, storing) and problems of utilisation, rituals, traditions, spiritualism and taboos, conservation and domestication. To speed up the interview, some questions were pre-coded and instead of writing long phrases, pre-coded abbreviations could replace phrases.

Every question was asked for both tree species, baobab and tamarind, at the same time in one questionnaire. Answers on the two trees could be given separately or for both species at the same time.

Because of the enormous interview duration of the first interviews (one interview took about 5 hours), the individual questionnaire was shortened in the field by moving some question sections into the group discussion, village introduction interview or village mapping exercise

and have therefore been asked only once per village. No interview part was lost since it was only shifted and not changed so that the information from the first interviews can still be used in data analysis. After the changes, interviews normally took between one and three hours, depending on the willingness, interest, patience and knowledge of the informant, as well as on the surrounding conditions (silence, private or public place).

Normally the interviews took place at the homes of the respondents, inside the house or in the front yard. Visiting informants' homes allowed the observation of daily life actions and to ask questions about actions or situations, not forgetting that the respondent could exhibit objects or skills that he or she considered relevant to the questionnaire.

Key informant interviews

Individually structured interviews about the medicinal knowledge were done with the key informants. The medicinal questionnaire included most of the questions of the other individual questionnaire and additional questions about the medicinal and spiritual utilisations of baobab and tamarind parts, the clientele of the key informant, classification systems of baobab and tamarind varieties and agricultural calendar.

Key informants were identified by villagers through snowball sampling. Visited key informants were well known people in the village, such as traditional healers, herbalists, gardeners or people who were known by villagers because of their knowledge on plants in general or baobab and/or tamarind specifically.

Since access to these "important" people was sometimes difficult or even impossible and because a "local expert" did not always exist, key informant interviews were not done in every village. Therefore key informant interviews have to be understood as additional, specific information not asked in the general individual interviews.

Many "local experts" did not have much time and willingness to stay long with the interview. In these cases the questionnaires were shorten by eliminating questions that had been duplicated from individual questionnaire for cross checking purposes.

Questions about medicinal and spiritual utilisations were somehow complicated and sensitive because they related to secrets, which were exclusively kept by the local expert. Local healers chose not to share much of their knowledge, and were not tried to be persuaded. Therefore only a small part of their knowledge could be documented.

If the author could have stayed longer at one place and spend at least a month with the special informants more information about medicinal and spiritual utilisations might have been gathered, but time limitations did not allow this.

Free lists

Free lists (Bernard, 2002) were included in the individual interviews for identifying items of a domain. Generally free lists are used to understand if the domain is locally salient or meaningful, which items are included in the domain and which of the items are most salient or most important. Free lists, which have been included in our questionnaire, have been the following:

- Listing of used trees near the house
- Listing of trees used for nutrition
- Listing of trees used for traditional medicine

Ranking of preferences

As part of the individual questionnaire preferences of trees used for nutrition and medicine, different kinds of utilisations, most important characteristics of baobab/tamarind and most efficient protection strategies were noted.

The informant listed, for example, first the different uses of baobab/tamarind and then ranked the uses by giving the most preferred first and so on. By analysing ranks of each respondent, preferences of local people were concluded.

Non-participant and participant observation

Whenever possible, the author observed and participated, in activities related to the questionnaire, such as demonstrations of cooking, transforming of products and, harvesting baobab and tamarind. During the activity, the author posed arising questions and took field notes. These observations and participations at some activities helped to verify information given in the interviews, and to better understand the topic.

Field diary

Additional observations, impressions and remarks, which were not included in the questionnaires, were regularly noted at the field diary. These notes included example observations of different processing and cooking methods, impressions and remarks about the interviews and the informants as well as remarks about informal discussions, which took place between the interviews or in the evenings while sitting around the fire.

Audio recording

Some interviews were tape-recorded to control the translator since the author depended heavily on the translator. The translator was informed about the recording, which was done pressure the translator to take the job seriously.

Before recording, every respondent was informed about the sense and asked for his or her consens. People, who did not want to be recorded, were not interviewed out of respect. This did not occur often as people were highly amused by hearing their own voice played back at them from the tape.

Photography

Not only for documentation of the already described *Plus Trees* but also for general documentation, pictures were taken with a digital camera whenever possible.

3.3.3. Sample

Sampling

The sample covered three ethnic groups (Peulh, Serer, Wolof) and nine villages (see researched sites) in three different regions in Senegal.

Sampling was based on the one hand on purposeful sampling (Bernard, 2002), and on the other hand on snowball sampling (Bernard, 2002). The purposive sample was chosen by the sex and age class, of three different ethnic groups in three different phytogeographical regions. The author described in every village the system of purposive sampling by explaining to the village chief how many men and women will be needed as well as the fact that the informants should have different ages. The assortment of individual interview partners happened by snowball sampling, since the village chief or, the translator sometimes insisted to choose the persons or informants recommended by other villagers or respondents. This was often the case in identifying key informants. Sometimes the author interviewed people, who just happened to pass by.

Informants

The investigated informants were described through some socio-economic parameters. The respondents were half men, half women and between six and 99 years old. Most of the informants were muslim, some Serer also catholic. The level of education was no selection criteria. The respondents had different levels and forms of education (French school, school of Koran, alphabetisation), some of the informants had never attended school. The level of education as well as the marital status were documented. The marital status varied from unmarried, married to widow/er. The number of wives (1-4 wives) per household and the number of household members was inquired. And finally the principal and second activity (agriculture, household, pupil, commerce, etc.) of the informants was documented.

Sample size

The sample size was fixed to 20 informants, 10 men and 10 women of different ages for each ethnic group. The different ages were not classified into groups but care was taken to choose different ages.

Three ethnic groups were questioned, resulting in a total number of 60 individual interviews.

3.3.4. Pre-Tests

Pre-tests of the elaborated methods were undertaken by Christine Buchmann in a six-week exploratory phase, including two weeks in Senegal. Interviewed ethnic groups in Senegal were the Wolof, Madingue, Toucouleur and Serer in the western and west-northern regions of Senegal. The visited villages were Sakal, Coki, N'Dande, Niakhoul, Foua 1, M'Bassis and Mont Rolland.

Within this pre-testing phase Christine Buchmann tested the elaborated methods. The questionnaire was adapted after every interview and the new version was tested. Subject of testing were "*the relevance and appropriateness of wording, order and topics of questions for the specific study area*" (Buchmann in Vogl et al., 2007).

Christine Buchmann identified ethnic groups, research sites conditions, road access and infrastructure for further research of the intensive data collection.

Form and intensity of cooperation concerning availability of additional staff, infrastructure etc. with the local partner CERAAS, were discussed and planed.

3.3.5. Intensive field research

Methods used and described below are the result of identification of useful methods in the preparative and exploratory phases by Christine Buchmann.

For comparing and analysing the data gained from the field, methods and tools were used consistently for every ethnic group.

Data collection took from mid November 2007 until mid March 2008, which amounts to a period of four months during dry season. This was the recommended time, since rainy season is the peak period for agricultural work and people might not have time to answer the questionnaires. Another reason to choose the dry season are the "easier" conditions, meaning the more tolerable climate and better condition of road.

Christine Buchmann accompanied the author for the first two weeks of field research to introduce and clarify the methods, as well as resolving initial problems. Additionally, Christine Buchmann gave the author a written manual detailing interview guidelines and some background information.

The DADOBAT team of the local partner CERAAS facilitated and helped organising the author's field trips to the villages under the responsibility of Sali Bourou.

Beside the documentation of local knowledge, socio-economic information about the informants was recorded.

The interview language was either French or translation of local language (Peulh, Serer, Wolof), later put back into French.

3.4. Used methods according to hypotheses

In this section, the applied methods are listed according to the hypothesis they support. Since the main information was gained from questionnaires, the questions asked to the specific hypothesis will be listed.

Hypothesis 1: Baobab and tamarind play an important role for local communities.

The information for this hypothesis was gained through individual questionnaire questions, which were all questions about the utilisation habits and frequencies and especially by the questions "Is the baobab/tamarind important for you?" and "why is the baobab/tamarind important for you?". Additionally, daily observations and field notes were made about routine uses of both trees.

- *Sub-Hypothesis 1.1: All plant parts of baobab and tamarind are used in a multifunctional way.*

  Multifunctional uses were eludicated through the questions of how people use different plant parts of baobab/tamarind and through the questions of the symbolic and cultural value, as follows: "do you know any ceremonies with baobab/tamarind?"; "Are some genies or spirits connected with baobab/tamarind?" and "does the baobab/tamarind play an important role in cultural life, other than those that have already been listed?".

- *Sub-Hypothesis 1.2: There is already an existing local market on baobab and tamarind plant parts.*

  The question of commercial use was not asked separately, but was included in questions on how to use plant parts of baobab/tamarind. Furthermore, the subject of commercial value sometimes raised the question of harvesting methods, where respondents stated not to harvest, but to buy baobab/tamarind products on local markets. Additionally, the author visited some local markets in villages and towns, focusing on baobab/tamarind plant parts and taking field notes.

Hypothesis 2: Baobab and tamarind plant parts are not only used in a nutritional and medicinal context, but also in social and cultural life.

This hypothesis has been covered again by the questions "do you know any ceremonies with baobab/tamarind?"; "Are some genies or spirits connected with baobab/tamarind?" and "does the baobab/tamarind play an important role in cultural life, other than those that have already been listed?".

- *Sub-Hypothesis 2.1: There are some local traditions or beliefs that could hinder plantations of baobab or tamarind.*

  No questions were specially focused on this hypothesis, but the issue was included in the questions mentioned above (hypothesis 2) and raised by questions such as "do you plant baobab/tamarind trees?", "why/why not do you plant baobab/tamarind trees?", "do you cultivate baobab/tamarind trees?" or "why/why not do you plant baobab/tamarind trees?".

Hypothesis 3: There are almost no traditional cultivation systems and local people are harvesting unsustainably from wild baobab and tamarind trees.

Cultivation techniques have been covered in the questions “do you cultivate baobab/tamarind trees?”, “if yes, how do you cultivate baobab/tamarind trees?”. The supposedly unsustainable harvest techniques were not directly investigated, but raised by questions of “does the baobab/tamarind disappear?” and “if yes, why does the baobab/tamarind disappear?”, which were asked during group discussions. Furthermore, the author took a walk in every village to see the most preferred trees and took pictures of them. Obviously, those trees were well utilized and showed marks of unsustainable harvest (pollarding) which were noted in the field diary.

- *Sub-Hypothesis 3.1: Baobab and tamarind are not or rarely planted, but protected by local communities.*

  This hypothesis was directly addressed in individual interviews through the questions “do you plant baobab/tamarind trees?”, “why/why not do you plant baobab/tamarind trees?”, “is the baobab/tamarind protected by the community?”, “why/why not is the baobab/tamarind protected by the community?”, “do you protect the baobab/tamarind?” and “why/why not do you protect the baobab/tamarind?”.

- *Sub-Hypothesis 3.2: Local people are already feeling some shortage of baobab and tamarind.*

  Questions during group discussions assisted for this hypothesis. These have been “is the access to baobab/tamarind fruits limited?”, “why/why not is the access of the baobab/tamarind fruit limited?”, “does the baobab/tamarind disappear?” and “why/why does not does the baobab/tamarind disappear?”. Sometimes indicators for this hypothesis were raised by the questions “are there young baobab/tamarind trees?” and “why are there/why are there no young baobab/tamarind trees?”.

Hypothesis 4: Baobab is an indicator of former settlements and accompanies actual human settlements.

The controversy of baobab as indicator for former settlement was investigated through the question of habitat. When people mentioned villages, fields or former human settlements as habitat for baobab, the author inquired further whether the baobab is connected with the human being and therefore grows on these sites.

Hypothesis 5: Local people do have their own selection criteria and concepts of classifications for varieties of baobab and tamarind.

This hypothesis was included in group discussions, where people were asked to name local varieties or types of baobab and the differences between the types, as well as linkages between single attributes such as fruit taste and size, the colour of bark and leaf taste and so on.

- *Sub-Hypothesis 5.1: The varieties have different values or importance for local people.*

  The questions “for what do you use this special type of baobab/tamarind?”, “which are your preferred baobab/tamarind trees?” and “why is this baobab/tamarind preferred by you?” addressed this hypothesis.

3.5. Data Storage

An Access database, version 2003-2007, was developed in collaboration with Dr. Brigitte Vogl-Lukasser and Christine Buchmann. The raw data was entered into this database.

The Access database consists of tables, reflecting the different sections of the questionnaires. All tables are linked, to enabling combination and comparison of all data stored.

The data base consists of the following tables:

- Administrative and socio-economical data
- General plant knowledge and transmission of knowledge
- Utilisations of baobab/tamarind plant parts
- Preferences
- Utilisation problems
- Cultivation (conservation and domestication)
- Administrative data of group discussion participants and ecology section
- Administrative data of village introduction interview, village infrastructure and property section

3.6. Data analysis

Before analyzing the data, answers with similar content to each question were categorized when possible. One example of categorization is the first figure shown (Figure 1), where all kinds of food utilisations are categorized as “nutrition”, all medicinal and therapeutical utilisations as “medicinal” and all kinds of medico-magical or traditional utilisations are categorized as “symbolic” purpose and so on.

After categorisation, tables and figures were developed by counting answers in relation to the total number of respondents, number of respondents per ethnic group or number of group discussions. “Yes or No” answers were calculated directly in the Access program (version 2003-2007); other results were calculated in Excel 2008. The figures show results of descriptive statistics of frequencies created in Excel. These figures and tables (developed in Microsoft Word 2008) visualize the data and help to better understand the content. Because of financial and time constraints only quantitative descriptive statistics of frequencies were calculated, no further statistical tests were performed.

Beside descriptive statistics, results were analyzed qualitatively by description of details and background information of the respondents’ answers. This information may lead to a better understanding of the tables and figures shown, as well as the topic’s complexity and the shown tables and figures.

3.7. Material and Tools

Beside the copies of the questionnaires, paper, crayons and ribbon in different colours, a voice recorder and a digital camera (Canon Digital IXUS 50) for documentation were used during fieldwork.

3.8. Authorizations

For field research no special authorizations were necessary. The author obtained a research visa. During the author's stay in Senegal she was insured in the frame of CERAAS as a student apprentice.

3.9. Consideration of Ethic Subjects

ISE ethics were respected wherever applicable (http://ise.arts.ubc.ca/ethics.html)

Before starting research, people were informed about the aims and purpose of the author's stay and research. The author tried to keep the research as transparent as possible and questions or doubts could be interjected freely. All informants stay anonymous, only the data are used.

The initial idea was to repatriate results to the villages and participants but it seems exceedingly complicated to do so, because the author cannot personally return the results of her study to every village. In addition, all data are presented in English, which is not generally spoken. Analphabetism may further complicate the correspondence.

However, since the DADOBAT partners of CUC (Center of Underutilized Crops) Southampton are responsible for repatriating the data of the project and, including the present thesis to local communities, dissemination is taken care of.

The author hopes to publish the data as previously recorded, indigenous knowledge and intellectual property of the named ethnic groups.

4. Results

The results chapter is subdivided into utilisations, symbolic and cultural value, harvest and storage management, propagation and cultivation systems and conservation practices of baobab and tamarind. The two species are covered individually and not compared with each other.

The analyses were normally undertaken with the complete sample size of individual interviews, which count 60 persons. If remarkable differences were found between ethnic groups or gender, these differences were analyzed separately. Each ethnic group counts 20 persons each, with 30 persons of each gender. In case of analyses of group discussions, the sample consisted of nine groups.

4.1. Utilisations

4.1.1. Use categories of baobab

Asked for uses, the respondents (n=60) listed 502 utilisations (including multiple answers) of baobab, whereof the Peulh named 144 (29%), the Serer 186 (37%) and the Wolof 172 (34%), men named 246 (49%) and women 256 (51%) utilisations.

From these 502 utilisations, almost half-234 (47%) are for nutritional purpose, 71 (14%) for medicinal, 14 (3%) for spiritual and 6 (1%) for veterinarian purpose. Furthermore, 177 (35%) other utilisations, which are described in detail below, were listed (Figure 1). The 502 cited utilisations mean an average of about 8.3 different forms of uses per informant.

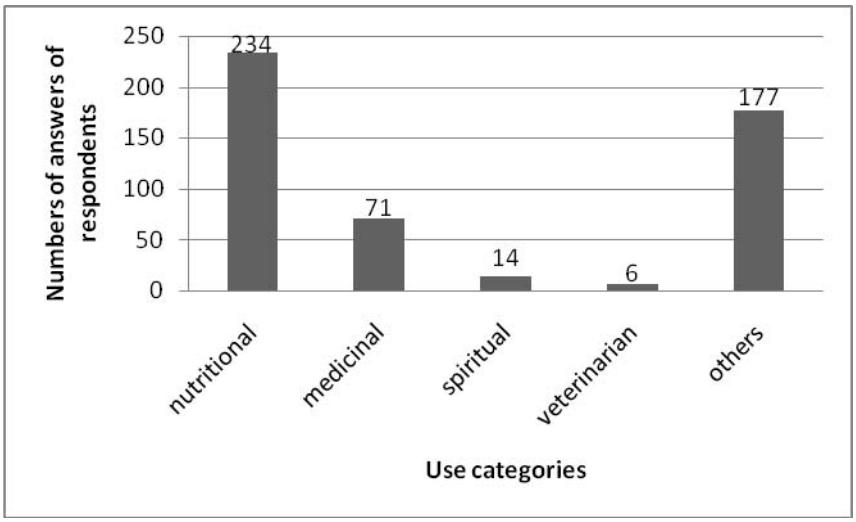

Figure 1: Number of all answers (including multiple answers) of all respondents (n=60) sorted by use categories of baobab (502 answers)

Regarding the three ethnic groups-Peulh, Serer and Wolof, -there are some differences concerning the use categories. While the nutritional utilisations seem to be quite equilibrated, the Wolof (n=20) name nearly half of medicinal utilisations and the Serer (n=20) about one third. Even for the spiritual uses the Wolof name nearly two thirds, while Peulh (n=20) and Serer name about 20% of spiritual uses each (Figure 2).

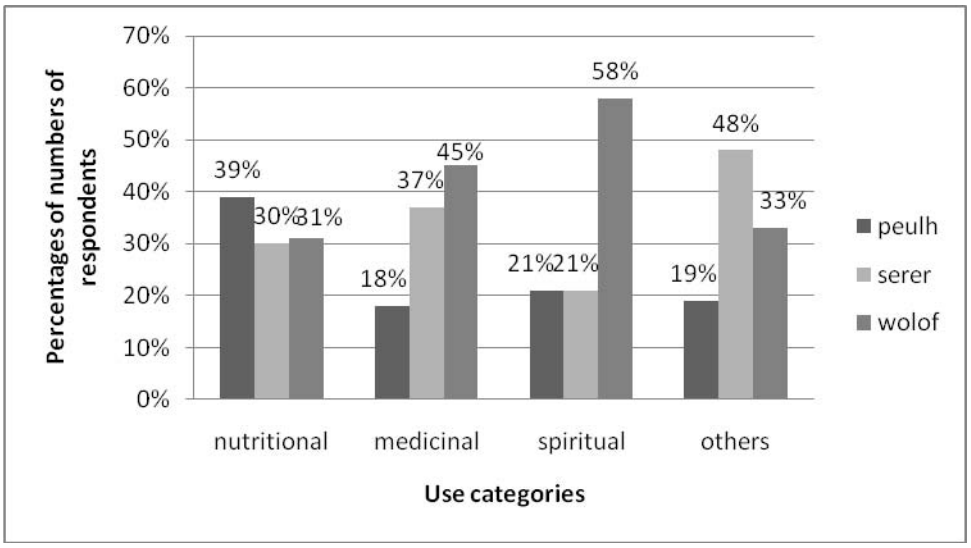

Figure 2: Contribution of ethnic groups (n=60; 20 respondents per ethnic group) concerning different utilisation categories of baobab (nutritional: 234 answers, medicinal: 71 answers, spiritual: 14 answers, others: 177 answers)

4.1.2. Importance of baobab

97% of all sampled respondents (n=60) confirm that the baobab is important for them. The reasons given for the importance (including multiple answers) of the baobab are for 95% of respondents for food function, for 15% of informants the commercial benefit was important, for 15% of informants the medicinal function, for 3% of respondents the baobab was part of their tradition and for 3% of informants the baobab is significant as the emblem of Senegal (Figure 3).

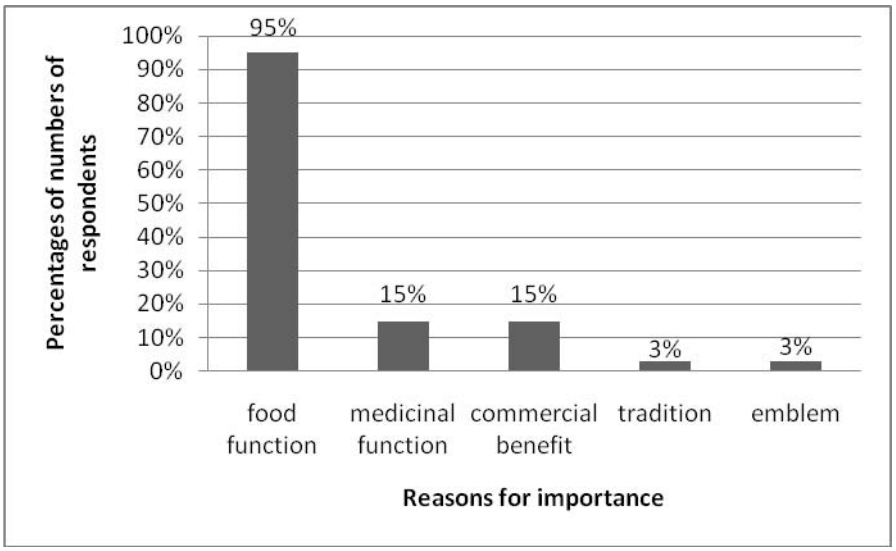

Figure 3: Listed reasons by local people (including multiple answers) for the importance of baobab (n=60)

4.1.3. Detailed description of food utilisations of baobab

Pulp

The pulp of the baobab is used as an ingredient for sauces and the *bouillie,* which is a kind of porridge. Mixed only with water, the pulp is drunk as juice. The frozen juice is consumed as so called *crème,* which is ice cream. The pulp can also be mixed with milk or even serves as milk substitute. It was mentioned once, that one can make jam with the pulp of the baobab.

The *bouillie:*

The *bouillie, Lakh* or *Nec* is a common warm meal normally prepared with maize flour (*Zea mays*), millet (*Pennisetum glaucum*), rice (*Oryza sativa*), fonio (*Digitaria exilis*) or sorghum (*Sorghum bicolor*), as well as water, sugar and baobab fruit pulp. It also appears in a salty version with groundnuts (*Arachis hypogaea*), with or without sugar. The versions with groundnuts (*Arachis hypogaea*) are unknown by Peulh, but only by Serer and Wolof. In sum, the *bouillie* can be described as kind of porridge; the consistence varies from very liquid to pulpy.

To prepare the *bouillie,* the fruit pulp of the baobab is soaked in usually hot water and mixed until the seeds separate from the pulp. Afterwards the liquid is filtered and added into the *bouillie.* The fruit of the baobab gives the taste and serves as substitute for milk. Instead of baobab tamarind, bisap (*Hibiscus sabdariffa*), lemon (*Citrus limon*), milk or milk powder can be used for the *bouillie*.

The juice:

To prepare the juice, the fruit is soaked in water until the seeds separate from the pulp and then the liquid is filtered. The juice is drunk with sugar.

Seeds

The seeds are used for preparing sauces, such as the *Mafé*. The seeds replace groundnuts (*Arachis hypogaea*) and serve as substitute for groundnuts (*Arachis hypogaea*). Informants state that today the utilisation of seeds as replacement for groundnuts (*Arachis hypogaea*) is gradually diminishing, because groundnut (*Arachis hypogaea*) shortages are rare nowadays. Crushed, the seeds serve as a substitute for “soup stock”. Oil can be obtained from pressed seeds.

The *Mafé:*

The Mafé is a common meal with couscous or rice (*Oryza sativa*) and a sauce of roasted and crunched groundnuts (*Arachis hypogaea*) -the *degge degge.* Additionally, if available, onion (*Allium cepa*), vegetables (carrots (*Daucus carota ssp. sativa*), cabbage (*Brassica ssp.*), beans (*Phaseolus vulgaris*)), leaves of pumpkin (*Cucurbita spp.*), manioc (*Manihot esculenta*) or nerverdie and meat can be added. It is common to add some *lalo* (described below) into the sauce to make it stickier.

Husk

Some Peulh report the use of the husk ashes as an ingredient for sauces.

Leaves

The leaves, in form of powder (*lalo*), are directly mixed with couscous. The *lalo* or fresh leaves are added to sauces, such as the *Mafé*. It is reported that young baobab trees have more palatable leaves and are therefore preferred.

The utilisation of *lalo* is widely spread under Peulh and Serer, while the Wolof report that today the utilisation of *lalo* is becoming rare. The Wolof consume more rice (*Oryza sativa*) instead of couscous and when they prepare couscous, the *lalo Mbep (Sterculia setigera)* is preferred because of its easier preparation.

The *lalo*:

The so-called *lalo* is the powder of dried baobab leaves. To gain this powder the leaves are sundried, pounded and sieved. Sometimes the leaves are cut into small pieces before desiccation.

The *lalo* is used in all meals with couscous. Mixed directly with couscous, it facilitates swallowing because of the mucilaginous properties of the *lalo.* Local people state that they are not able to eat couscous without *lalo,* because it would be to dry and impossible to swallow*.*

Couscous is a ground cereal, normally maize (*Zea mays*), millet (*Pennisetum glaucum)*, fonio *(Digitaria exilis)* or sorghum *(Sorghum bicolor)*. Different kind of sauces can be served with couscous, which are among others, sauces with groundnuts (*Arachis hypogaea*)- the *Mafé*- or just leaves of different plants (pumpkin (*Cucurbita spp.*), manioc (*Manihot esculenta*)), but can also contain beans (*Phaseolus vulgaris*), bisap (*Hibiscus sabdariffa*), vegetables or even fish or meat when available.

The mucilaginous function of *lalo* can be replaced by bisap (*Hibiscus sabdariffa*) or the so-called *lalo Mbep (Sterculia setigera)*, for which the sap of the bark is used.

4.1.4. Frequencies of baobab food utilisations

Regarding the frequencies of consumption of different meals prepared with baobab plant parts, parts, the importance of the baobab in daily diet is illustrated. The calculated percentages rarely reach 100% since not all respondents prepare the following meals. The *bouillie* prepared prepared with the baobab fruit is consumed by 75% of Peulh (n=20) and 60% of Serer (n=20) (n=20) throughout the whole year. Both ethnic groups consume the *bouillie* once a day, the Peulh in the morning and the Serer at midday. Only 20% of Wolof (n=20) eat the *bouillie* every every day throughout the whole year, but 70% of Wolof mention to consume it from time to time time (

Table 1).

The seeds as an ingredient for sauces and as substitute for groundnuts (*Arachis hypogaea*) are are used by a minority of 10% of Peulh and 20% of Serer throughout the whole year. Wolof and and some Peulh mention to use the seeds from time to time (

Table 1).

The *lalo* for the preparation of couscous is consumed by 90% of Peulh and Serer throughout the whole year, once or even twice per day. The couscous is eaten in the morning and in the evening. 60% of the Wolof state to consume the couscous irregularly and only occasionally (

Table 1).

The Peulh use the *lalo* also as ingredient for sauces: 30% of Peulh mention to consume these these sauces throughout the whole year, once a day (

Table 1).

Table 1: Frequencies of consumption of selected nutritional utilisations of baobab plant parts. P=Peulh, S=Serer, W=Wolof. Percentages are calculated per ethnic group: 100%=20 respondents (n=60). The calculations do rarely reach 100% since not all respondents do prepare all listed meals.

Plant part	Meal	Ethnic group	The whole year	Time of the day	Times per day	Not regularly
Fruit	Bouillie	P	75%	Morning	1x	15%
		S	60%	Midday	1x	35%
		W	20%	Morning or midday	1x	70%
Seeds	Sauces	P	10%			20%
		S	20%	Morning and evening	2x	
		W				15%
Leaves	Lalo for the couscous	P	90%	Morning and evening	1-2x	
		S	90%	Morning and evening	2x (1x)	10%
		W		Evening	1x	60%
Leaves	Lalo for sauces	P	30%		1x	

4.1.5. Detailed description of therapeutic and medicinal uses of baobab

All baobab plant parts are medicinally or therapeutically used for treatment of different diseases. A complete list of all cited utilisations is given in the table (

Table 2) below and only commonly used applications will be pointed out in the text.

Most common utilisations are the application of the pulp against diarrhoea. This treatment is not known by Peulh, but widely spread amongst Serer and Wolof communities. In addition, the pulp is commonly used, again by Serer and Wolof, against any kind of stomach pain or illness. Some Serer and Wolof respondents report to use the pulp against fatigue.

The leaves are known by all three ethnic groups for their application against tiredness. Against stomach pains the baobab leaves or the bark are soaked in water and drunk.

The root of the baobab is often cited to be applied in traditional medicine, but no details were disclosed by respondents, as the application of traditional medicine is often linked to spiritual ceremonies.

Some Serer and Wolof use the resin of the baobab against teeth pains and cavities. The resin can be put directly into the hole of the tooth.

A (semi-) parasite (*Tapinanthus sp.*), which grows on the baobab and is usually considered as “part of the tree”, is described to be applied in traditional medicine. Details were not given.

Table 2: Treated diseases by baobab plant parts, form of application, ethnic groups and percentages of given answers by respondents. P=Peulh, S=Serer, W=Wolof (n=60)

Plant part	Treated diseases	Form of application	Ethnic group	Answers in % (n=60)
Pulp	Diarrhoea	Juice (drink)	S,W	39
	Stomach pains and illnesses	Juice (drink)	S,W	15
	Tiredness	Porridge, juice (drink, eat)	S,W	7
	Strengthen lean children	Juice (drink)	P, W	3
	Cold	Juice (drink)	P,W,	3
	Fever	Juice (drink)	S,W	3
	Malaria	Juice (drink)	S	3
	Dysentery	Juice (drink)	W	2
	“Ndoye”: Illness with blood in the dejection	Juice (drink)	W	2
	Headaches	Juice (drink)	S	2
	Lactating women	Juice (drink)	W	2
Seeds	Vomiting	Liquid (drink)	P	2
	Eye pains		S	2
	Stomach pains	Liquid (drink)	W	2
Husk	Wounds and lesions	Mixture (external application)	P,S	3
Flowers	Wounds	Bath (external application)	S	2
	Skin problems	Bath (external application)	S	2
Leaves	Tiredness	Sauce, liquid (drink)	P,S,W	17
	Stomach pains and illnesses	Liquid (drink)	P,S,W	10
	Dysentery	Liquid (drink)	P,S	3
	Tending eyes	Liquid (external application)	W	3
	Burns	Liquid (external application)	W	2

Bark	Stomach pains	Liquid (drink)	P,W	5
	Wounds	Infusion (drink)	S,W	3
	Yellow fever	Mixed in meals (eat)	P	2
	Vomiting	Liquid (drink)	P	2
Bark	Fractures	Mixture (external application)	S	2
	Burns	Infusion (drink)	W	2
	Skin illnesses	Liquid (drink)	W	2
Root	Traditional medicine		S,W	5
Resin	Teeth pains and cavities	External application	S,W	5
(Semi-) Parasite	Traditional medicine		P,S,W	10
	Tiredness	Liquid (drink)	P	2
	Stomach pains	Liquid (drink)	P	2
	Headache	Liquid (drink)	P	2
	Stopping urinating	Liquid (drink)	P	2

All juice applications with the pulp are prepared by soaking the fruit pulp in water. This juice is drunk. The porridge is the same as already described in the chapter of food uses. To prepare the liquid with seeds against vomiting and stomach pains, the seeds are soaked in water and sugar can be added. The liquid is drunk. For bath treatments with flower, a bath is taken in water containing baobab flowers.

For the treatment of wounds and lesions with the husk, one has to scrape off the external surface of the husk and affix it directly to the wound. For all treatments with leaves, fresh leaves are used, with sauce being the only exception, in which powdered leaves are used. In the cases of treatments in form of liquids, fresh leaves are soaked in water and drunk. For treatments in form of external application, fresh leaves are soaked in water and then pressed before applying on the eyes or burns.

Bone fractures are treated by mixing the pounded bark with salt and affixing it directly to the fracture. In cases of treatments in form of liquids, the bark is soaked in water and then filtered before drunk or even drunk directly. Salt or sugar can be added to the preparation. For infusions the liquid is boiled and then drunk.

In cases of teeth pains and cavities the resin is directly placed on the tooth's hole. For the treatment of tiredness, stomach pains and headache the fresh bark is soaked in water and then drunk. To stop urinating, the whole plant is soaked in water and drunk.

The pulp is the plant part of the baobab, which is mostly applied in disease treatment, followed by the bark, the leaves and the (semi-) parasite (*Tapinanthus sp.*) of the baobab (Figure 4). The pulp is reported to treat 11 diseases, the bark 7, the leaves and the (semi-) parasite (*Tapinanthus sp*.) five each. The seeds are said to treat three illnesses, the flowers two and the husk, the root and resin one each.

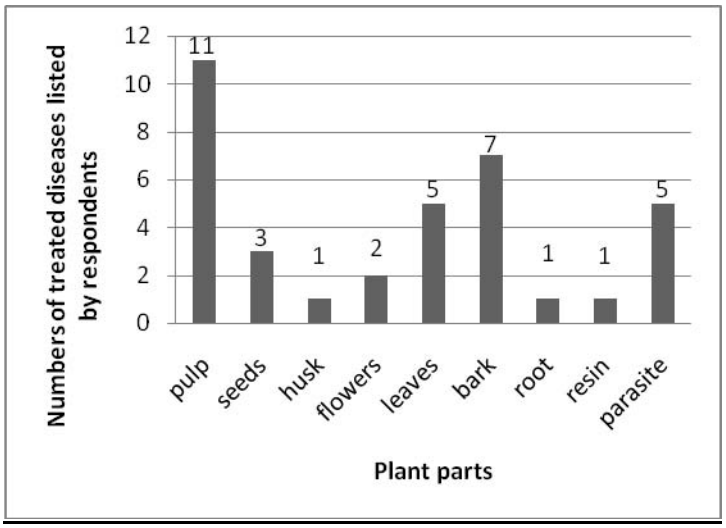

Figure 4: Numbers of treated diseases (36 treated diseases listed by all respondents) per baobab plant part (n=60)

4.1.6. Other utilisations of baobab

In the category “other utilisations” (177 answers), main uses are the fibres for cordage with 21%, wood as firewood with 22% and leaves as fodder with 15% (Figure 5). Other uses and details are described below.

Husk

The ash of the husk is used as fertilizer for the fields. It is mentioned that the ash of the husk is applied for making soap. Furthermore, it is used to dye clothes. For washing horses, people use the ash of the baobab husk. The ash of the husk can also serve as a salt substitute. The husk is used as a vessel for seeds and other materials.

The Serer use the ash of the husk to mix it with tobacco and then place it on the lower teeth ride or in the nose and leave it there for some time. This described application is a luxury food and is mostly used by elder men and women. Normally elder people take it at least once a day. It is reported, once one gets addicted, withdrawal symptoms include headaches and sickness.

Fruit fibres

The fibres of the baobab fruit are used for washing dishes. It is even reported that one washes and scrubs one’s own body with the fibres.

Leaves

In Serer and particularly Wolof communities, people feed their animals with baobab leaves. It is assumed that in Serer and Wolof regions, tree resources are more exploited and therefore receive more pressure. This assumption is confirmed by some statements concerning the conflicts between villagers and shepherds about baobab trees in Serer and particularly Wolof communities.

Wood

The wood of the baobab is used as firewood. While the Peulh try to avoid taking the baobab wood as firewood because of its bad quality (it is described that the wood burns, but that the “flame does not come out”), it is widely used in Serer and Wolof communities. The author concludes that in the Sahelian and in the Guinea-Congolia zone, where the Serer and Wolof are settled, there is more pressure on resource trees, while the Soudanian zone, where the Peulh were studied, has a higher tree diversity and density and therefore the Peulh have more alternatives for firewood. Serer report to use baobab branches and wood for smoking fish, which is a specialty of the regions near the sea. The Wolof even use the wood for charcoal.

The ash of the wood is reported to be used as fertilizer.

Bark

The fibres of the baobab bark are used to fabricate cordages and ropes. These ropes are used for tying animals, fabricating fences, tying straw for the construction of house roofs, collecting water from fountains, binding millet (*Pennisetum glaucum)* together, making hammocks and clothesline.

To make the ropes, people take the middle part of the bark: The fibres are gained by extracting the bark of the surface, then cutting half of the middle bark and then tearing it. The fibres are sundried. Two or three of them are twisted, rolled or bound with a little bit of water to facilitate the work process. It is reported that young baobab trees are preferred for the fabrication of ropes because fibres of young trees are said to be more resilient.

Serer and Wolof report that traditional cordages fabricated of baobab are more and more replaced by modern industrial cordages. Industrial cordages are said to be stronger than baobab cordages.

In dry seasons, the bark is fed to horses. The bark is said to contain a high amount of water.

Resin

The resin is used as glue for paper and for filling holes in bottles. In addition, Serer and Wolof apply the resin for laundry. It is described that after the normal washing process, people soak their clothes again in water with the resin of the baobab. People report that this procedure leads to cleaner clothes.

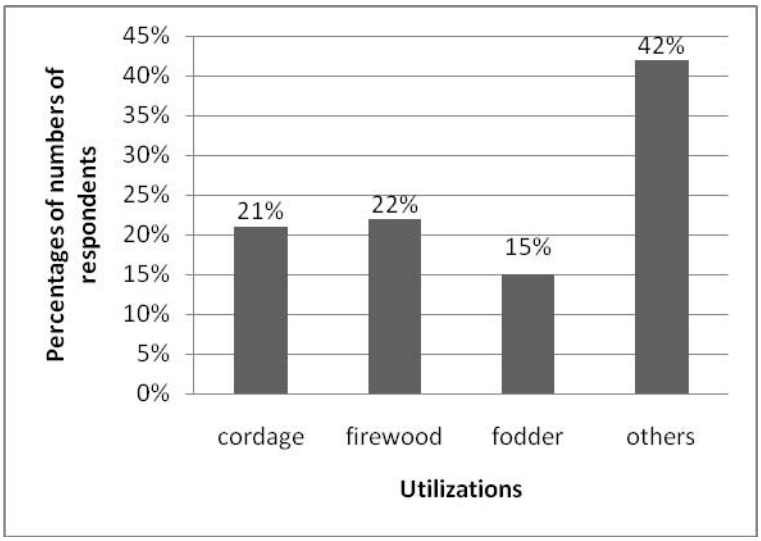

Figure 5: Contribution of selected uses of the category "other utilisations" (177 answers=100%) of baobab (n=60)

4.1.7. Commercialisation of baobab

Some respondents mention that the importance of the baobab has changed in so far, as today people benefit from the baobab commerce. It is reported that the commercialization is a new development and did not exist in former times. Some Serer and particularly Wolof report that today they do not even harvest the baobab fruits and leaves themselves, but buy them on local markets or from traders. While fruits are not specified to any gender, leaves trade is classified as women's activity and the sale of bark or ropes is a male domain.

The percentages rarely reach 100% since not all respondents use baobab plant parts for commercial purpose.

Fruit

63% of all sampled respondents (n=60) state that the baobab fruit is sold by men and women, 13% of all informants define it as women's activity and 10% of all respondents mention that young boys sell the baobab fruit (Figure 6). Some Serer state that shepherds also use the baobab fruit for commercial purpose.

While Peulh and Serer trade the baobab fruit from hand to hand, the Wolof buy baobab fruit products on the local market or in shops. The fruit is either sold as a whole or the pulp is sold in form of powder. Wolof report, that the baobab fruit is available across the whole year.

Leaves and *lalo*

Commercial use of the baobab leaves is more defined as women's activity- 42% of all sampled respondents (n=60) confirm, that only women sell baobab leaves (Figure 6). This gender separation is mostly done by Peulh and Serer, where over the half of each ethnic group report that the baobab leaf trade is done by women.

However, 28% of all respondents, which are Serer and Wolof, do not associate gender with the commercial use of baobab leaves (Figure 6). Some Serer report that, children also trade with baobab leaves.

The Wolof state to buy baobab leaves on the market or in shops throughout the whole year, while Peulh and Serer trade more from hand to hand. The leaves are either sold as whole leaves or in form of *lalo.*

Bark

The trade of baobab bark is considered as men's activity. 17% of all sampled respondents (n=60) confirm that men sell the baobab bark. 7% of all informants, all Wolof, state that the sale can be done by both genders (Figure 6). Often, the bark or rope is not traded, but people harvest and fabricate it for own use.

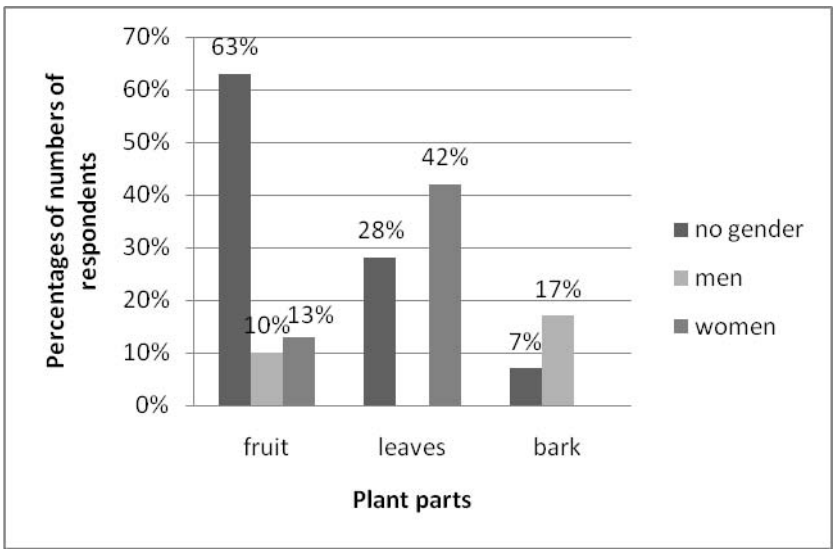

Figure 6: Contribution of gender in commercial use of baobab plant parts (n=60). Percentages will rarely reach 100% since not all respondents do use baobab plant parts for commercial purpose.

4.1.8. Use categories of tamarind

Asked for uses, the respondents (n=60) named 357 utilisations of tamarind (including multiple answers), whereof the Peulh name 88 (25%), the Serer 124 (35%) and the Wolof 145 (40%), men name 176 (49%) and women 181 (51%).

From these 357 utilisations 186 (52%) are nutritional, 77 (22%) medicinal, 3 (0.8%) spiritual, 2 (0.6%) veterinarian and 89 (25%) others were listed (Figure 7). 357 cited utilisations amount to an average of about 6 (5.95) different forms of uses per respondent.

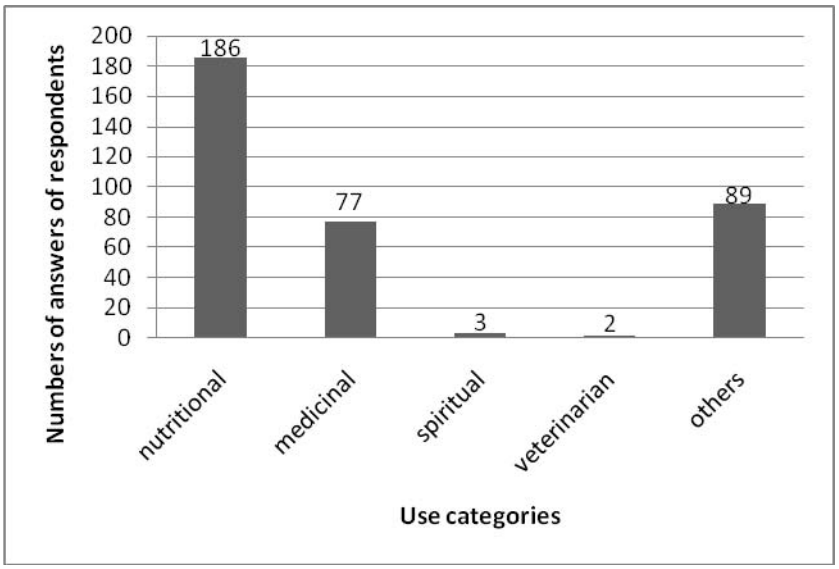

Figure 7: Number of all answers (including multiple answers) of all respondents (n=60) sorted by use categories (357 answers) of tamarind

While the contribution of the nutritional utilisations is quite evenly spread between the three ethnic groups, the category of medicinal utilisation varies between the ethnic groups. The Wolof (n=20) name over half of the medicinal utilisations, the Serer (n=20) one third and the Peulh (n=20) 16% (Figure 8).

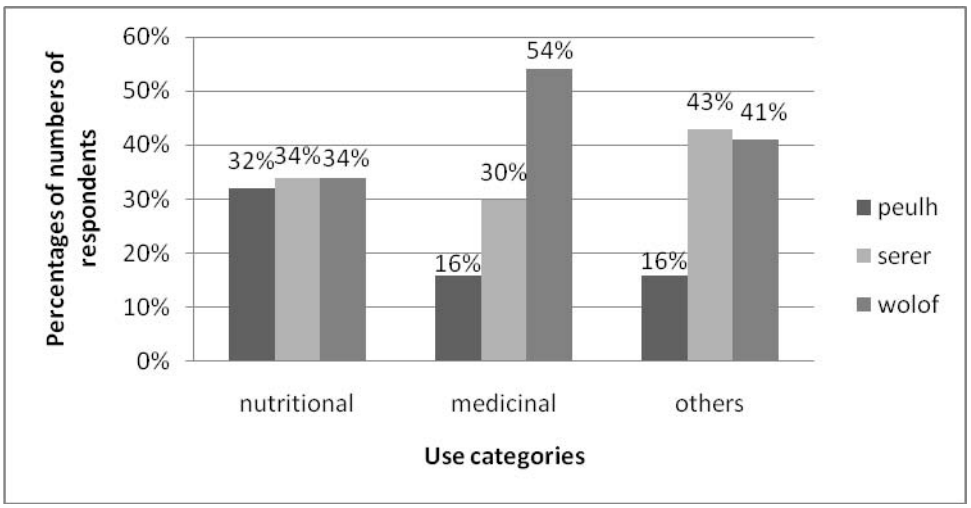

Figure 8: Contribution of ethnic groups concerning different utilisation categories (nutritional: 186 answers, medicinal: 77 answers, others: 89 answers) of tamarind (n=60)

4.1.9. Importance of tamarind

All sampled respondents, 100% (n=60), confirm that the tamarind is important for them. The reasons for its importance (including multiple answers) are for 85% of all respondents its food function, for 20% of all informants commercial use, for 13% of all respondents medicinal function (Figure 9).

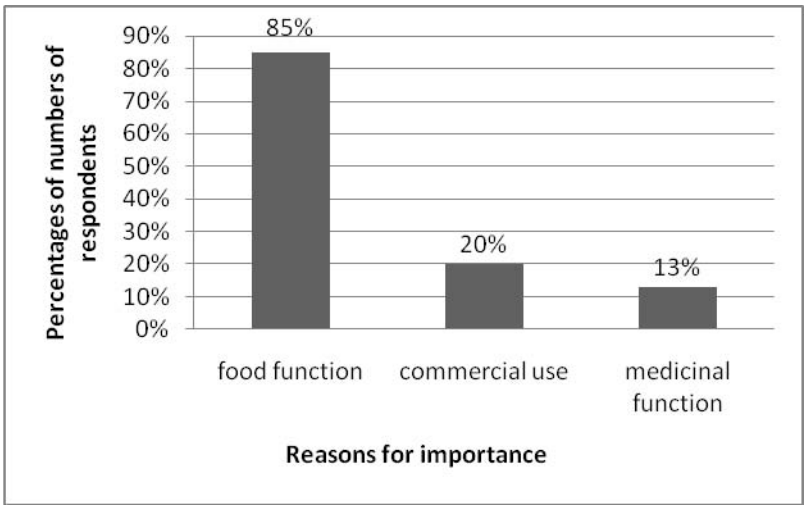

Figure 9: Listed reasons by local people (including multiple answers) for the importance of tamarind (n=60)

4.1.10. Detailed description of food utilisations of tamarind

Pulp

The pulp of the tamarind is used as an ingredient for the *bouillie,* which is a kind of porridge. The preparation of *bouillie* with the tamarind is common in communities of all three ethnic groups. Nevertheless, some Serer and Wolof report that nowadays the preparation of the *bouillie* with tamarind is decreasing. Furthermore a juice can be prepared with the tamarind pulp. Frozen, the juice is consumed as *crème*-as ice cream. Even a jam can be prepared from pulp of the tamarind.

Finally, the tamarind pulp serves as ingredient for sauces. Sauces prepared with tamarind are more common in Serer and Wolof communities than in Peulh. The most frequently prepared meal is called *Thiebo Dienne.*

The *bouillie, Lakh* or *Nec*

The *bouillie*-a warm meal, similar to porridge-has already been described for the baobab. The preparation is similar: the fruit is soaked in cold water and mixed until the seeds separate from the pulp. The liquid is filtered and added to the *bouillie.* In the case of the *bouillie* with tamarind, local people mention that a lot of sugar is needed because of the acidity of the fruit.

The *bouillie* can be prepared with flour of maize (*Zea mays*), millet (*Pennisetum glaucum)*, rice (*Oryza sativa*), fonio (*Digitaria exilis)* or sorghum (*Sorghum bicolor)*, water and sugar or salt and groundnuts (*Arachis hypogaea*). The consistence varies from very liquid to pulpy. Again there is a sweet and a salted version of *bouillie,* whereof the salted version with groundnuts (*Arachis hypogaea*) is more common with tamarind than with baobab. The salted *bouillie* is called *Lakh neteri.* The salted version is common in Serer and Wolof communities, but not known amongst the Peulh. The tamarind can be replaced by baobab, bisap (*Hibiscus sabdariffa*) and lemon (*Citrus limon*).

The juice

For the tamarind juice, fruits separated from the husk are soaked in cold water, mixed and filtered. The juice can be drunk sweetened with sugar or salty with chilli pepper (*Capsicum spp. annuum*).

The *Thiebo Dienne*

The *Thiebo Dienne* is a common meal, which directly translated means rice with fish. Normally it is served with palm oil (*Elaeis guineensis*), onion (*Allium cepa*), vegetables (carrots (*Daucus carota ssp. sativa*), cabbage (*Brassica ssp.*), manioc (*Manihot esculenta*)), chilli pepper (*Capsicum spp. annuum*), garlic (*Allium sativum*) and tamarind. There is also a red version where tomatoes (*Lycopersicon esculentum*) are added. If there is no fresh fish available, local people use dried fish. The tamarind is used for its taste and vitamins. The tamarind can be replaced by lemon (*Citrus limon*), vinegar or bisap (*Hibiscus sabdariffa*).

The Peulh do not prepare the *Thiebo Dienne* as described above, but only serve the tamarind fruits with different rice (*Oryza sativa*) meals. The Serer know the *Thiebo Dienne.* To prepare it, there are two possibilities, known by Serer and Wolof: 1) the tamarind is soaked in water and then filtered. The filtered water is added to the sauce and cooked. Sometimes it is reported that the whole fruit is added directly to the sauce and then cooked. 2) The whole fruit or only the fruit without husk is added to the sauce at the very end and is not boiled.

Some Wolof also prepare *Mathiate*. In this case the tamarind is not added to the sauce, but is served after the *Thiebo Dienne*, together with a sauce of lemon (*Citrus limon*), bisap (*Hibiscus sabdariffa*), pepper (*Piper nigrum*), manioc (*Manihot esculenta*), chilli pepper (*Capsicum spp. annuum*), tomatoes (*Lycopersicon esculentum*) and pieces of fish.

Husk

The Peulh use the tamarind husk as a replacement for the fruit. When there is no fruit available, the stored and pounded husk is added to the *bouillie* to improve the taste of the bouillie.

Flowers

Flowers serve as replacement for fruit in Serer and Wolof communities. In case there is no fruit available, people prepare the *bouillie* with the flowers of tamarind. In addition, the Serer use flowers as an ingredient for sauces. Even juice is reported to be prepared from tamarind flowers. The Wolof mention to eat the flowers mixed with sugar, salt or chilli as a snack between meals.

Leaves

The leaves of the tamarind are used in a way similar to the husk and flowers; to replace the fruits in the *bouillie*, in case there is no fruit available. This utilisation is more common in Peulh communities than in Serer and Wolof communities. The Serer state to also use the leaves as an ingredient for sauces.

4.1.11. Frequencies of tamarind food utilisations

Regarding the frequency of consumption of different meals prepared with tamarind plant parts, the importance of the tamarind in daily life is highlighted. The calculations of percentages rarely reach 100% since not all respondents prepare every meal listed. The *bouillie* prepared with tamarind is consumed by 75% of Peulh (n=20), 40% of Serer (n=20) and 20% of Wolof (n=20) consumed throughout the whole year, once per day (Table 3).

The fruit as ingredient for sauces-the *Thiebo Dienne*- is not cited in Peulh communities. 35% of Serer and 55% of Wolof consume it throughout the whole year, once per day, at midday (Table 3).

Table 3: Frequencies of consumption of selected nutritional utilisations of tamarind plant parts. P=Peulh, S=Serer, W=Wolof. Percentages are calculated per ethnic group: 100%=20 respondents (n=60). Percentages do not reach 100% since not all respondents do prepare every listed meal.

Plant part	Meal	Ethnic group	The whole year	Time of the day	Times per day	Not regularly
Fruit	Bouillie	P	75%	Morning	1x	15%
		S	40%	Midday	1x	10%
		W	20%	Morning or midday	1x	70%
Fruit	Sauces (Thiebo Dienne)	S	35%	Midday	1x	25%
		W	55%	Midday	1x	10%

4.1.12. Detailed description of therapeutical and medicinal uses of tamarind

Almost all plant parts of tamarind are medicinally and therapeutically used. A complete list of all cited disease treatments is given below (

Table 4). The most common applications will be described in the text.

The pulp of tamarind is used as a laxative against constipation and treats stomach pains and illnesses. Leaves are also used to treat stomach pains. The treatment of constipation and stomach pains or illnesses is not applied in Serer communities, but common in Peulh and Wolof populations. The pulp is also applied against fever.

The bark of the tamarind is commonly used by Serer and Wolof to treat bone fractures, wounds and injuries. In addition, Peulh and Serer use it to treat teeth pains.

The root of the tamarind and the (semi-) parasitic plants *(Tapinanthus sp*.), which grow on the tamarind are widely spread in traditional medicine. Details about treated illnesses or the form of application were not disclosed by informants.

Table 4: Treated diseases by tamarind plant parts, form of application, ethnic groups and percentages of given answers by respondents. P=Peulh, S=Serer, W=Wolof (n=60)

Plant part	Treated illnesses	Form of application	Ethnic group	Answers in % (n=60)
Pulp	Constipation	Juice (drink)	P,W	10
	Stomach pains and illnesses	Juice (drink)	W	7
	Fever	Juice (drink)	S	5
	Diabetes	Juice (drink)	W	3
	Curing and tending bones	Juice (drink)	W	3
	Wounds	Mixture (external application)	P	2
	Cold	Sauce (eat)	S	2
	Flu	Juice (drink)	W	2
	Malaria	Porridge, juice (drink, eat)	W	2
	Tiredness	Juice (drink)	W	2
Husk	Traditional medicine		W	3
	Vomiting	Eaten raw	P	2
Leaves	Stomach pains	Liquid (drink)	W	7
	Wounds	Bath (external application)	P,S	3
	Eye pains and illnesses	Vapour (external application)	S,W	3
	Tiredness	Liquid (drink)	W	3
Bark	Wounds and injuries	Mixture (external application)	S,W	27
	Fractures	Mixture (external application)	S,W	27
	Teeth pains	Liquid (gargling)	P, S	7
	Luxations	Mixture (external application)	S, W	3
	Stomach pains and illnesses	Liquid (drink)	W	3
	Renal pains	Mixture (external application)	W	2
Wood	Cleaning teeth	Piece of wood (tooth	S	2

Wood		brush)		
Root	Traditional medicine		S,W	12
	Stomach pains	Liquid (drink)	P,W	3
	Parasites or worms in the stomach	Liquid (drink)	W	2
	Rheumatism	Liquid (drink)	W	2
Resin	Teeth pains and cavities	External application	S	2
(Semi-) Parasite	Traditional medicine		P,W	7
	Body pains	Infusion (drink)	P	2
	Stop urinating	Liquid (drink)	P	2
	Wounds	External application	W	2

To prepare the juice for treatments with the tamarind fruit pulp it is soaked in water and then drunk. Sugar can be added if desired. The preparation of porridge is identical to the procedure described in the chapter “food uses”. For the treatment of wounds, the fresh pulp is mixed with a little water and then affixed to the wound. In cases of vomiting, the husk is eaten raw. No more details were given on the treatment of vomiting.

To treat eye pains and diseases, the eyes are held over the steam of boiling leaves. For treatments with liquid, in cases of stomach pains and tiredness, the leaves are soaked in water and then drunk with sugar. For treating wounds, the leaves are cooked and then pressed and placed on the injured part or used for washing children’s wounds.

For the treatment of wounds, injuries and fractures, luxations and renal pains the pounded bark is mixed with salt and sometimes Shea butter (*Vitellaria paradoxa)* and then applied to the injured part. In case of teeth pain, the bark is soaked in water. The water is gargled directly or filtered. For treating stomach pains and illnesses, the bark is soaked in water and drunk.

For treatments using the root, the root is soaked in water and then drunk. In case of teeth pain and cavities the resin of the tamarind is put directly in the hole of the tooth. Against body pains, all parts of the (semi-) parasitic plant (*Tapinanthus sp.)* are cooked and then drunk. For stopping urination, all plant parts of the parasitic plant are soaked in water and then drunk. The (semi-) parasite (*Tapinanthus sp.*) is used to treat wounds by affixing it to the wound after soaking in water. Details are not given about the kind of plant parts are used for treating wounds.

The pulp treats most of illnesses, with 10 listed treatments, followed by the bark with six and the leaves, root and (semi-) parasite (*Tapinanthus sp.*) with four treated illnesses each. The husk is applied in the treatment of two illnesses; the wood and the resin treat one illness each (Figure 10).

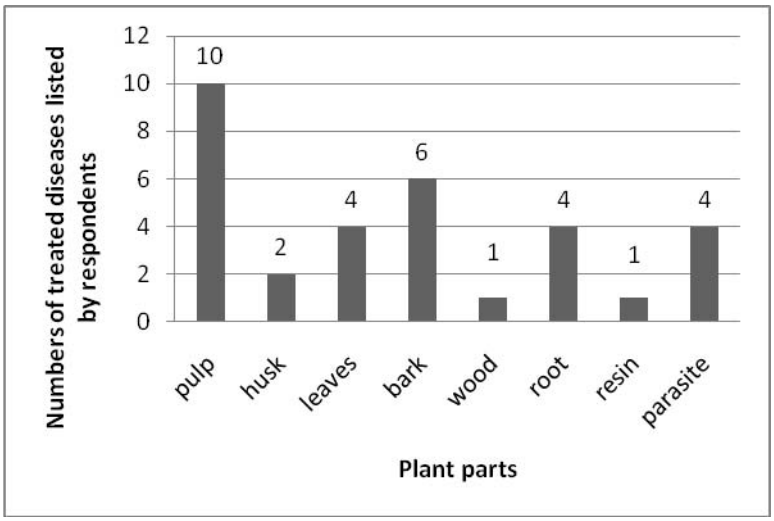

Figure 10: Numbers of treated diseases (32 treated diseases listed by all respondents) per tamarind plant part (n=60)

4.1.13. Other utilisations of tamarind

Main uses of the category "other utilisations" (89 answers) are the utilisation of wood as firewood with 52% and for construction with 11%, leaves for fodder with 17% and charcoal with 6% (Figure 11).

Leaves

Some Serer and Wolof report to feed their animals with tamarind leaves. While some feed the leaves regularly, others mention to feed the tamarind leaves only in emergencies, since leaves are very bitter and can cause stomach problems for the animals.

Wood

The wood is used by all three ethnic groups as firewood. Nevertheless, this is more common in Serer and Wolof communities than in Peulh. Respondents mention that the tamarind is good-quality firewood. Furthermore the wood is described to have a good quality as construction wood. Local people fabricate fences, tools and construct trestles for houses.

The ash of the wood can be used as fertilizer for fields. In addition, local people use the charcoal of the tamarind.

Serer use the branches of the tamarind as toothbrush and as a slingshot.

Resin

The resin is used by Serer and Wolof for cleaning clothes. After doing the laundry, clothes are soaked in water mixed with tamarind resin. This procedure is said to have a cleansing effect.

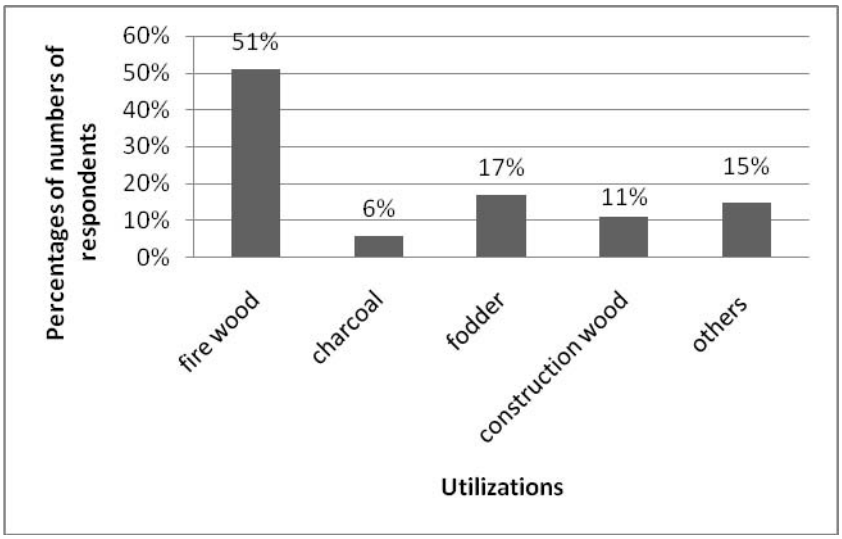

Figure 11: Contribution of selected uses of the category "other utilisations" (89 nominations=100%) of tamarind (n=60)

4.1.14. Commercialisation of tamarind

Respondents state that the tamarind has become more important recently than it was in former times. This is connected to its commercial value, which is described as a new trend. In former times people did not trade with tamarind, but only used it for auto-consumption. Some Serer and many Wolof mention that today, they do not even harvest the tamarind fruit themselves, but buy it on local markets or from traders. Fruit and wood trade is seldom associated with gender.

Percentages rarely reach 100%, since not all respondents use tamarind plant parts for commercial purpose.

Fruit

55% of all sampled informants (n=60) state that both, men and women use the tamarind fruit for commercial purpose. 16% of all respondents define the sale of tamarind fruit as women's and 10% of all informants as men's business (Figure 12). Among the three ethnic groups, over two thirds of the Wolof do not attach a gender to the sale of the tamarind fruit. The Wolof declare buying fruit on the market or in shops, where it is available throughout the whole year.

Wood

The tamarind wood is not as commonly traded as the fruit, for this reason only about the half of respondents could give statements on the question of commercial use. 20% of all sampled respondents (n=60) state that selling the wood is done by both genders, 13% of all respondents define it as men's and 12% of all informants as women's business (Figure 12).

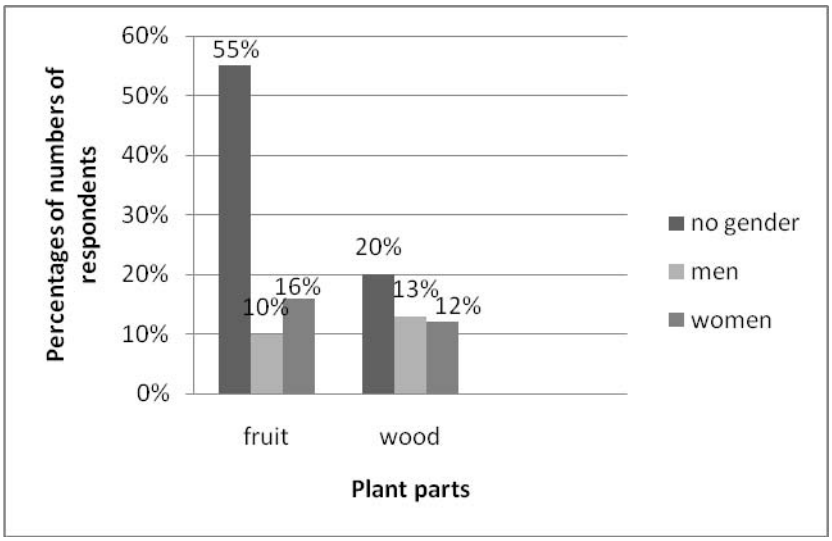

Figure 12: Contribution of gender in commercial use of tamarind plant parts (n=60). Percentages do not reach 100% since not all respondents do use tamarind plant parts for commercial purpose.

4.2. Symbolic and cultural value

4.2.1. Ceremonies connected with baobab

25% of all sampled respondents (n=60) report of ceremonies around the baobab tree. Most of the ceremonies listed-73%-are cited by Serer, 27% by Wolof, while the Peulh do not list any ceremony connected with the baobab tree.

Peulh

None of the Peulh respondents list any ceremonies connected with baobab (Figure 13).

Serer

55% of Serer respondents (n=20) report different kinds of ceremonies connected with the baobab (Figure 13). The Serer describe ceremonies connected with totems, which are called *bangol,* as well as ceremonies under sacred trees. These are ceremonies where people sacrifice milk or other offerings. The oblations can serve for protection or family production, which means money and children. These ceremonies cannot be held at just any baobab tree, but around special individual trees. Ceremonies can take place in form of ritual sacrifices, prayers or so-called *feu de nuit*. Some Serer report of the existence of some interdictions connected with individual trees.

Furthermore, Serer report to have used the baobab as gravesites for so called *griots*. This ceremony does no longer exist today. People use cemeteries for reasons of administration.

Wolof

The ceremonies of the Wolof, described by 20% of Wolof respondents (n=20) (Figure 13), are mainly ceremonies around sacred trees, where people sacrifice sheep, goats or porridge (*bouillie*). There are interdictions of touching sacred baobab trees. Particularly around the baobab, ritual dances and *nuits de danse* are held.

During a baptism or marriage a special kind of baobab porridge (*bouillie*) is served in the morning and in the evening in addition to a baobab juice. These preparations are offered to guests.

4.2.2. Spirits connected with baobab

57% of all sampled informants (n=60) confirm the existence of spirits connected with baobab. 15% of these informants are Peulh, 41% Serer and 44% Wolof. 62% are male and 38% female. Detailed information on spirits is given below:

Peulh

25% of Peulh respondents (n=20) confirm the existence of spirits connected with the baobab tree (Figure 13). The Peulh report bad spirits and invisible genies housed in baobabs. These genies can only seen by *marabouts* (traditional healers). Trees with resident bad spirits are not harvested to avoid suffering pain, or the bad spirits are asked to move out before harvesting. In this case the person, willing to harvest, has to close their eyes to let the spirit pass by.

The trees, which shelter invisible genies, are also not harvested because of the risk of falling ill. But it is possible to collect the fruits, which have dropped to the ground.

Other Peulh again report not to have sacred baobabs, myths or taboos connected with the baobab tree. The baobab is cited to serve only for consumption.

Serer

70% of Serer informants (n=20) mention spirits connected with the baobab (Figure 13). The Serer respondents confirm the existence of bad spirits, genies or devils but also of good spirits or genies. Apart from this, people report of fetish trees. Some informants state that nowadays only the elders know about the existence of these spirits and genies, while younger generations ignore these traditions increasingly.

Usually, trees with bad spirits or genies are not used; baobabs, which shelter devils, are also not touched because of the risk to suffer pain. Trees with good spirits or genies are partly used, partly untouched and sometimes, only the fruits are left out from harvest. It is reported that before harvesting, people come together for praying and “offering” millet (*Pennisetum glaucum)* and sugar. To use the sacred trees, the person has to return the seeds to the tree.

Wolof

Spirits connected with baobab are reported by 75% of Wolof informants (n=20) (Figure 13). Most of the Wolof report bad spirits, genies, as well as devils. Also the existence of good spirits and genies is confirmed, even if bad spirits are cited to be more common.

Normally trees with bad sprits or genies are not used or, if used one has to sacrifice millet (*Pennisetum glaucum)*, milk or sugar. For other trees the hours of harvesting are limited: it is not allowed to harvest at midday around 2pm, in the evening between 7 and 8pm and at night. Baobabs with bad spirits or genies cannot be cut.

The informants state that nowadays the spirits disappear: young people are reported not to know anything about these spirits.

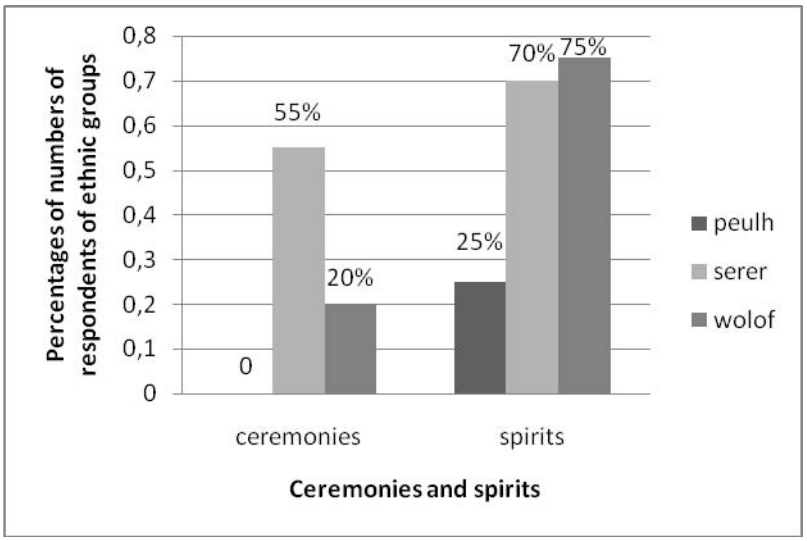

Figure 13: Comparison of positive answers of ethnic groups to the existence of ceremonies and spirits connected with baobab (n=60; total number per ethnic group: 20)

4.2.3. Additional aspects of baobab in cultural life

Respondents of the Serer communities state that the baobab serves as *arbre à palabres,* as source of shadow for reposing and meeting other people. Another informant mentioned that "when the roots of the baobab come out of the soil, people build a hole in the root for collecting water during rainy season for watering their fields".

As additional cultural aspects the Wolof mentioned using the baobab as a shade tree for meetings. Others mentioned that the baobab is the emblem of their nation and history.

4.2.4. Ceremonies connected with tamarind

12% of all sampled respondents (n=60) report ceremonies connected with tamarind, whereof the main part-86% is mentioned by Serer, 14% by Wolof and none by Peulh. 75% are male respondents and 25% female.

Peulh

None of the Peulh respondents report of practiced ceremonies connected with tamarind (Figure 14).

Serer

30% of Serer (n=20) report of ceremonies connected with sacred tamarinds, fetishes or totems, which are called *bangol* (Figure 14). At these ceremonies people present sacrifices. The sacrifices serve to demand protection and a good family production, which is defined by money and children. Furthermore the informants mentioned ceremonies in form of *nuits de danse* and *feu de nuits*, where people light fires and meet around the tamarind tree for dancing or praying.

Wolof

With only one exception (5%) in the sample the Wolof (n=20) do not report of any ceremonies connected with tamarind (Figure 14). The only mentioned ceremony is one around sacred trees, where people sacrifice sheep or goats. It is forbidden to touch these sacred trees.

4.2.5. Spirits connected with tamarind

50% of all sampled informants (n=60) confirm the existence of spirits connected with tamarind, whereof 3% are Peulh, 43% Serer and 54% Wolof. 57% were male respondents and 43% were female. Detailed information on spirits is given below:

Peulh

Apart from two examples (10%) the Peulh (n=20) do not confirm the existence of spirits connected with tamarind (Figure 14). One Peulh described the existence of bad spirits. If the tree shelters such a bad spirit, one has to ask the spirit to move out before harvesting. The person has to shut their eyes so that the spirit can pass by.

Other Peulh confirm that the Peulh do not have any sacred trees, spirits, myths or even taboos connected with trees.

Serer

65% of Serer informants (n=20) confirm the existence of bad spirits or genies and devils, but also of good spirits or genies and fetishes (Figure 14). Bad spirits or genies are said to appear more often than good ones. Tamarind normally shelters more bad spirits and devils than the baobab. The respondents mention that today children or young people ignore these spirits more and more.

Normally, trees harbouring bad spirits or genies, are not used by local people because it is said that the user of this tree will fall ill. Even trees, which host a devil should not be touched because this risks getting problems. These trees are said to cause pain.

Wolof

80% of Wolof informants (n=20) report of spirits connected with tamarind (Figure 14). Wolof respondents confirm the existence of bad spirits or genies, as well as devils. Some informants speak about good spirits or genies. Good spirits or genies do not appear as often as bad ones. The informants state that devils, bad and good spirits appear more often in association with the tamarind than with the baobab.

The methods of handling tamarinds with bad spirits or genies are quite different. Most of the informants state that tamarinds, which shelter bad spirits or genies are either not touched or, if nonetheless used, one has to give sacrifices such as milk, millet or sugar, sheep or chicken. Others again state that these tamarinds can be used anyway, but one cannot be planted or cultivate it in ones own house. Tamarinds, which host bad spirits or genies, are not cut. Nevertheless, one informant states to eliminate all young tamarinds because of the bad spirits. Tamarinds, which host devils are said to be dangerous.

The Wolof report of interdictions of harvesting during certain hours. Different times are given: at midday, between 1 and 2pm, in the evening, between 7 and 8 pm and at night. These times are described to be the active periods of bad spirits.

A few statements are given about tamarinds, which shelter good spirits or genies. It is mentioned that the user has to sacrifice sheep or chicken. Some state that not everyone can use these tamarinds, but only the marabouts.

The informants report that today young people do not believe or know anything about these spirits, which is confirmed by statements that these spirits disappear because no one sees them anymore.

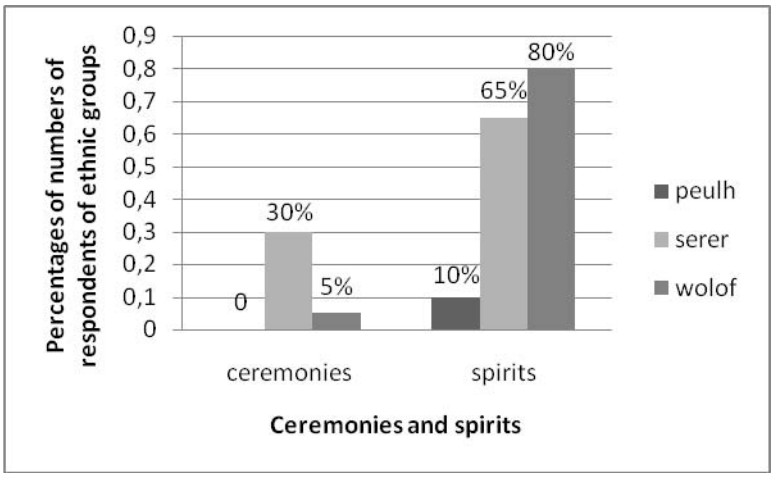

Figure 14: Comparison of positive answers of ethnic groups to the existence of ceremonies and spirits connected with tamarind (n=60; total number per ethnic group: 20)

4.2.6. Additional aspects of tamarind in cultural life

Serer informants cite that the tamarind serves as *arbre à palabres,* as shade tree for reposing and meeting people for discussion. The Wolof only mention once the function of the tamarind as a shadow tree.

4.3. Harvest and storage management

4.3.1. Harvest practices of baobab

The percentages rarely reach 100%, since not all informants are using or harvesting the different plant parts of baobab. Mostly, Wolof report not to harvest the fruit themselves, but to purchase it at the market or in shops.

Fruit harvest

61% of all sampled respondents (n=60) do not identify any gender connected with the harvest of the baobab fruit. 18% of all respondents state, that the fruit is harvested by young or adolescent boys, and it is mentioned only once that the harvest of the baobab fruit is a women's activity (Figure 15). Focusing on gender, the ethnic groups are quite in consensus to the general statistics.

The informants state several times that women collect fruit from the ground, while men climb up the tree to obtain the fruit. Some informants cite that women harvest primarily for consumption while men harvest mainly for sale.

35% of all sampled respondents (n=60) state that the harvest is done by children or adolescents, while 15% of all informants explain that adults are harvesting the baobab fruit and 10% all of informants cite elder people to feature in harvesting (Figure 16). In Peulh communities, 45% (n=20) of the harvest is done by children or adolescents, 40% by adults and 30% by elder people. In Serer communities 40% (n=20) of harvest is described to be done by children or adolescents and 5% by adults. Some Serer point out that mainly young boys and shepherds harvest the baobab fruit. In Wolof villages, only children and adolescents, 20% (n=20), are cited to harvest baobab fruit.

Leaf harvest

Nearly half (45%) of all sampled respondents (n=60) do not identify any gender with the harvest of baobab leaves. 35% of all respondents explain that the harvest of baobab leaves is done by men, whereof the majority are young or adolescent boys. 13% of all informants declare it to be women's work (Figure 15).

The contribution of gender differs between ethnic groups. 30% of Peulh (n=20) do not associate a gender with the baobab leaf harvest, 40% of Peulh declare it to be men's and 30% of Peulh as women's labour. In Serer communities 60% of Serer (n=20) state that the harvest is done by both genders and 35% of Serer declare it as men's work. In the case of the Wolof, 45% of Wolof (n=20) do not define any gender for the harvest of baobab leaves, while 30% of Wolof define it as men's labour.

Regarding age 36% of all sampled informants (n=60) confirm that the harvest of baobab leaves is done by children or adolescents, while only 6% of all respondents mention that the work is done by adults and 5% say elder people partake in harvesting (Figure 16).

The contribution of age differs between ethnic groups. In Peulh communities, 50% of Peulh (n=20) confirm, that the baobab leaves are harvested by children or adolescents, 20% by adults and 15% by elder people. 45% of Serer (n=20) mention that the harvest is done by children or adolescents, mainly by young or adolescent boys or shepherds. The Wolof comment that the harvest is done by children or adolescents and again-mainly by young or adolescent boys.

Bark harvest

The harvest of baobab bark for gaining fibres is clearly defined as men's labour, which is confirmed by 42% of all sampled informants (n=60). 5% of all respondents mention that the harvest can be done by both, men and women (Figure 15).

12% of all sampled informants (n=60) state, that the work is done by young or adolescent boys, 5% by adults and 7% by older people (Figure 16).

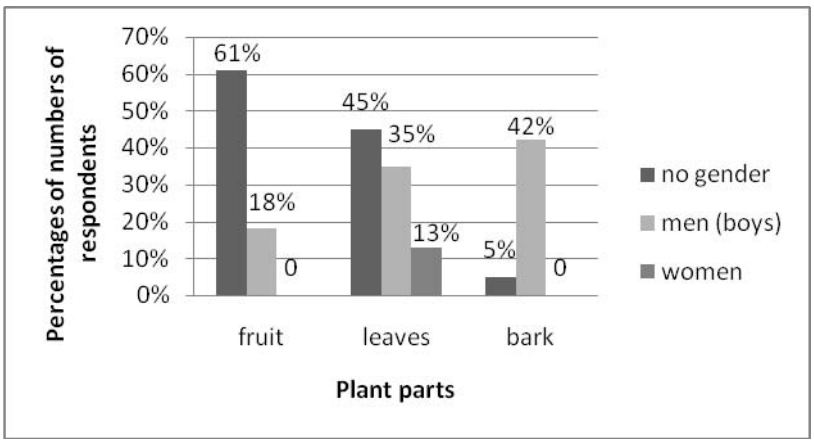

Figure 15: Contribution of gender in baobab plant parts harvesting (n=60). Percentages do not reach 100% since not all respondents do harvest or use all listed baobab plant parts.

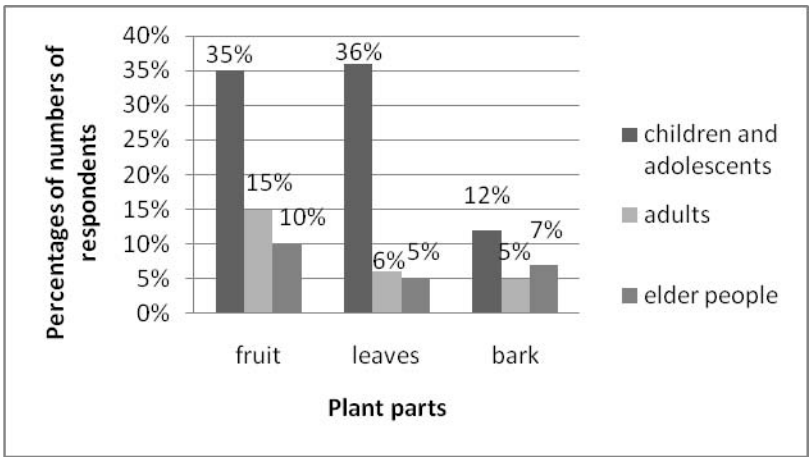

Figure 16: Contribution of age in baobab plant parts harvesting (n=60). Percentages do not reach 100% since not all respondents do harvest or use all listed baobab plant parts.

4.3.2. Harvest and utilisation problems of baobab

Nearly half (47%) of all sampled respondents (n=60) confirm that the harvest of baobab plant parts is linked to some problems. The main cited problems are the risk of accidents and difficulties when climbing up the tree as well as limited access and interdictions through properties of the baobab trees. Some Serer even report of individual trees, which people are not allowed to climb for the high risk of falling. In addition, people mention, that hairs of the fruit husk cling to the skin and also for harvesting the baobab bark or fibres, some force is needed. Also, limitations in access because of the existence of totems, devils and sacred trees, as well as bees, are reported. Some informants describe conflicts between shepherds and villagers concerning the utilisation of baobab plant parts. It is reported that some people cut the baobabs for gaining wood, even if the tree does not belong to them. Some report of getting in troubles with the foresters for cutting a baobab tree. These respondents state that cutting baobab trees is forbidden for reasons of protection. Some Serer report of interdictions of harvest when fruits are not yet ripe. Local people were asked for solutions to the listed problems, which are described in the table (Table 5).

Table 5: Proposed solutions by all respondents for harvest and utilisation problems of baobab plant parts

Problems	Solutions
accidents and difficulties to climb up	Let the fruits fall down Harvest with a long stick (bamboo) and fix a knife or sickle on it, then climb up a little bit and cut Throw a stick or stones Make some little holes in the bark with the knife to facilitate climbing up
properties or owners	Ask for permission
clinging hair of the husk	Harvest with a long stick without climbing up Harvest after a strong wind, when fruits have fallen down Wear long sleeved clothes
Totems, devils and sacred trees	Harvest with a long stick and a fixed knife on it Harvest trees without any totems, devils or sacred trees
Bees	Make a fire in the hole of the bees Harvest during night

In addition, all participants of all nine group discussions confirm the viability of fruit production of the baobab. Informants state that there are years with high fruit production and some with low fruit production. All groups agree that the production is directly connected to rainfall: more rainfall means more fruit, and less rainfall means less fruit production.

4.3.3. Is the access to the fruit of the baobab limited?

Informants of 5 (55%) group discussions, from 9, state that the access to the fruit of the baobab is limited. Named reasons are property rights with limited access and interdictions, and furthermore, seasonality as limitating factor. One group declares that the quantity is insufficient and that people have to search outside the village for fruit.

4.3.4. Diseases of baobab and their influence on harvest and utilisation

Participants listed known and observed diseases of the baobab. Described diseases are: insects or worms, which feed on the baobab leaves; insects in the fruits, which eat and destroy the fruit pulp, and a disease in resulting black fruits. Insects, which destroy the flowers of the baobab, are observed once. Furthermore, holes in the wood, which are assumed to be from insects and black coloured wood, have been observed. Informants explain a disease which is called *Pakok*, an illness where the branches of the baobab turn black and fall off the tree, while others report of a quite similar disease called *Makh* where the wood turns black and which finally destroys the wood. Both are probably a fungal attack. A disease on the branches is mentioned, where insects degrade the baobab branches. It could be possible that all three described diseases of wood and branches are a single disease.

Participants of four (44%) group discussions (9 groups) confirm that the listed illnesses influence the utilisation in so far that the affected part of the baobab cannot be used anymore, while the other four (44%) groups state that it does not affect the utilisation.

4.3.5. Harvest periods of baobab plant parts

The following figures on harvest periods shall be understood as demonstration of tendencies, therefore no numbers or percentages have been mentioned. Furthermore, the fact that for example the statistics of the Wolof fruit harvest are lower than the Serer and the Peulh does not mean that Wolof have less fruit to harvest than Peulh and Serer. It is simply the result of the interviews' statements where the Wolof gave fewer statements about the baobab fruit harvest than the Peulh and the Serer, since the Wolof are used to buying products at the market.

All three ethnic groups agree on the harvest period of the baobab fruit, which is described to take place in the dry season, with peaking in the cold dry season from November to March (Figure 17). The dry season is defined from October or November until May or June in the Soudanian and Sahelian zone (Serer and Wolof communities) and from December until April or May in the Guineo-Congolian/Sudanian zone (Peulh communities).

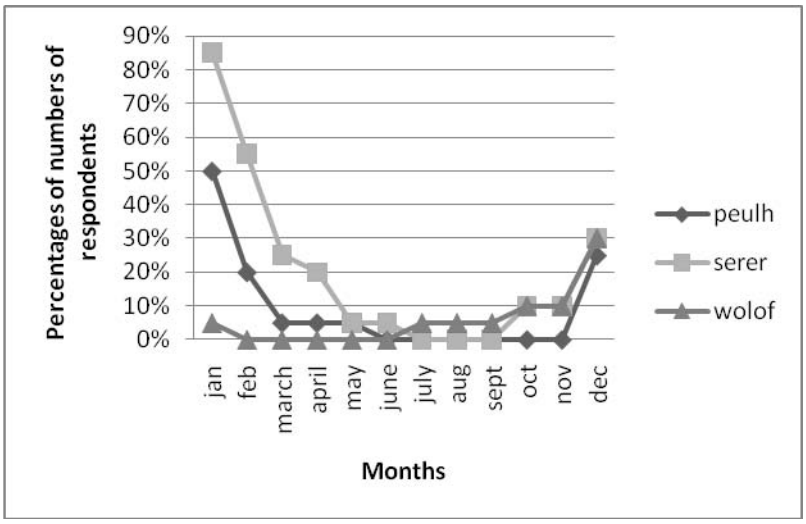

Figure 17: Harvest periods of baobab fruit sorted by ethnic groups (n=60; number per ethnic group: 20). Percentages do not reach 100% since not all respondents do harvest or use the baobab fruit.

The harvest periods of baobab leaves differ from region to region. Every ethnic group defines two peak harvesting periods (Figure 18). There is one harvest period at the end of the rainy season and the beginning of the cold dry season. In the Guineo-Congolian/Sudanian zone (Peulh communities) the season starts with a small peak in July or August and has its second main peak in November. In the Soudanian zone (Serer communities) the harvest period starts in August or September with a peak in October. There is a second smaller peak of harvest around May. On the border between Soudanian and Sahelian and in the Sahelian zone (Wolof communities) there are two peaks of harvest period: one from May to July and one longer period starting in September or October with a peak in December. The Wolof mention, that baobab leaves can be harvested throughout the whole year. This statement can be explained by the fact, that many Wolof do not harvest the leaves themselves, but buy them on the market, where they are available throughout the whole year.

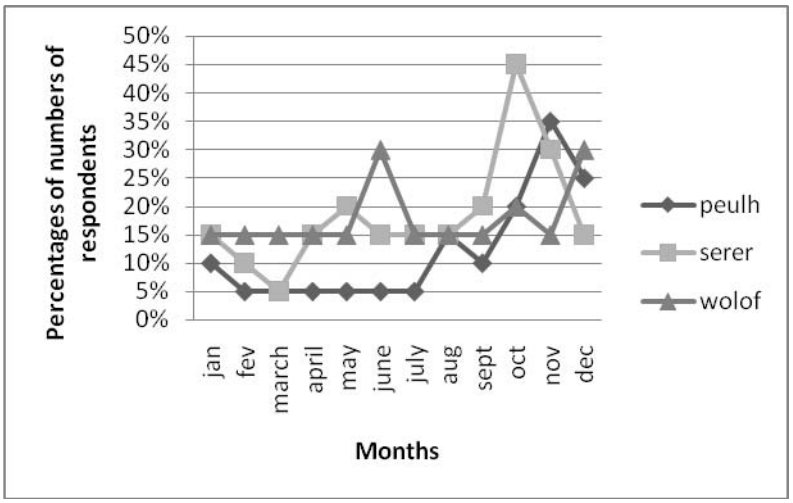

Figure 18: Harvest periods of baobab leaves sorted by ethnic groups (n=60; number per ethnic group: 20). Percentages do not reach 100% since not all respondents do harvest or use baobab leaves.

The baobab bark can be harvested throughout the whole year. Anyway, some ethnic groups have their preferred harvest times (Figure 19). While the Peulh in the Guineo-Congolian/Sudanian zone report to prefer harvesting the bark mainly in the rainy season from May until November, the Serer in the Soudanian zone harvest the baobab bark either at the end of the cold and in the hot dry season from January until April, or at the end of the rainy season in September. Most preferred by Serer are the first and the last rain. Both, Peulh and Serer describe, that it is easier to harvest the baobab bark when it is wet or moist. Normally, one tree can be harvested once per year. The Wolof in the Sahelian zone do not mention any preference of harvesting period and confirm to harvest the bark throughout the whole year. The author suspects that many Wolof communities have given up the harvest of the baobab bark and therefore have lost some knowledge for example about best harvest times of baobab bark. This notion is accented by the statements of three out of four Wolof group discussions, where participants explained, that the baobab bark is not harvested anymore.

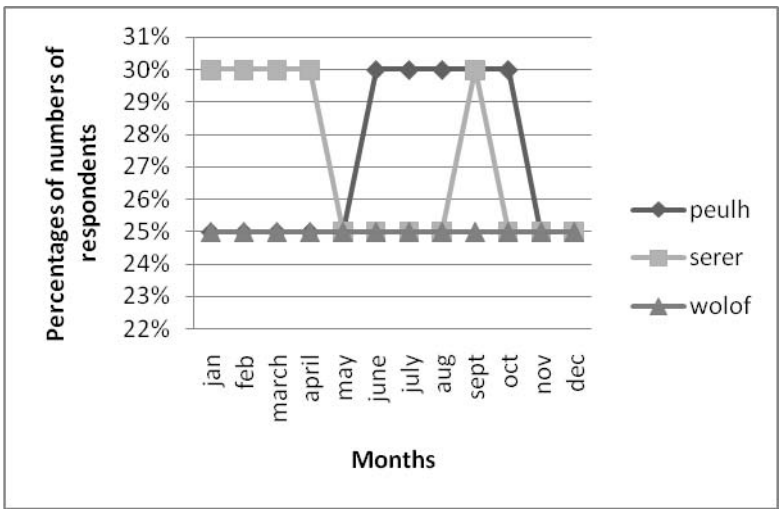

Figure 19: Harvest periods of baobab bark sorted by ethnic groups (n=60; number per ethnic group: 20). Percentages do not reach 100% since not all respondents do harvest or use baobab bark.

4.3.6. Storage management of baobab

Percentages rarely reach 100% since not all respondents store baobab plant parts.

Fruit storage

32% of all sampled respondents (n=60) state that both, men and women store the baobab pulp, 45% of all informants define the storage of baobab fruit as women's and 5% of all respondents as men's work (Figure 20).

In the Peulh communities the definition of gender activity is clearer than in the general statistics. While 25% of Peulh respondents (n=20) do not associate any gender with the storage of baobab fruit, 65% of Peulh define it as women's and 10% of Peulh as men's activity. Respondents explain that it is women's labour, because women also prepare the food.

Also in Serer communities there is a clearer definition of gender than in the general statistics. 40% of Serer (n=20) do not identify any gender with the storage of the baobab fruit, while 60% of Serer see it as women's responsibility.

Some Wolof state, that they do not store the baobab fruit, but buy it on the market when needed. However, of those, who store the fruit, 30% of Wolof (n=20) explain, that both, men and women store the baobab fruit and 10% of Wolof declare it to be women's activity.

The fruit, as a whole or detached from the husk, are mostly stored in bags and left in the room.

Leaf storage

7% of all sampled informants (n=60) do not identify any gender for storing baobab leaves, while 75% of all respondents declare it clearly as women's activity (Figure 20).

For 100% of Peulh (n=20) and Serer (n=20) storing of baobab leaves is seen as a women's activity. It is argued that the woman prepares the meals and is responsible for the household, therefore it is also her responsibility to store the baobab leaves.

20% of the Wolof (n=20) instead, do associate any gender with the storage of baobab leaves. 25% of Wolof declare it as women's activity. Some Wolof mention that they do not store the leaves, but buy them at the market or in shops, when needed.

The baobab leaves are normally stored in bags, sometimes in baskets, either as leaves or in the form of powder. Before leaves can be stored, they are sundried.

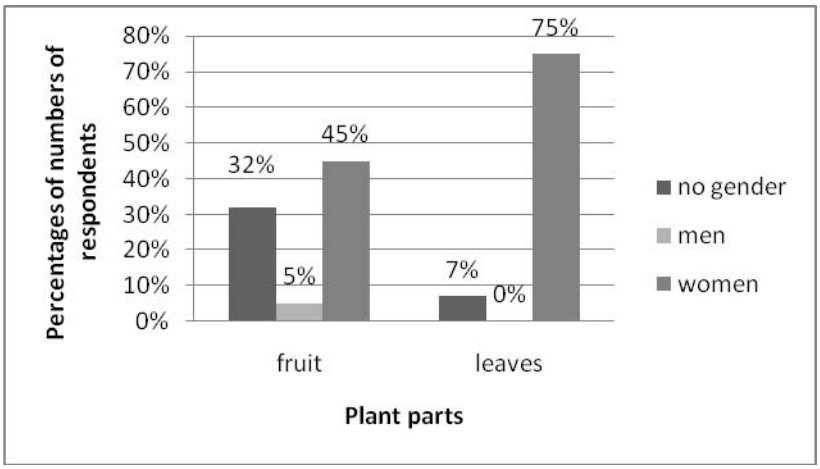

Figure 20: Contribution of gender in baobab plant parts storing (n=60). Percentages do not reach 100% since not all respondents do store baobab plant parts.

4.3.7. Harvest practices of tamarind

The percentages rarely reach 100%, since not all informants are using or harvesting the different plant parts of tamarind. Mostly, Wolof report not to harvest the fruit themselves, but to purchase it at the market or in shops. For the definitions of the "age classes"-children, adolescents, adults and elder persons- no strict age classes were given, so the definition was up to the individual informant.

Fruit harvest

52% of all sampled informants (n=60) do not associate any gender with the harvest of tamarind pulp. These informants describe that, the harvest is done by both, men and women. However, 32% of all informants identify this labour with men or young or adolescent boys. 3% of all respondents define it as women's work (Figure 21).

43% of all sampled informants (n=60) report that children and adolescents, mainly boys, harvest tamarind pulp. 10% all of respondents state that the harvest is done by adults and 10% of all informants report that it is done by elder persons (Figure 22).

The Peulh differ from the general statistics in so far, that 65% of Peulh (n=20) cite, that the harvest is done by children and adolescents-mainly boys, 30% by each, adults and elder persons.

In the Serer and Wolof communities no one agrees that adults or elder persons harvest the tamarind pulp, but that children and adolescents are doing it. Some Serer point out that the harvest is normally performed by young or adolescent boys. Some Wolof explain, that they do not harvest the tamarind pulp themselves but buy it at the local market or in shops.

Leaf harvest

As the leaves for nutritional purpose are only used in times of shortages, which means as replacement of the tamarind pulp and husk, in case pulp and husk are not accessible. This habit is not practiced everywhere, only a few respondents can give statements about the harvest of tamarind leaves.

15% of all sampled respondents (n=60) state that both, men and women, harvest tamarind leaves. 23% of all respondents define it strictly as women's part of labour and 3% of all informants as men's work (Figure 21).

In the Peulh villages 20% of Peulh (n=20) do not associate any gender with the harvest of tamarind leaves. 40% of Peulh, however, see it as a women's work.

For the Serer, 10% of Serer (n=20) state that the men and women harvest the leaves, 30% of Serer that only women are harvesting. The harvest was once declared as men's part of labour.

The Wolof (n=20) mentioned at 15% that men and women harvest tamarind leaves. It was once mentioned that harvesting of leaves is done by men, exclusively.

Focusing on age, local people do not really define a special age class for the harvest of tamarind leaves. However, 7% of all sampled respondents (n=60) report that the harvest is done by children and adolescents, 3% all of informants say that adults harvest tamarind leaves and it was once mentioned that it is done by elder people (Figure 22).

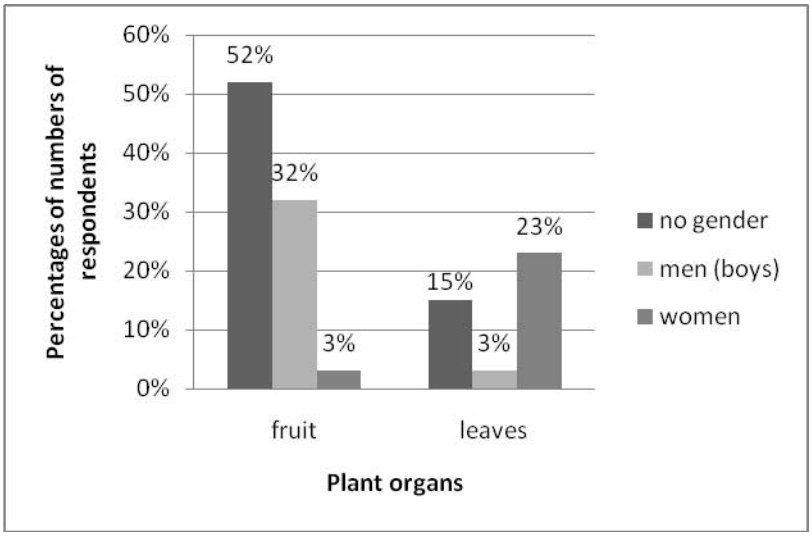

Figure 21: Contribution of gender in tamarind plant parts harvesting (n=60). Percentages do not reach 100% since not all respondents do harvest or use all listed tamarind plant parts.

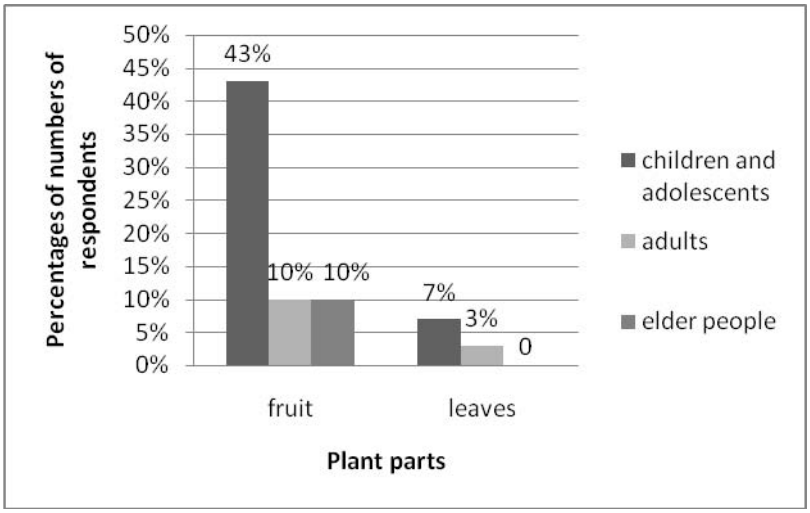

Figure 22: Contribution of age in tamarind plant parts harvesting (n=60). Percentages do not reach 100% since not all respondents do harvest or use all listed tamarind plant parts.

4.3.8. Harvest and utilisation problems of tamarind

35% of all sampled respondents (n=60) confirm that the harvest of tamarind plant parts is linked with problems and difficulties. Mainly cited problems are the risk of falling and difficulties in climbing up the tree, as well as access limitations and prohibitions because of property rights on tamarind trees. Some Serer report of individual trees, which are forbidden because of the risk of falling. In addition, people mention that the fruits are difficult to harvest in the sense that fruits are difficult to pick from the tree and that some trees are limited because of devils and bad spirits. It is reported that harvesting fruits is forbidden as long as they are not ripe. Some informants mention that there are conflicts between shepherds and villagers and that there are some people, who cut the tamarind tree for gaining wood, even if the tree does not belong to them. It is also reported, that one can get problems with the foresters by cutting a tamarind tree. These informants state that it is forbidden to cut tamarind trees for reasons of conservation. The informants have been asked for solutions to the listed problems, which are described in the table below (Table 6).

Table 6: Proposed solutions by all respondents for harvest and utilisation problems of tamarind plant parts

Problems	Solutions
risk of falling down	Harvest with a long stick (bamboo) and a fixed knife, then climb up a little bit and cut Throw some stones
properties	Ask for permission
difficulty of harvesting fruits	Take a knife Let the fruits falling down
Devils and bad spirits	Harvest with a long stick and a fixed knife on it Harvest the tamarinds without any devil or bad spirit
Bees	Waiting until the bees have removed

In addition, participants of group discussions were asked about the tamarind fruit production viability. All nine groups agreed to the existence of annual variability in the tamarind fruit production and that this variability is connected to rainfall. In case of high rainfall the tamarind produces well, in case of low rainfall the tamarind has a low fruit production. Two groups (22%) from 9 even report that the tamarind can have a high fruit production in one year, but in the following year the tamarind does not produce anything.

4.3.9. Is the access to the fruit of the tamarind limited?

Six of 9 (67%) groups confirm the limited access to tamarind fruits. Main reasons are similar to the baobab: property rights with limited access rights and interdictions as well as the factor of seasonality. Additionally, shortages are reported concerning the quantity in general but also the annual variability of tamarind in fruit production.

It is reported that property rights and connected limited access rights are more severe in the case of the tamarind than of the baobab because of the higher market value.

4.3.10. Diseases of tamarind and their influence on harvest and utilisation

Participants of the group discussions listed known and observed diseases of tamarind, which are: insects, which feed on the tamarind fruits: The tamarind may produce well but when the fruits becomes ripe they are black coloured and only the husk without pulp is left. Furthermore, informants report of insects or worms feeding on the leaves, and insects or ants, which destroy the flowers of the tamarind. A probably fungal disease, called *Makh,* is described, where the wood turns black and is destroyed.

Only two groups of 9 (22%) state that the listed pests and diseases negatively influence the utilisation of affected plant parts, which may not be used anymore. Three groups (33%) confirm that the reported diseases are of no consequences and that plant parts can be used anyway.

4.3.11. Harvest periods of tamarind plant parts

The following figures on harvest periods shall be understood as a demonstration of tendencies, therefore no numbers or percentages are mentioned.

All three ethnic groups agree that the tamarind pulp is harvested in the dry season (October/November in the Soudanian and Sahelian zone and December in the Guineo-Congolian zone until April, May or June), mainly in the cold dry season (Figure 23). In all three regions-the Guineo-Congolian/Sudanian, the Sudanian and the Sahelian zone-the peak is from November until February. The Peulh in the Guineo-Congolian/Soudanian zone mention a second smaller peak, just before the main season, in September. The Wolof in the Sahelian zone also cite a second smaller peak, after the main season, in June.

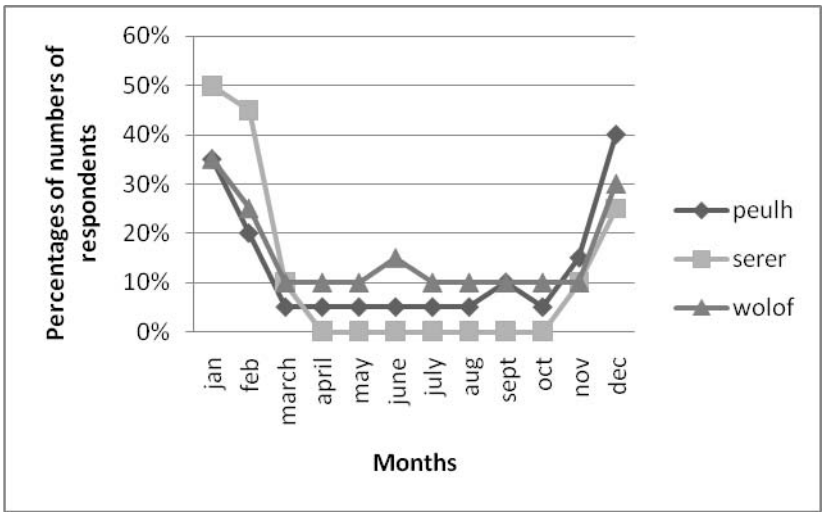

Figure 23: Harvest periods of tamarind fruit sorted by ethnic groups (n=60; number per ethnic group: 20). Percentages do not reach 100% since not all respondents do harvest or use tamarind fruit.

Theoretically, leaves can be harvested at any time of the year, since the tamarind is an evergreen tree. Nevertheless, there are two periods of tamarind leaves harvest (Figure 24). The Peulh and Serer in the Guineo-Congolian/Soudanian and in the Soudanian zone state that the main season of leaves harvest is in the rainy season, which lasts from October or November until April or May in the Soudanian zone (Serer communities) and from December until May or June in the Guineo-Congolian/Soudanian zone (Peulh communities). While the

Serer harvest the leaves at the beginning of the rainy season, the Peulh harvest in the middle of the rainy season.

The Wolof state to harvest the tamarind leaves throughout the whole year, with only one small peak in January. These two tendencies-one of Peulh and Serer, and the other of Wolof-are explained by the different forms of utilisations of tamarind leaves. While Peulh and Serer use the leaves to replace the tamarind fruits in the *bouillie*, the Wolof feed their animals with tamarind leaves. Therefore, Peulh and Serer harvest leaves when no fruits are available and Wolof harvest throughout the whole year for nourishing their animals.

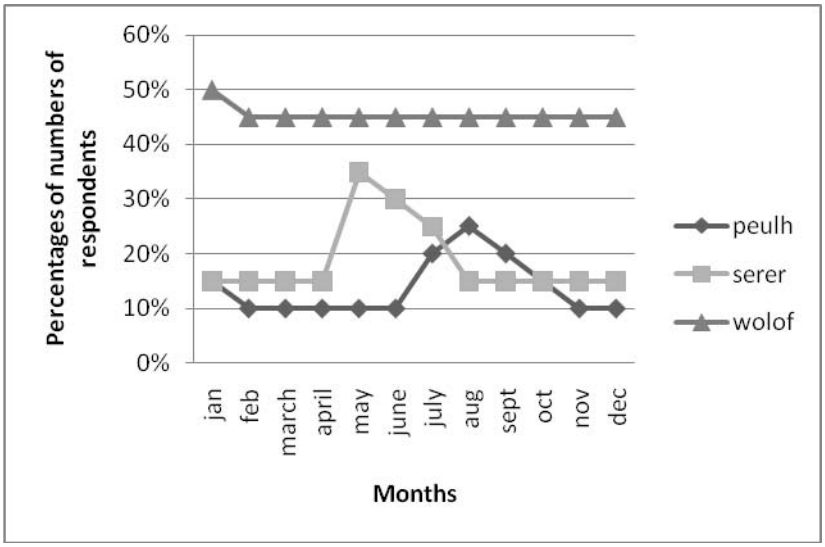

Figure 24: Harvest periods of tamarind leaves sorted by ethnic groups (n=60; number per ethnic group: 20). Percentages do not reach 100% since not all respondents do harvest or use tamarind leaves.

4.3.12. Storage management of tamarind

Informants were asked about storage managements of tamarind leaves, but as only some Serer store tamarind leaves and, furthermore do not give details, the storage of leaves will be omitted. Leaves are accessible throughout the whole year and storage is therefore not obligatory.

Percentages do not reach 100% since not all respondents do store tamarind fruit.

Fruit storage

The storing of the tamarind fruit is reported by 38% of all sampled informants (n=60) to be done by both, men and women. For 38% of all respondents it is seen as women's activity and for 7% of all informants as men's activity (Figure 25). It is remarkable that men mainly store for commercial purpose, while women store for reasons of subsistence.

The Peulh differ from the general statistics in so far that 45% of Peulh (n=20) respondents do not associate any gender with storing of tamarind fruits, while 50% of Peulh define it as women's labour. It is once mentioned that the storage is done by men. It is stated that women store for food purpose and men for sale.

The Serer statements are more or less similar to the Peulh, with 35% of Serer (n=20), who do not identify any gender, 50% of Serer who declare storing as women's activity and one respondent, who declares it as men's activity. It is said that men store the fruits for sale.

For 35% of Wolof (n=20) informants there is no identification with gender and both, men and women do store tamarind fruits. 15% of Wolof see it as women's labour and 10% of Wolof as men's part of work. Some Wolof state that they do not store tamarind fruits, but buy it on the market, if needed.

The fruits, either stored as whole fruit or detached from the husk, are normally reported to be stored in bags. Before storing, the fruits are dried.

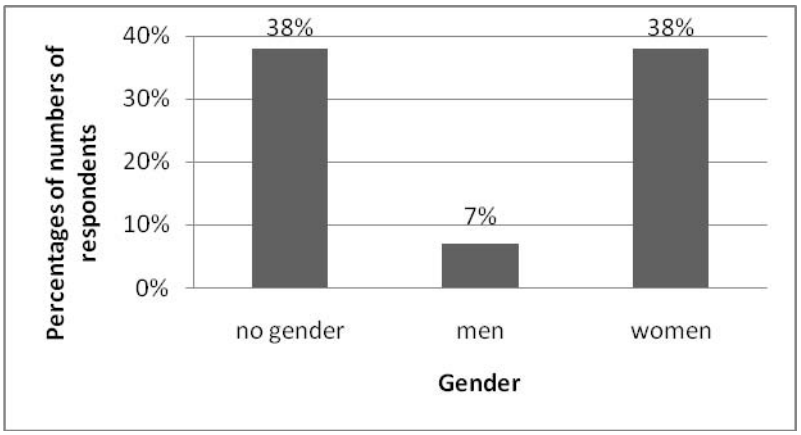

Figure 25: Contribution of gender in tamarind fruit storing (n=60). Percentages do not reach 100% since not all respondents do store tamarind fruit.

4.4. Propagation and cultivation systems

4.4.1. Habitat of baobab

Before asking about existing local propagation and cultivation systems, people were asked about their ecological knowledge on-the habitat of the baobab. Six out of nine (67%) groups do not list special locations of the baobab, but infer that it grows everywhere. The other three groups (33%) state that the baobab appears in fields, in the bush land, in and around villages and on every type of soil.

4.4.2. Interdependence of baobab and humans

Five out of nine (56%) groups agree to the statement that the baobab is linked with human presence and that there is a relationship of interdependence between the baobab and the human being. All five groups concur that the baobab and the human being always appear together. In addition, three groups (33%) confirm that the baobab grows at sites of former human settlements or habitations. These groups state that a large number of baobab trees at any one place is an indicator of former human settlement.

Nevertheless, one group disagrees and states that there is no connection between baobab and the human being and this group also cannot see any dependence of the baobab on humans either.

4.4.3. Plantation systems and cultivation techniques of baobab

Existing traditional plantation systems of baobab are not known among the researched groups in Senegal. Only single trees are planted, but again rarely: 15% of all sampled respondents (n=60) declare to plant baobab trees. Baobabs are planted for own benefits. 33% of all informants cultivate baobab trees, whereof 25% are Peulh, 50% Serer and 25% Wolof.

The main cultivation techniques of baobab are sowing, transplanting and watering practiced by 17% of all sampled respondents (n=60), planting by 15% of all informants, eliminating herbs and trees around the baobab by 8% of all informants and cutting branches as improvement technique of production by 5% of all respondents (Figure 26). Furthermore, people protect the baobab by building fences around the tree. Some special cultivation techniques have been described: one method involves sundrying the seeds for one month, then sowing 10-20 seeds in small holes of 0.5cm during rainy season and protecting them from cows and sheep. Another informant reports to leave the seeds for 5 months in paper filled with soil and water and then transplanting them into the earth and building a fence for protection. Only one informant confirms selection of specific plants after sowing.

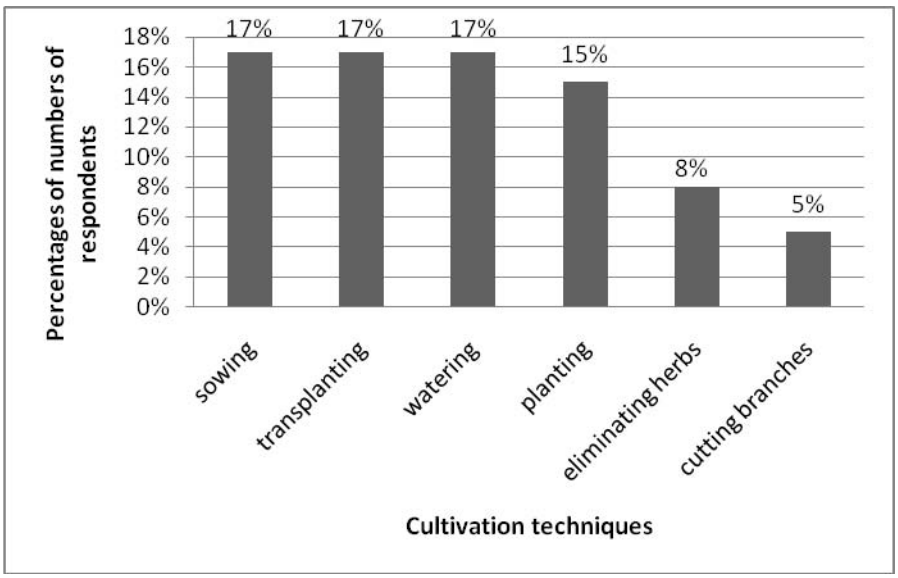

Figure 26: Percentages (including multiple answers) of listed main cultivation techniques of baobab by respondents (n=60)

Local people were asked for reasons why they do not plant or cultivate baobab trees. Respondents mentioned, that the plantation or cultivation of the baobab is not part of their culture or tradition. People state, that they have never observed anyone cultivating a baobab tree. Others mention that the baobab tree is seen as a wild tree or tree of the bush land and therefore simply grows by itself. Nevertheless, some informants state that previous generations (their parents) have planted baobab trees, but that this is not practiced anymore. Some informants state that they do not have the knowledge required to cultivate a baobab and that they do not own any field for the plantation of baobab. It is also mentioned that the baobab tree would need a lot of water. Single statements are given about people do not having sufficient time to care for a baobab seedling and, that, only young boys cultivate baobab trees. Local folklore also points out that the person will die before the baobab has grown up and that the baobab tree is not a suitable field crop.

4.4.4. Folk classification and selection criteria of baobab

Eight groups out of 9 (89%) are in consensus that there are no “types” of baobab. Informants of 5 out of 9 (56%) groups mention that there are differences in fruit, leaves and bark qualities, but to distinguish them, one has to test or try each individual tree. Fruit qualities are normally identified by sweetness or acidity, as well as by size, and leaves, which are differentiated by the quantity needed for the production of *lalo.* It is described that there are leaves where one needs only a little quantity of *lalo* for the couscous and others

where a large quantity is required to make the couscous slippery. In general, young baobabs are preferred for the production of *lalo.* People report that there are trees, which are used to gain fruits, and again others are valued for their leaves. This can be explained in so far that for obtaining the leaves people cut whole branches, which means that the tree will not be able to produce a large quantity of fruit.

Participants of three out of nine (33%) group discussions, however, state that there is only one single type of baobab and that there are no differences between individual trees.

One village reports of two "types" of baobab: "Dioukar" the sweet type, where the fruit can have any shape or size, the other type is called "Ngokole", which is a type of baobab, with half-moon shaped fruit.

4.4.5. Habitat of tamarind

Local people have been asked to list the sites, where tamarind appears. Six out of nine groups (67%) conclude that the tamarind grows everywhere without any special preferences. In four of nine groups (44%) participants agree that the tamarind grows on any type of soil. Again, participants of four (44%) group discussions conclude that the tamarind grows in bush land. Three (33%) groups state that the tamarind grows in or around villages and two groups (22%) mention that the tamarind appears in crop fields.

4.4.6. Interdependence of the tamarind and humans

To elucidate whether the tamarind is connected with humans and their activities, two (22%) out of nine groups agree to this theory and another explains that the tamarind has been and still is transported by human beings, who throw away the seeds. Two of nine groups (22%) mention that the tamarind grows at sites of former human settlements or habitations.

4.4.7. Plantation systems and cultivation techniques of tamarind

There are no existing traditional plantation systems for tamarind among the researched groups in Senegal. Single trees are planted infrequently: 18% of all sampled respondents (n=60) do confirm to plant tamarind trees. These trees are planted for reasons of own benefits. 28% of all informants cultivate tamarind trees, whereof 24% are Peulh, 47% are Serer and 29% are Wolof.

Primarily cited cultivation techniques are: planting (practiced by 18% of all sampled informants (n=60)), sowing, transplanting and watering (17% of all respondents), eliminating herbs and protection by building fences (5% of all informants) (Figure 27). In addition, informants list cutting branches for the improvement of production. Some informants reported of more specified cultivation techniques, which are: sundrying the seeds for one month, then sowing one kilogram or more seeds in a hole of 5cm and watering them. One respondent mentions sowing the seeds in sand and watering them once. Another explains to leave the seeds for 5 months in a paper parcel filled with soil and water, then planting the seeds into soil, watering them and building a fence for protection. One informant confirms to select the plants after sowing.

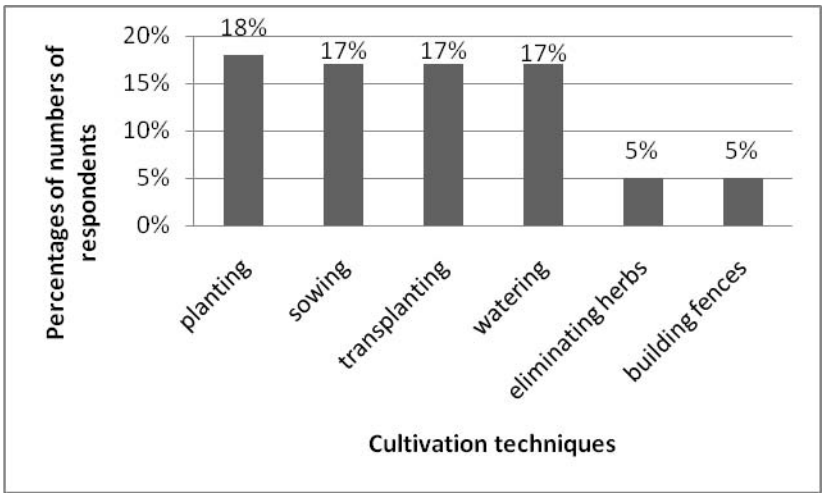

Figure 27: Percentages (including multiple answers) of listed main cultivation techniques of tamarind by respondents (n=60)

Listed reasons for local people who do not to plant or cultivate a tamarind are that the plantation or cultivation of tamarind is not part of their culture or tradition. People state to have never seen someone planting or cultivating a tamarind. Tamarinds are viewed as wild trees or trees of the bush land or forest and therefore grow without human input. Some informants mention not to have the knowledge needed to plant or cultivate a tamarind. Others state that they do not have time to plant or cultivate a tamarind or not owning any field for planting or cultivating a tamarind tree. Single statements are given about young boys exclusively cultivating tamarind trees, that the tamarind takes too long to produce fruits and that the tamarind would need a lot of water.

4.4.8. Folk classification and selection criteria of tamarind

All 9 (100%) villages agree that there are no specific types of tamarind. Four groups (44%) explain that there are differences in fruit qualities but to distinguish them, one has to test or try each individual tree. The fruit quality is defined by taste and size.

Participants of three out of nine (33%) group discussions state that there is only one single type of tamarind and that all tamarinds are similar.

4.5. Conservation management

4.5.1. Decreasing populations of baobabs

Local people were asked, if they observe a tendency towards decreasing populations of baobab. Seven out of 9 groups (78%) confirm the decline of baobab, while one group disagrees to this statement and insists that the baobab population is increasing. The last group mentions that the baobab does not disappear because of its long lifetime.

Four of nine (44%) groups explain the disappearance of the baobab with climatic changes such as, drought and water shortage. Participants of two (22%) group discussions explain that people cut the baobab, too much. Again two (22%) groups have observed that old baobabs have disappeared. One last group states that in former times people used to plant baobab trees but nowadays neems and mangoes are preferably planted.

4.5.2. Regeneration of baobab

The presence of young baobab trees is a significant factor for its reproduction. 88% of all sampled respondents (n=60) confirm the existence of young baobabs, while the nonexistence of young baobabs is only mentioned once. The reason given for the non-existence of young baobabs is as following: “here no young baobabs exist, because in the places, where we cultivate, we cut the young trees”.

83% of informants (n=53), who confirm the existence of young baobabs, describe that young baobabs grow in scrublands or forests. 75% of respondents say that young baobabs appear in or beside fields. 45% of informants confirm, that young baobabs grow in villages. 26% of respondents state that young baobabs grow in, beside or near houses. Local people explain that young baobabs grow in villages, in, beside or near houses because people throw the seeds away near their houses. Finally, 15% of respondents explain that young baobabs grow on former habitations (Figure 28).

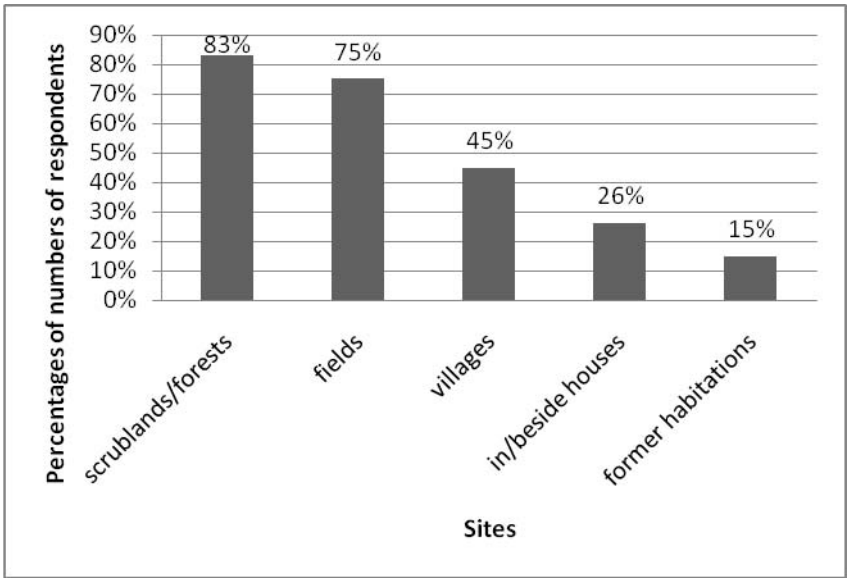

Figure 28: Percentages (including multiple answers) of appearance of young baobabs listed by respondents (n=53 respondents, confirming the existence of young baobabs)

4.5.3. Protection of baobab

68% of all sampled respondents (n=60) describe the baobab tree as a species protected by the community. Local people argue that the baobab is mainly protected because of its utilisation and importance, while others mention that it is protected to prevent people from cutting or causing other kinds of damage. It is once cited, that the baobab is protected by the government and foresters to put a halt to the decrease and degradation of forests.

Again 68% of all sampled informants (n=60) confirm to protect the baobab themselves and 30% of all respondents cite to protect the baobab more than other tree species. Listed protection management strategies (including multiple answers) are (Figure 29): utilisation interdictions, controlling and especially taking care of children to prevent damage listed by 40% of all sampled respondents (n=60), no cutting was mentioned by 34% of all informants, weeding and eliminating herbs around the baobab tree to prevent damage by bush fires was named by 29% of all respondents, building a fence around the baobab tree was reported by 7% of all respondents, letting the fruits maturate was mentioned by 7% of all informants, and

5% of all informants listed watering the baobab tree. It is cited once by a Wolof respondent that he interdicts the Peulh to cut baobab trees.

Fences are built to protect the baobab from domestic animals, such as sheep, cattle, horses, camels, donkeys and goats, which eat baobab leaves and parts of the bark. Besides domestic animals, some respondents have observed monkeys, which eat the fruits and others report of squirrels which again devour fruits.

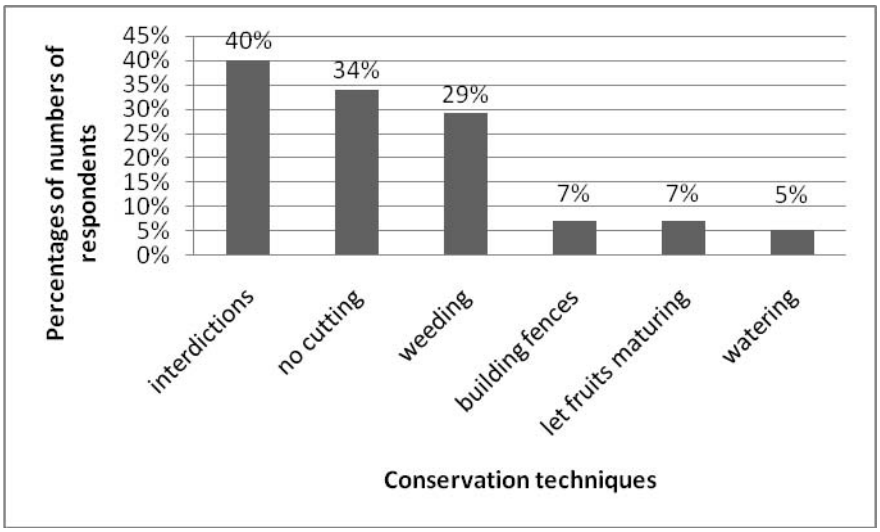

Figure 29: Percentages (including multiple answers) of conservation techniques of baobab by respondents (n=60)

4.5.4. Felling of baobab trees

53% of all sampled respondents (n=60) state to have seen a felled baobab. While only 25% of Peulh (n=20) have seen a felled baobab, 60% of Serer (n=20) and 75% of Wolof (n=20) can report of a felled baobab.

Some of the Peulh mention that baobab trees are felled to obtain honey and or as form of selection, when too many baobabs sprout at one place. Furthermore it is mentioned that baobabs will be cut beside fields if there is a risk that the tree could fall down.

The Serer report that baobabs are felled if the tree is obstructing construction work. Others report that the baobab has fallen down itself because of wind or its old age.

The Wolof mention felling baobab trees for gaining firewood and if the location of the baobab hinders construction work. Some Wolof report, that the baobabs sometimes succumb to old age.

4.5.5. Decreasing populations of tamarinds

Local people were asked, if they have observed a decreasing population tendency of tamarind. In the case of tamarind, 5 groups out of 9 (56%) state that the tamarind disappears, while only one group disagrees and insists that the tamarind is increasing.

Four of nine groups (44%) figure that the cause for the disappearance is climate change: drought and water shortage. One group mentions that people cut the tamarind to feed their animals and another group reports that old tamarinds simply die.

4.5.6. Regeneration of tamarind

The presence of young tamarind trees is a significant factor for the reproduction of the species. 83% of all sampled respondents (n=60) confirm the existence of young tamarinds. 82% (n=50) of informants, who confirm the existence of young tamarinds, state, that tamarinds grow in scrublands and forests. 60% of respondents mention that young tamarinds appear in or around fields. 40% of respondents describe that young tamarinds grow in villages and 14% of informants say that young tamarinds appear beside houses. The appearance of young tamarinds in villages, beside houses is explained by the fact that people throw their seeds away, beside their houses. At the same time, it was once mentioned in a Wolof village that people do not throw too many seeds beside their houses because of bad spirits, which are sheltered by the tamarind. 8% of informants report that young tamarinds grow at former habitations but 6% of informants, however, do not specify any special site, explaining that young tamarinds appear everywhere (Figure 30).

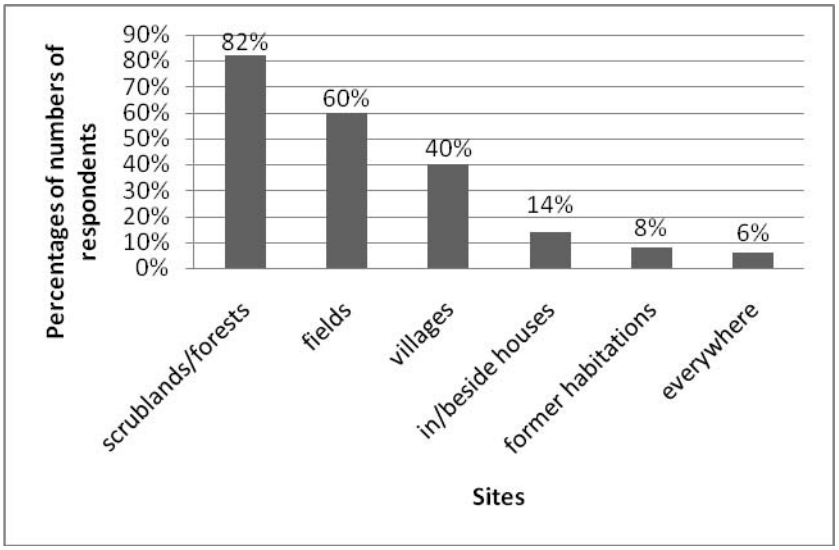

Figure 30: Percentages (including multiple answers) of appearance of young tamarinds listed by respondents (n=50 respondents, confirming the existence of young tamarinds)

4.5.7. Protection of tamarind

75% of all sampled respondents (n=60) describe the tamarind tree as a species protected by the community. Local people state, that the tamarind tree is mainly protected because of its utility and importance by preventing people from cutting and causing damage. It was once mentioned, that the tamarind tree is protected by foresters to prevent the degradation of forests. Another informant states that the tamarind is protected for commercial purposes.

68% of all sampled informants (n=60) confirm to protect the tamarind tree and 35% of all respondents state to protect the tamarind tree more than other trees. Listed forms of protection (including multiple answers) are (Figure 31): utilisation interdictions, controlling and taking special care of children to prevent damages was described by 37% of all informants, weeding and eliminating herbs around the tamarind tree to prevent damage by bush fires was listed by 34% of all informants, no cutting was mentioned by 32% of all informants, building fences around the tamarind tree was reported by 7% of all informants, letting the fruits maturate was named by 5% of all respondents and watering the tamarind was listed by 5% of all respondents. One informant points out that cutting the tamarind tree

can land you to prison. It is once cited by a Wolof respondent that he interdicts the Peulh to cut tamarind trees and another interdicts herdsmen from harvesting the tamarind.

Respondents mention to build fences to protect the baobab, among others, against domestic animals, which consume tamarind leaves and bark. These are: sheep, cattle, horses, donkeys, camels and goats. Also monkeys have been observed to consume tamarind fruits.

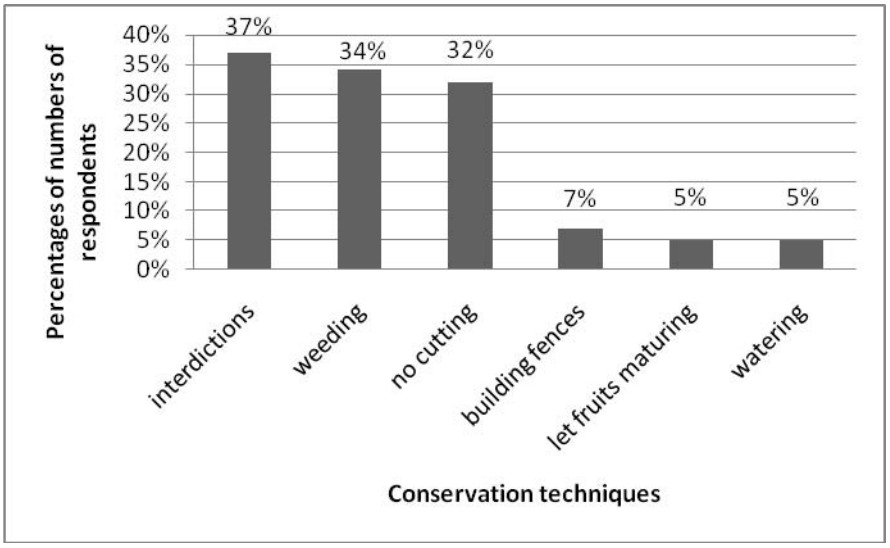

Figure 31: Percentages (including multiple answers) of conservation techniques of tamarind listed by respondents (n=60)

4.5.8. Felling of tamarind trees

43% of all sampled respondents (n=60) confirm to have seen a felled tamarind. Focusing on ethnic groups 15% of Peulh (n=20) have seen a felled baobab, 40% of Serer (n=20) and 75% of Wolof (n=20).

The Peulh state to fell tamarinds for selection: if too many tamarinds are at one place, some will be cut to support the growth of others. Other Peulh state that tamarinds could be felled if someone wanted to cultivate a field.

The Serer fell tamarind trees if the tree grows on a prospective construction site. Others mention that tamarind trees fall down because of their old age. It was mentioned once that a dead tamarind tree was chopped to obtain fire wood.

Wolof reasons for felling a tamarind tree are gaining firewood and in case the tree is growing on a site where someone wants to construct a building. In addition, some Wolof mention, that people fell tamarind trees if they touch the power line, or for gaining charcoal. Some respondents report that old tamarinds topple down themselves.

5. Discussion

5.1. Research findings compared to literature findings

5.1.1. Utilisations

Baobab

The baobab still remains a multifunctional tree and is mainly used for alimentation, fodder, domestic utilisations and its medicinal properties, as previously reported by Billand & Diallo (1991). Additionally, this study has shown that local people consider the baobab tree as an important species, mainly because of its food function. Baobab fruits and leaves are regularly consumed throughout the whole year and are part of daily diet, as described by Chastanet (1991), although, in Wolof communities, the baobab is, by convention less consumed than in Serer and Peulh villages. The only plant part, which is mainly used in times of crisis and shortages are the seeds, as already described by Berhaut (1974).

Even, if the main interest for all three ethnic groups remains the food function, this study has pointed out that the groups of Peulh, Serer and Wolof have different interests and knowledge for uses. While the main interest and function of the baobab for the Peulh is in its nutritional purpose, Serer connect a lot of ceremonies with the baobab tree and Wolof have a vast number of medicinal and therapeutical uses of baobab. Furthermore, uses of baobab seem to change but not to decrease in number, since for example, the Wolof do not use the baobab for nutrition as intensively anymore as other ethnic groups, but more for firewood and fodder than the others. These observations lead to the conclusion that some uses are lost, while other uses increase in importance.

The present study has shown, that the utilisation of *lalo* for sauces and couscous could decline, because of new nutritional habits concerning couscous to rice dishes and the preference of *lalo Mbep (Stercularia setigera)*, which is described to be easier to prepare. These tendencies have been pointed out mainly by Wolof and some Serer communities. Again in Serer and Wolof communities people tend to change from baobab cordages and ropes to modern industrial cordages, since modern cordages are described to be more durable. This change of habits could indicate a decline in the traditional utilisation of baobab ropes. The preference for industrial ropes has already been described by Dhillion & Gustad (2004). In contrast to the ropes, the utilisation of baobab as source of fodder and firewood, although described as poor quality wood by Booth & Wickens (1988), Burkill (1985), Dhillion & Gustad (2004) and Diop et al. (2005), seems to increase, at least in Serer and Wolof communities. In these communities people report conflicts between villagers and shepherds on tree resources. These newly observed problems may point to new development trends, increasing future conflicts of interests.

Numerous food uses and food processing of baobab described in the literature by Assogbadjo et al. (2005), Berhaut (1974), Blench (2001), Booth & Wickens (1988), Burkill (1985), Dhillion & Gustad (2004) and Wickens & Lowe (2008), such as baobab juice, porridge, leaves or *lalo* for couscous and sauces are confirmed by the present study. Only the utilisation of the cooked and eaten root, mentioned in Arbonnier (2004), Booth & Wickens (1988) and Burkill (1985) could not be corroborated in the present study. The *ngalakh* described by Owen (1970) in Wickens & Lowe (2008), a kind of special porridge seems to be similar to the porridge known as *bouillie, lakh or nec*, with the difference that the *ngalakh* is consumed at ceremonial events, while the *bouillie* is part of the daily diet. The statement of Dhillion & Gustad (2004), that glabrous leaves are preferred can be confirmed

by the observation, that local people in Senegal prefer those trees for the *lalo,* as only small quantities are needed, because those leaves are more glabrous.

Hollow baobabs, used as tombs, shelters, lofts, stores and water cisterns, which are cited by Anonymous (1993), Arbonnier (2004), Booth & Wickens (1988) and Burkill (1985), have not been reported by informants of the communities studied here. The special use of baobab husk ash mixed with tobacco to add force to it, reported by Berhaut (1974), is widely spread in Serer communities. Instead of smoking the powdered husk, as reported by Booth & Wickens (1988) and Burkill (1985), people use the ash and not for smoking, but place it between teeth and lips or in the nose.

The increasing use of the baobab as cash crop, leads to new habits and value changes of the baobab with all the consequences of overexploitation and reproduction problems, which has been postulated by Bergeret (1986) and Chastanet (1991). Informants of the present study rank the commercial value besides medicinal function as the second reason for the importance of the baobab. This new value can play an important role for additional household income, as already the Serer and particularly Wolof communities in the present study report, not to harvest anymore, but to buy baobab products on the market, where it is available throughout the whole year. At the same time, Wolof seem to loose some of their knowledge about harvesting times, since they do not practice harvest anymore. Wolof state to harvest leaves and bark at any time of the year, while the other two ethnic groups know specifically when to harvest leaves and can cite the best time for bark harvest.

The observation of Kerharo & Adam (1964) in Wickens & Lowe (2008) concerning the application of baobab pulp against diarrhoea by Wolof and the application's refusal by Peulh is confirmed by the present study. The application is widely spread in Serer and Wolof communities but not once mentioned in Peulh communities. Furthermore, in Serer and Wolof villages, the pulp is used for any kind of stomach pain and disease, which has already been mentioned by Burkill (1985). But, contrary to the description by Burkill, people do not use the ash, but drink the juice to cure stomach troubles. The application of baobab pulp against fever, as cited in Kerharo (1974) has been listed in the present study, but instead of infusion, as reported in Kerharo (1974), people reported to extract a juice for treatment. Quite a common application of baobab pulp, not cited in the literature, is against fatigue.

Seeds are widely cited in Arbonnier (2004), Berhaut (1974), Booth & Wickens (1988), Burkill (1985), Dweck (1996) Kerharo (1974) and Wickens & Lowe (2008) for their numerous medicinal applications, but rarely named in the present study.

Leaves are mainly used against fatigue and stomach pains and diseases, which was previously reported by Arbonnier (2004), Berhaut (1974), Booth & Wickens (1988), Burkill (1985), Dweck (1996) and Kerharo (1974). The Senegalese application of leaves, cooked as a tea and serving as emollient and calmative against fever, cited by Berhaut (1974), was not reported by informants and has not been observed, but the author has worked in the field at a time, when fresh leaves were not available, which could be a reason for the missing information.

Irvine (1961) and N'Diaye (1962) in Wickens & Lowe (2008), report of a bark decoction gargled against toothache in Senegal, which has not been reported in the present study. It might be possible, that nowadays this application has been abandoned or declined, since the first report was nearly 50 years ago. But, after this study, bark seems to be a common agent against stomach pains.

Tamarind

The tamarind, still a multifunctional tree, is part of daily diet, as reported by Slingerland & Kiema (2001), consumed in form of *bouillie,* as reported by Arbonnier (2004) and Burkill (1995) or the *Thiebo Dienne*. Tamarind as an ingredient in *Thiebo Dienne* has not been described in the literature, although it is one of the main dishes in Wolof and Serer communities. Furthermore, it is said to an important food source during times of crisis, as mentioned by Burkill (1995). Billand & Diallo (1991) report that leaves are used as substitute for sauces. The role of tamarind in times of famine and the use of leaves as a substitute for sauces is highlighted by the present study through the consumption of tamarind flowers, husks and leaves as a flavouring agent for the *bouillie* during times of shortage. As a regularly consumed food and substitute in times of crisis, the tamarind is highly valued in local communities and is considered an important tree. The main interest in the multifunctional, tree remains the food function, although it is also highly praised in traditional medicine particularly by Wolof communities.

Nevertheless, the tamarind has gained new values as cash crop. Billand & Diallo (1991) and Burkill (1995) report that the fruit can be bought at every market, even Grollier et al (1998) report of the juice, being commercialized. The present study also reports of tamarind wood as an additional market product beside the fruit. Nevertheless, young tamarind leaves, steamed in water vapour and shaped into bowls and dried, as described by Bergeret (1986) could not be found on local markets and have not been reported by respondents in the present study. Since informants reported that uses of flowers, husks and leaves are increasingly rare today, it could be possible that this product has disappeared from the market. Informants of the present study have listed the commercial use as the second most important reason for the merits of tamarind, which is significant for the potential of tamarind as cash crop and influence on household income. In this study, Serer and Wolof respondents mentioned not to harvest anymore, but to buy tamarind products on the market. This increasing and relatively new value of tamarind as a cash crop will lead to new problems and conflicts. Overexploitation and conflicts between different users could be the consequence. In the present study, informants already reported that access to the tamarind resources is more and more limited because of people insisting on their property rights to the cash crop. Furthermore the abandon of harvest could lead to declining knowledge on tamarind management such as harvesting periods and techniques.

Uses as construction-timber are common, as cited by Arbonnier (2004), Berhaut (1975), Burkill (1995), Grovel (1993) and N'Diaye et al (2003). Beside the good-quality charcoal, reported by Arbonnier (2004), Burkill (1995) and Grovel (1993), the tamarind is used as firewood, particularly in Serer and Wolof communities, but it is also common in Peulh villages. Leaves are used as fodder, as mentioned by Arbonnier (2004).

Almost all tamarind plant parts are medicinally used, only the flowers and seeds have not been listed in this study, but cited by Berhaut (1975). Main pulp utilisations, already mentioned by Berhaut (1975), Kerharo (1974) and Maydell (1990), are the application in cases of fever, constipation and intestinal troubles. The meal *bêgal*, cited by Arbonnier (2004), Burkill (1995) and Kerharo (1974), which is said to be prepared in Senegal and consumed as a laxative or febrifuge, has not been cited by respondents of the present study. Instead of this, people report to prepare a juice in cases of constipation and fever.

Leaves were not cited to be applied against diarrhoea, as mentioned by Arbonnier (2004), but are consumed against stomach diseases and pains, which could be interpreted as a similar application. The application in case of illnesses of the eye, again cited by Arbonnier (2004) is confirmed by this study, although rarely mentioned and therefore not commonplace.

A frequent application of the bark by Serer and Wolof is for healing wounds and fractures, as already documented by Arbonnier (2004), Berhaut (1975) and Burkill (1995). Not mentioned in the literature is the practice of gargling a bark decoction in cases of teeth pains, which is popular with Peulh and Serer. For stomach pains and diseases informants do not use the ash of the bark, as mentioned by Maydell (1990), but soak the bark in water and drink it.

5.1.2. Symbolic and cultural value

Baobab

The baobab is still the subject of numerous legends and traditions, as mentioned by Burkill (1985), Diop (2005) and Dellatola (1984). Assogbadjo et al. (2005) and Burkill (1985) write about the baobab as a sacred and fetish tree, which is confirmed in the present study. There are still sacred and fetish trees and the baobab still shelters good and bad spirits and genies, as well as devils, although these traditions and beliefs seem to loose importance and influence as informants of the present study mention that young people do not value these historical conventions anymore. Rainmaking ceremonies held by Serer, as described by Anonymous (2005) in Wickens & Lowe (2008), were not in the investigated Serer communities. The reason for the absence of these ceremonies could be that the author was not present at the beginning of dry season, when these ceremonies are said to be held. Informants of the present study have reported of ceremonies, where sacrifices are made to sacred and fetish trees, which was previously described by Wickens & Lowe (2008). The present study points out that ceremonies around baobab trees depend on the ethnic group in question, since Peulh do not practice any ceremonies linked to the baobab, while they are widely spread among the Serer and known by Wolof.

The present study shows that sacred trees or trees, which are inhabited by genies, are connected with several taboos and interdictions. Usually these trees are not harvested or utilised. Nevertheless, except for those interdictions, sacred trees and genies do not have any influence on the plantation or elimination of baobabs: none of the informants mentioned to eliminate a baobab tree, which is said to be inhabited by bad spirits, as is cited to be the case in Mali, nor has anyone mentioned planting a baobab for protection, as reported by Sidibé & Williams (2002).

The utilisation of the baobab by Serer and Wolof as a gravesite for *griots*, as described by Gillet (1986) and Wickens & Lowe (2008) seems have been abandoned. In the present study none of the Wolof mentioned this tradition, while the Serer reported of this habit, which used to be practiced in former times but has been renounced today.

The baobab, prepared as special dish for baptisms and marriages, as mentioned by Assogbadjo et al. (2005) was observed in the present study and is still a common tradition in Wolof communities. Dishes prepared for Good Friday, the end of Lent and the end of Ramadan, as described by Owen (1970) in Wickens & Lowe (2008) have not been noted in the present study, but this may be because the author was not in the field at those times.

Tamarind

The tamarind is still preferred as shade tree and meeting point, and serves as *arbre à palabres*, as cited by Arbonnier (2004), Rocheleau et al. (1988) and Giffard (1974). Medico-magical treatment practices for mental disorders, folly, insanity, impotence and sterility, as described by Arbonnier (2004), Berhaut (1975) and Burkill (1995) have not been observed in the present study but could be part of the numerous traditional medicinal practices, which are kept secret and are not disclosed strangers.

The tamarind serves as housing for genies, as cited by Burkill (1995) and Kerharo (1974), although this study points out that these genies are mainly bad ones. Informants mentioned that the tamarind is known as the tree, which shelters more bad spirits than good ones and many more than the baobab. Those bad spirits and genies seem to have different influences, depending on the traditions of each ethnic group. While Peulh, with only one exception, do not have any beliefs of genies in the tamarind, Serer do not harvest those trees and Wolof sometimes do not plant the tamarind next to their houses or even eliminate young tamarind trees because of the risk of harbouring bad spirits. This belief could be a constraint to cultivation of tamarinds and limit tamarind regeneration. At the same time tamarinds, which shelter bad spirits are not cut by Wolof, which again can be seen as conservation management.

Sacred trees are known by Serer and Wolof, who also practice ceremonies, but not by Peulh, contrary to the report by Diallo (2001). However, as the investigated Peulh in the present study were sedentary Peulh and Diallo (2001) reports of nomadic Peulh, this belief could still be present today.

5.1.3. Harvest and storage management

Baobab

The baobab fruit and leaf harvest is mainly done by boys or women, as reported by Bergeret (1986) and Dhillion & Gustad (2004), but men also participate in the harvest procedure, which seems to be an exception from the habits of food gathering, as mentioned by Chastanet (1991). The present study conforms with the study by Dhillion & Gustad (2004) in so far as there are two times of harvest: one around May and the other mainly from August or September to October. Another agreement is that women prefer not to climb trees while men do. While Dhillion & Gustad (2004) describe that women harvest small amounts for daily consumption and men vast quantities for storage, informants of the present study report that men mainly harvest for sale. Bergeret (1986) reports that trees, harvested for leaves, produce hardly any fruit, which is highlighted by a finding of the present study. Local people cited to have specific trees for leaf harvest and others for fruit harvest. In addition local people stated that the baobab disappears because of people cutting the baobab too much. The only harvest clearly defined by gender is the bark harvest, which is only performed by men. This finding has not been reported in previous studies.

While fruit and leaves harvest practices are not really categorized by gender, the storage of leaves and fruits remains mainly women's work, as it is them, who are responsible for cooking and feeding the family. Only the Wolof do not really identify any gender, as they hardly store baobab products because of buying them on the market. Gender issues concerning storage could not be found in literature.

Tamarind

In the literature no topics concerning labour division by gender and age concerning tamarind harvest were found. The present study points out that mainly children and adolescents, principally boys, are harvesting the tamarind fruit, while leaves are more harvested by women, as leaves only serve as a fruit substitute in times of shortages and do not have any cash value, contrary to the fruit. Fruits are mainly harvested from November to February, which corresponds to the findings of Bergeret (1986). Peulh and Wolof reported of two additional periods, the Peulh in September, the Wolof in June, beside the principal harvest time. The September harvest is concerned with unripe green fruits, as was already reported by Bergeret (1986). The harvest in June is questionable because there should be no fruit at this time of year. Harvest problems because of fragile husks, as mentioned by Maydell

(1990) have not been reported by informants of the present study. Fruits is dried, as described by Grollier et al (1998) and stored in bags.

Bergeret (1986) reports that leaves are mainly harvested from May to July, which corresponds to the rainy season mentioned in the present study and appears logical, since the leaves, used as substitute for fruits, are harvested when no fruit is available. Only the Wolof harvest leaves throughout the whole year, since they use them as animal fodder.

5.1.4. Propagation and cultivation systems

Baobab

In the investigated areas of Senegal, there are no existing plantation- or cultivation systems of baobab, as previously mentioned by Blench (2001), Diop et al. (2005) and Pélissier (1966). In the present study, some informants reported to plant baobab trees, but in the cases only one or a few baobabs had been planted. The present study points out that even if not planted or cultivated, the human being still has extensive influence on the regeneration and distribution of baobab, firstly by distributing seeds by throwing them away after consumption of the fruit and secondly by protecting or eliminating young baobabs.

None of the respondents, with one exception, did actively select baobab seeds or seedlings, so genetic material is not selected, as proposed by Jama et al (2007). Nevertheless, the present study reports Peulh to cut trees in order, to support the growth of a selected one.

The fact that local people care for baobab seedlings when they germinate, as reported by Bosch and Asafa (2004) and Pélissier (1966), is stressed by the present study, where respondents mention to transplant, water, eliminate herbs around baobab trees and cut lower branches of the baobab to improve its growth. The observation of Bergeret (1986), that young baobab trees receive more attention in Peulh communities, and are absent in Wolof fields cannot be confirmed by the author of the study presented here. Niang (1981) reports of an agroforestry system in Serer villages in Central Western Senegal around Thiès, where people sow sorghum around baobab trees to profit from the organic matter. These cultivation systems could not found in the present study, nor were they reported by informants in villages around Thiès. Since the study of Niang is more than 25 years old, this cultivation system could have been abandoned in the meantime.

Bergeret & Ribot (1990) and Blench (2001) cite that local people do not plant wild trees, such as the baobab, as wild trees “belong to the bush”. This statement can be confirmed in the present study, since informants mentioned the belonging of baobab to the bush as the second most important reason for not planting or cultivating a baobab tree. The first argument for local people not to plant a baobab tree is because it is not part of their culture or tradition. This may appear contradictory, as some informants report that their parents and grandparents did plant baobab trees in former times. This statement of cultivations in former times can be underlined by the fact, that baobab trees grow mostly around villages and old village sites and indicate abandoned, former villages, as reported by Anon. (1993), Arbonnier (2004), Burkill (1985), Diop et al (2005), Giffard (1974) and Niang (1981) and was also confirmed by informants of the present study. These observations raise new questions: why do people nowadays consider the baobab as a wild tree and state that the plantation or cultivation of baobab trees is not part of their culture, when their ancestors did plant baobab trees? If this statement of cultivation in former times is true, maybe there are new motives, why people have abandoned the plantation or cultivation of baobab trees. These constraints could include the need for sufficient manpower, land and water, as mentioned by Savard et al (2006) and was also suggested by informants of the present study. People in this study mentioned not to have enough time (for preparing the field, eliminating herbs, irrigating and protecting the baobab by building fences), not to own a field for planting a baobab or that the

baobab would need water for growing. Another constraint, mentioned by Jama et al (2007), is the lack of skills and knowledge concerning harvest and processing methods. This observation is also valuable for plantation and cultivation techniques, since informants of the present study state not to have knowledge on how to plant or cultivate baobab.

Folk classification and selection criteria of baobab

In contrary to former studies by Assogbadjo et al (2005) and Sidibé & Williams (2002), where different types of baobab are described, the present study concludes that informants of the investigated areas do not identify different types, but different characteristics. Local people distinguish between the taste and size of fruits, the sliminess of the leaves and the quality of the bark. These criteria have already been cited by Assogbadjo et al (2005) and Sidibé & Williams (2002). Only the leaf and bark colour, again mentioned by Assogbadjo et al (2005) and Sidibé & Williams (2002) as selection criteria, have not been reported by informants of the present study. The characteristics and quality of fruit, leaf and bark are not connected with morphological characteristics, since the informants mention that every tree is different from the others. However, villagers do have preferred individual trees and select individual trees for fruit, leaf and bark harvest, which explains why some trees are practically untouched, as reported by Dhillion & Gustad (2004).

Tamarind

In the Sahel zone, the tamarind is rarely domesticated or planted, as reported by Billand & Diallo (1991), Diallo (2001), Grovel (1993) and Maydell (1990). This finding is confirmed by the present study. Treatments or active selection processes are rarely undertaken in this region, again mentioned by Billand & Diallo (1991), Diallo (2001), Grovel (1993) and Maydell (1990), and also confirmed by this study. Only one exceptional respondent reported to select seedlings, which means that germplasm is largely unimproved, as cited by Jama et al (2007). Although these authors state that sowing and transplanting is rare, these practices could be found in the areas investigated in the present study, even if they are not widely spread, they are still practiced by some informants. These practices are not part of a large-scale cultivation system, but can be viewed as taking care of plants by local people. Even if the tamarind is not cultivated or planted, the human being plays still an important part in the regeneration and distribution of tamarind, since man distributes the seeds by throwing them away after consumption and protects or eliminates the tamarind. Since local people usually consume the more appreciated fruits, throwing away uneaten seeds can be considered as a passive selection mechanism. Already Burkill (1995), Giffard (1974) and Grovel (1993) reported that the tamarind often grows around habited areas, which indicates the influence of man, who distributes the seeds. Some respondents in the present study confirmed that the tamarind grows on former habitations, though not clearly as the baobab. Moreover it is reported in the present study that, the tamarind has been transported by people, who have thrown the seeds away.

Reasons for the non-existing cultivation and plantation systems of tamarinds could lie in the constraints of the tamarind itself. The tamarind has a slow growth rate and a very irregular fruit production, cited by Billand & Diallo (1991), Diallo (2001), ICRAF (2007) and reported by the informants of the present study, although the irregularity of fruit production has not been mentioned in relation to constraints or limits of cultivation and plantation, but as limit to fruit access. The fact that no other vegetation grows under a tamarind tree, reported by ICRAF (2007) and Maydell (1990), seems not to be a limiting factor for cultivation, as it was not mentioned by any informant of the present study.

Other constraints of cultivation include the same limits as in the case of baobab: it is not part of culture or tradition, the tamarind is considered as a wild tree of the bush, a lack of skills and knowledge on how to plant and cultivate a tamarind, lack of time, no available land and the need of water for cultivation were mentioned. These constraints have not been mentioned in the literature, but should be taken into account when introducing cultivation systems in the future.

Folk classification and selection criteria of tamarind

Although Schütt et al (2006) cite different types of tamarind, none of the respondents of the present study identifies different types of tamarind. Some mention that there is a difference in fruit quality, which is defined by taste and size, as reported by Diallo (2001), but has nothing to do with the differentiation by form type of the fruit cited by Schütt et al (2006). The different levels of fruit quality are not linked to morphological characteristics. Every tree is considered as an individual tree, possessing different qualities and characteristics. Also, the factors mentioned by Soloviev et al (2003) of productivity and resistance to pests and diseases, were not part of the selection criteria in the present study.

5.1.5. Conservation management

Baobab

Even if not cultivated or planted, the baobab is still protected by local communities, as reported by Anon. (1993) and Jama et al (2007). Blench (2001) mentions that baobabs are not cut for firewood as baobabs are believed to harbour spirits, which is only partly acceptable, since the Wolof in the present study are used to cutting the baobab for firewood. It is true that Peulh hardly cut baobab trees, but not because of superstitions, since Peulh hardly believe in these customs, but to preserve the baobab trees for their own utilities. Most local people of the investigated areas did recognize the regeneration problem of the baobab, as predicted by Assogbadjo et al (2005) and Wilson (1988). Reasons listed by informants for the little recruitment of the baobab were the climatic changes with the consequences of drought and water shortage and the fact that people cut the trees too much, which has again been predicted by Assogbadjo et al (2005) and Wilson (1988). However, this awareness has no influence on conservation management, as it has never been stated as reason for protecting a baobab tree. People simply protect the trees for their own benefit.

Tamarind

No information has been found in the literature about conservation management of tamarind, only that seedlings have to be protected from cattle as cited by Grovel (1993). This kind of protection is also practiced in the investigated areas of the present study, where informants report to build fences around young tamarind trees for protection from domestic animals. Reasons for the protection of tamarind are not the regeneration problem due to climate change and overexploitation, which was recognized by some informants, but the own benefits of auto-consumption, other utilisations and commercial purpose.

5.2. Evaluation of hypotheses

Hypothesis 1: Baobab and tamarind play an important role for local communities.

This hypothesis can be accepted by the present study's findings. Both, baobab and tamarind are well known and commonly used in all investigated communities. Both trees are used in a nutritional, medicinal, spiritual way, for domestic purpose and have additional socio-cultural values. Both, baobab and tamarind are used for commercial purpose to increase household income. The majority of all respondents define baobab and tamarind as an important tree.

- *Sub-Hypothesis 1.1: All plant parts of baobab and tamarind are used in a multifunctional way.*

  This hypothesis holds true in general. The baobab pulp, seeds and leaves are used in nutrition and medicine, the bark is used for domestic purpose by fabricating ropes, the wood as firewood, the resin in medicine, the husk as fertilizer, the root in traditional medicine and so on. These are only a few examples of the numerous utilisations of baobab, which support the hypothesis.

  In the case of the tamarind the pulp, husk, flowers and leaves are used in nutrition. Wood serves as firewood and construction wood. The bark, root and resin are used in medicine. Only, the seeds do not have any function for the investigated respondents.

- *Sub-Hypothesis 1.2: There is already an existing local market for baobab and tamarind plant parts.*

  A local market for baobab does exist. Traded plant parts of baobab are fruits, leaves and the bark. Fruits can be found on markets in form of powder, leaves are processed to powder and sold as so called *lalo* and the bark is commercialized as cordages. Through today's commercialization, the baobab has even gained a new value.

  Tamarind fruits and wood are traded on local markets in Senegal. The tamarind fruit has higher commercial value than the baobab fruit. The commercialization of tamarind plant parts serves to increase family income. Through this trend of commercialization, the tamarind gains additional value.

Hypothesis 2: Baobab and tamarind plant parts are not only used in a nutritional and medicinal context, but also in social and cultural life.

This hypothesis holds true generally. Baobab and tamarind are a part of daily life as a social communication and meeting point and as a source of shade. Both trees can be found at special events such as ceremonies, baptisms and marriages, either serving as place for the event or as ingredient in special dishes. Both, baobab and tamarind are connected with myths, stories, legends and traditions. Only the Peulh do not celebrate any ceremonies connected with baobab or tamarind.

- *Sub-Hypothesis 2.1: There are some local traditions or beliefs that could hinder plantations of baobab or tamarind.*

  This hypothesis is rejected for the baobab, but accepted for the tamarind.

  In the case of the baobab, no local traditions or beliefs were found, which could hinder the plantation of baobab. Only access and utilisation limitations for reasons of the existence of bad spirits have been communicated.

  Tamarind trees host many bad spirits and devils, therefore some informants in Wolof communities stated to eliminate young tamarind trees near their houses.

Furthermore, some people argued against planting a tamarind tree in or near their houses for the same reasons. These limitations of tamarind plantations were not found in Peulh and Serer communities.

Hypothesis 3: There are almost no traditional cultivation systems and local people are harvesting unsustainably from wild baobab and tamarind trees.

This hypothesis is accepted. During research no explicit cultivation system was seen or mentioned. Nevertheless, some local people do cultivate single baobabs or tamarinds, but rarely have an adapted or specially developed system for the tree species. Reported cultivation techniques are held general, such as sowing, planting, transplanting, watering, eliminating herbs and cutting branches. Details about specific techniques are rarely given.

Concluding on the non- or rarely existing cultivated baobabs or tamarinds, people do mainly harvest from wild growing or self-reproduced baobabs and tamarinds. These trees are either someone's property or grow wild. Some informants report of overexploitations and conflicts of interests between shepherds and villagers, which could point to an unsustainable way of resource management.

- *Sub-Hypothesis 3.1: Baobab and tamarind are not or rarely planted, but protected by local communities.*

  This hypothesis is accepted. No baobab or tamarind plantation systems were seen or told of during research. Local people do sometimes plant single baobab or tamarind trees. Both, baobab and tamarind are viewed as wild tree species and therefore remain in the bush land. But once, a baobab or tamarind grows tall, people tend to protect the tree by building fences and taking care of the tree.

- *Sub-Hypothesis 3.2: Local people are already feeling some shortage of baobab and tamarind.*

  This hypothesis can neither, be accepted or rejected. Some informants confirm the tendency towards decreasing populations of baobab and tamarind, while others do not agree. However, people, who do observe a disappearance of baobab or tamarind, explain this mainly with climatic changes, drought and water shortages or the overexploitation by cutting the trees too much.

Hypothesis 4: Baobab is an indicator of former settlements and accompanies actual human settlements.

This hypothesis can generally be accepted. The majority of interviewed informants agree that the baobab is linked to human activities and that there is an interdependence between the baobab and the human being. This statement is supported by the fact that baobabs grow in and near villages and in fields. If one finds a site with many baobabs, it is confirmed by one third of informants, that there has been a village in former times. This statement concludes that the baobab can be seen as indicator for former human settlements.

Hypothesis 5: Local people do have their own selection criteria and concepts of classifications for varieties of baobab and tamarind.

This hypothesis has to be partly negated, since none of the informants confirmed the existence of different varieties or types of baobab or tamarind. But people state to differentiate each individual baobab and tamarind tree by fruit, leaf and bark characteristics. Selection criteria for fruit are the taste (sweetness) and size, for baobab leaves the mucilage quality or quantity of foliage, and for the baobab bark its durability. This concept of differentiation would conclude that people have no classification systems for the categorization of types, but have their own selection criteria concerning isolated

characteristics, which are not linked with morphology. These selection criteria depend on local people's personal preferences.

- *Sub-Hypothesis 5.1: The varieties have different values or importance for local people.*

  This hypothesis is rejected. Since there are no varieties or types of baobab or tamarind, there are no types having different values. Anyway, in some communities, there are well known individual trees, which are preferred by local people and therefore have higher values or importance than other trees. In the same way people prefer certain characteristics of baobab or tamarind, as mentioned above.

6. Conclusion and Future Perspectives

The present study has shown the importance and high value of baobab and tamarind for local people, since they are both multifunctional trees used in daily life of local communities. In addition, the study has pointed out that local people do protect or care for these trees for reasons of own benefits, but there is still a lack of developed cultivation or propagation systems, which may become necessary due to tendencies of overexploitation, unsustainable harvesting methods and climate change phenomena and the consequences of reproduction and regeneration problems of baobab and tamarind.

The results have shown that mostly local people do not have specific reasons for not cultivating baobab or tamarind (except the Wolof communities, which do not want to have tamarind near their housings because of bad spirits), but it had simply not yet occurred to them. Small-scale propagation and cultivation systems appear to hold high potential for local people for their own benefits of food, medicine and domestic utilisations. Moreover, cultivated baobab and tamarind trees can contribute to new family income resources, since the local market value of both seems to increase.

Future projects should focus on sensibilisation of local communities concerning the regeneration problem and following resource shortages and its anthropogenic causes, and on capacity building programs on how to select, propagate and cultivate baobabs and tamarinds in fields and gardens. Before starting these programs, more research is required: 1) ethnobotanical research in other African countries to check for the existence of possible traditional cultivation systems, 2) research on the preferential cultivation techniques for baobab and tamarind and on development of adapted techniques for local communities. The known projects from Mali raise hopes to the prosperity of these cultivation systems and furthermore, the acceptance of cultivation systems by local people.

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Table 7: Names of baobab and baobab plant parts, found in literature (Anon., 1993; Berhaut, 1974; Booth & Wickens, 1988; Burkill, 1985; ICRAF, 2007; Kerharo, 1974; N'Diaye et al., 2003)

English	French	Arabic	Wolof	Serer	Peulh
Baobab	Baobab	Tebeldi	Gui	Bak	Bohi orohi
Monkey-bread (the fruit) tree	Pain de singe (the fruit)	Tabaldi	Goui	Mbak	Boki
Upside-down tree	Arbre aux calebasses	Teidoum	Gwi		Boko
Sour gourd	Calebassier du Sénégal	Hamaraya	Bui (the fruit, pulp or flour)		Bavdé
Lemonade tree	Arbre de mille ans	Hamao	Buee		Bóy
Cream of tartar tree	Mapou etranger	Gangoleis (the fruit)	Gif (the seeds)		Boiö
Guinea tamarind	Mapou zombi		Lalo (the leaves or a mixture of dried powdered leaves)		Boré
Senegal calabash (the fruit)			Téga (the bark)		Bhôhè
			Ndaba (the mucilage)		Nemaari

Table 8: Local names of baobab and baobab plant parts in Wolof villages

Plant part	Niakhoul	N'Dande	Sakal	Coki
Baobab	Guiy	Gouye	Gouye	Gui
Fruit	Wouy	Bouye	Dom Bouye	Wouille
Pulp	Som Guiy	Bouye	Bol Bouye	Bouillie
Husk	Hote Guiy	Khote Gouye	Khot Bouye	Khot Wouille
Seed	Hoh/Khokh Guiy	Khokh Gouye	Dom Bouye	Khokhe Bouillie
Flower	Hage Guiy	Tortor Gouye	Khob Bouye	Mbotane Gui
Leaf	Hobe Guiy	Khob Gouye	Khob Bouye	Khobi Gui
Stem	Bate Guiy	Pére Gouye	Dath Bouye	Dattu Gui
Bark	Bate Guiy	Thieugue	Khanthe Bouye	**Theugue Gui***
Wood	Mate Guiy	Mat Gouye	Mathe Bouye	Mate Gui
Root	Réne Guiy	Reine Gouye	Reine Bouye	Reine Gui
Resin	Ndiondio Guiy	Bdab Gouye	Dakhade Bouye	/
(Semi-) Parasite	Tombe Guiy	Tob Gouye	Tob Bouye	Tob Gui
***Theugue Gui=the part of the bark, where the cordage is made of**				

Table 9: Local names of baobab and baobab plant parts in Serer villages

Plant part	Foua 1	M'Bassis	Mont Rolland
Baobab	Mbak	Mbak	Mbah
Fruit	Mbak	Mbak baak	Koy Mbah
Pulp	Mbak	Mbak baak (bidel)	Pirim Mbah
Husk	Mbarbargnakh	Okhob oxop	Kousswath Mbah
Seed	Khongue	Okhonge oxong	Onkongh Mbah
Flower	Poye	Olookaan	Bisbis Mbah
Leaf	Dande	Anaf	Mouley Mbah
Stem	Méme	Ofimb	Fane Mbah
Bark	Passe	Oxop	**Taha Mbah***
Wood	Diounde	Ojile	Gouyon Mbah
Root	Pathie	A Paye	Nil Mbah
Resin	Gone	Daakande	Loydit Mbah
(Semi-) Parasite	Tondate	Ndondane	Alimet Goumou
***Taha Mbah=the part of the bark, where the cordage is made of**			

Table 10: Local names of baobab and baobab plant parts in Peulh villages

Plant part	Ibel	Velingara
Baobab	Bohéhi (singular), Bohé (plural)	Bohi
Fruit	Bohéré	Bohéré
Pulp	Kolo Bohéré	**Pide Bohé***
Husk	Lala Gal Bohéré	Foro Wol Bohé
Seed	Kendaré Bohéré	**Bibere Bohé****
Flower	Pindi Bohé	Pindi Bohé
Leaf	Lalo/Thiondi Lalo	Hako Bohé
Stem	Dindé Bohé	Dindere Bohé
Bark	Thialdi Bohé	**Kobolal Bohé*****
Wood	Legal Bohé	Ial Bohé
Root	Dadi Bohé	Dadi Bohé
Resin	Thiabal Bohé	Moute Bohé
(Semi-) Parasite	Thiéké Bohé	Soto Bohé
***Pide means "child"**		
****Bibere means "many"**		
*****Kobolal Bohé= the part of the bark, where the cordage is made of**		

Table 11: Names of tamarind and tamarind plant parts, found in literature (Bergeret, 1986; Berhaut, 1975; Burkill, 1995; Diallo, 2001; Grovel, 1993; ICRAF, 2007; Kerharo, 1974; Merceron, 1997; N'Diaye et al., 2003)

English	French	Arabic	Wolof	Serer	Peulh
Tamarind	Tamarinier	Ardeib	Dakkar	Sob	Dabé
Indian tamarind	Tamarinde	Aradeib	Bêgal (the green fruit)		Diami
Indian date			Ndahar		N'Jabbi Yammere
Sour tumbler			Dahar		Ngatabbi
Madeira mahogany			Daharg		Dam
			Dakah		Djammi
			Dakhar		Dabbi
			Ndakhar		Dadmi
			Daxar		Dahnmi
			Dagaar		Dami
					Diabbhè
					N'jammi
					Jabbi

Table 12: Local names of tamarind and tamarind plant parts in Wolof villages

Plant part	Niakhoul	N'Dande	Sakal	Coki
Tamarind	Dahar	Dakhar	Dakhar	Dakhar
Fruit	Dahar	Dakhar	Dom Dakhar	Domou Dakhar
Pulp	Dom Dahar	Dakhar	Dakhar	Dakhar
Husk	Hote Dahar	Khote Dakhar	Khot Dakhar	Kholit Dakhar
Seed	Hoh/Khokh Dahar	Khokh Dakhar	Dom Dakhar	Khokhe Dakhar
Flower	Hage Dahar	Tortor Dakhar	Khob Dakhar	Tortor Dakhar
Leaf	Hobe Dahar	Khob Dakhar	Khob Dakhar	Khobi Dakhar
Stem	Bate Dahar	Pére Dakhar	Dath Dakhar	Dattu Dakhar
Bark	Bate Dahar	Ake	Khanthe Dakhar	Ak Dakhar
Wood	Mate Dahar	Mat Dakhar	Mathe Dakhar	Mate Dakhar
Root	Réne Dahar	Reine Dakhar	Reine Dakhar	Reine Dakhar
Resin	Ndiondio Dahar	/	Dakhade Dakhar	/
(Semi-) Parasite	Tombe Dahar	Tob Dakhar	Tob Dakhar	Tob Dakhar

Table 13: Local names of tamarind and tamarind plant parts in Serer villages

Plant part	Foua 1	M'Bassis	Mont Rolland
Tamarind	Somb	Somb	Karat
Fruit	Somb	Osoomb osoop	Koy Karat
Pulp	Somb	Osoomb osoop (bidel)	Koy Karat
Husk	Khomb	Okhob oxop	Kasit Karat/Khomb Karat
Seed	Khongue	Okhonge oxong	Koy Karat
Flower	Poye	Pid	Tiapus Karat
Leaf	Dande	Anaf	Saf Karat
Stem	Méme	Ofimb	Fane Karat
Bark	Passe	Oxop	/
Wood	Diounde	Ojile	Klic Karat
Root	Pathie	A Paye	Nil Karat
Resin	Gone	Daakande	Loydit Karat
(Semi-) Parasite	Tondate	Ndondane	Alimet Goumou/Karat

Table 14: Local names of tamarind and tamarind plant parts in Peulh villages

Plant part	Ibel	Velingara
Tamarind	Diabbéhi (singular), Diabbé (plural)	Diabbé
Fruit	Diabbéré	Diabbéré
Pulp	Kilseré Diabbé	Niri Diabbé
Husk	Goufi Diabbé	Foro Wol Diabbé
Seed	Kenseré Diabben Deng	*Bibere Diabbé
Flower	Pindi Diabbé	Pindi Diabbé
Leaf	Hako Diabbé	Hako Diabbé
Stem	Dindé Diabbé	Dindere Diabbé
Bark	Thiabal Diabbé	Kobolal Diabbé
Wood	Legal Diabbé	Ial Diabbé
Root	Dadi Diabbé	Dadi Diabbé
Resin	Bouthé Diabbé	Moute Diabbé
(Semi-) Parasite	Kobo Diabbé	Soto Diabbé
***Bibere means "many"**		

11. Summary

Baobab and tamarind are two tree species of arid and semi-arid regions in Africa. Both trees are used in a multifunctional way by local communities. Due to climatic changes, population growth and intensification of cultivation systems plant resources, such as the baobab and the tamarind suffer more and more from pressure. Overexploitation and unsustainable utilisation are the consequences. Regeneration problems of baobab and tamarind are already cited in literature. To fight these developments, new strategies of sustainable resource management have to be developed for protecting endangered species. For developing these strategies, research on traditional knowledge and management practices of local communities has to be done to understand people's way of thinking and creating with them adapted sustainable management strategies.

The baobab is a well known and researched tree species, which is often cited in literature. *Adansonia digitata*, the "upside down tree" of Africa, is widely spread in Western Africa. The baobab often appears together with humans and indicates former human settlements. All plant parts are commonly used by local communities. According to literature citations the fruit is used in nutrition in form of porridge and juice and in medicine, where it is primarily applied in case of diarrhoea. Seeds serve as substitute for groundnuts and are applied in medicine as febrifuge and in cases of teeth troubles. Leaves are processed to dried powder, which is known as *lalo* in all West African countries and added to couscous, a meal with millet. Leaves are furthermore used as fodder and often applied in medicine for asthma, kidney and bladder diseases, fatigue, fever, malaria and dysentery. The baobab bark is harvested to gain the fibres, which are processed to cordages and ropes. The bark has also a medicinal function as febrifuge and is used for tooth decay and anorexia. The spongy wood is hardly used, since it gives bad quality charcoal and is not useable for construction. Even the root is cited in literature to be used in cases of malaria and also serves as dye. The resin is used for cleaning wounds and calms teeth problems. Baobab products are common on local markets. Additionally, the baobab gains symbolic and cultural value in local communities, since it is part of numerous traditions, legends and beliefs. The tree serves as meeting point, shelters genies and spirits and is served in food preparations for special ceremonies, such as marriages and baptisms.

The baobab is rarely planted or cultivated, but often protected, as cited in literature. People seem to consider the baobab as a wild tree, which grows in the bush land. But once, a baobab has germinated, local people care for the baobab. Cultivation projects, however, have been initiated in Mali and have shown that cultivation techniques have been accepted by local communities.

According to literature, people do have their own folk classification systems concerning different varieties of baobab. These varieties are mainly defined through size, taste and colour of fruit and leaves and bark colour.

The tamarind is, similar to the baobab, well researched, not only in Africa, but also in Asia. *Tamarindus indica* is part of daily diets in local communities of Western Africa. Furthermore it is commonly used in local medicine. The at the same time acid and sweet pulp, is processed to juice or added to meals for improving the taste. Medicinally, the pulp is locally used for fever and as laxative. Flowers are used for liver infections. According to literature citations the seeds can be roasted or cooked and mixed under dishes. Leaves are used as a substitute in sauces or as tea. In addition, leaves are cited to be used for diarrhoea, malaria, coughs and other diseases. The tamarind wood is commonly used as firewood and for construction. The bark is applied in cases of coughs and wounds. Tamarind fruit and leaves can be found on every local market and have high cash value for local people. Finally, the

tamarind plays an important role in cultural life as a meeting point for local people. It is often part of medico-magical preparations and shelters genies and spirits.

Although protected, the tamarind is rarely planted or cultivated by local communities in Africa. Traditional management is limited to harvest. According to literature, possible constraints of cultivation could be the irregularity of fruit production and the slow growth rate of the tamarind.

The present study covers questions concerning forms of utilisations and processing, symbolic and cultural value, harvest management, propagation and cultivation systems and conservation management of local communities. In addition, differences and similarities between three ethnic groups (Peulh, Serer, Wolof) have been pointed out. The present ethnobotanical study can be seen as applied study, since it documents traditional knowledge on baobab and tamarind of local communities in Senegal. The gained data can be seen as base for further projects.

The research has been undertaken during the dry season in a period of four months. Three research areas in Senegal, defined by the three senegalasian phytogeographical regions (Soudanian, Guineo-Congolia/Soudanian and Sahelian zone) have been covered. The studied ethnic groups have been the three most dominant ethnic groups in Senegal: Peulh, Serer and Wolof. Nine villages have been investigated through 60 individual questionnaires, additional key informant interviews, group discussions, village introduction interviews and village mappings. The informants have been men and women of different ages. Additionally, participative and non-participative observations have been noted in a field diary. Pictures have completed and visualized the gained data. The data has been stored in a developed database in Microsoft Access and analyzed qualitatively and quantitatively through descriptive statistics.

The gained results have shown that both, the baobab and the tamarind are commonly used by local communities throughout whole Senegal. The main utilisation for both remains the food function, followed by medicine and other uses. Both trees are considered as important tree species for local communities.

The baobab is part of daily diets. The fruit is processed to juice or porridge (*bouillie*); the roasted seeds are used as substitute for groundnuts. The leaves are processed to a dried powder (*lalo*), which is added to couscous making it more slippery. *Lalo* and fresh leaves can also be added to sauces. The leaves are used as fodder. Both, the fruits and the leaves are daily consumed throughout the whole year by local communities. Additionally, the fruits and the leaves are found on every local market and play an important role for additional household income. The fibres of the baobab bark are used to fabricate cordages, although it seems that people tend to buy industrial ropes instead of the natural ones. The wood is rarely used, since it is said to be of bad quality, but gains nevertheless more and more importance as firewood. The husk is commonly mixed with tobacco by the Serer communities.

All baobab plant parts are used for medicinal or therapeutical treatments. Medicinally, the pulp is commonly used by the Serer and the Wolof to cure diarrhoea, stomach pains and diseases. Furthermore, the pulp, as well as the leaves, is applied for tiredness. The baobab leaves and the bark help against stomach pains. The root is often applied in traditional medicine. Teeth pains and cavities are cured by the baobab resin.

The baobab is often considered as sacred tree and is place of ceremonies in the Serer and the Wolof communities. It is inhabited by spirits and genies, which can influence harvest habits. The pulp is prepared as a special porridge and served to guests during baptisms and marriages.

Harvest of the baobab fruits and the leaves is not clearly associated with a gender, although there is a tendency towards women and boys. The bark harvest, however, remains a men's domain. Women are reported to stay on the ground, while men and boys climb up the tree to harvest. Climbing up the tree is considered as dangerous due to numerous accidents happening during harvest. People distinguish between trees for leaf and for fruit harvest. Storage however, is more considered as women's labour, since it is in her responsibility to nourish the family.

The present study has shown that there are no traditional propagation or cultivation systems of *Adansonia digitata* in the studied area. People, who plant baobab trees, do plant in small scale by planting single trees. Cultivation techniques include mainly sowing, planting, transplanting, watering, eliminating herbs. Selection does not appear. People do cultivate or plant baobabs for reasons of their own benefits. Reasons for not planting or cultivating baobab trees include that the cultivation is not part of their culture and that the baobab is considered as a wild tree growing in the bush land. Even if not planted or cultivated, the baobab is protected by the community and most of the habitants. Local people do mainly confirm the decreasing populations of baobab, although this observation does not influence the decision of protecting or not protecting a baobab tree.

Local people do not seem to identify different baobab types, but instead different characteristics such as the taste of the fruit and the quality of the leaves and the bark. These different characteristics stay isolated, meaning that they are not linked to each other (i.e. grey bark means sweet pulp). Every tree is different due to its individual characteristics.

Tamarindus indica is commonly used by local communities and is considered as important tree species. The main function remains for nutritional purpose followed by medicinal purpose. The pulp is used in form of juice, porridge (*bouillie*) and added to meals. The Serer and the Wolof prepare a special dish (*Thiebo Dienne*) consisting of fish and rice mixed with vegetables and tamarind. The leaves, the husk and the flowers are used as substitute in times when no pulp is available. The tamarind is consumed throughout the whole year. The wood is commonly used as firewood, for charcoal and as construction wood. The tamarind gains high additional value as cash crop on local markets.

Almost all plant parts of the tamarind are medicinally used. The pulp is commonly used in the Peulh and the Wolof communities as laxative and treats stomach pains and diseases. Furthermore, the pulp is used as febrifuge. Beside the pulp, also the leaves are used for stomach pains. The bark is applied by the Serer and the Wolof to treat fractures, wounds and injuries. The Peulh and the Serer use the bark for treating teeth pains. The root is commonly used in traditional medicine.

The tamarind is often connected with ceremonies in the Serer and the Wolof communities and is said to inhabit genies and spirits. Bad genies appear more often than good ones. In addition, the tamarind serves as communication and meeting point.

Harvest of the tamarind fruit is not really associated with any gender, while the leaves are more commonly harvested by women. The harvest is mostly done by children or adolescents. Storage is mostly done by women, since it is their responsibility to care for the family nutrition.

Traditional propagation or cultivation systems of the tamarind have not been found in the studied area. People, who plant tamarind trees, are planting in small scales by planting single trees. Cultivation techniques are limited to sowing, planting, transplanting, watering and eliminating herbs. Selection is not practiced. People, who do plant or cultivate tamarind trees, do it for their own profits. Reasons for not planting or cultivating tamarinds are that the cultivation of tamarind is not considered being part of their culture or tradition and that the

tamarind is seen as a wild tree growing in the bush land. Although not cultivated, the tamarind is protected by the community and the habitants.

Local people do not define different types of tamarind, but instead they differentiate between the characteristics of tamarind, such as the fruit taste and size. These characteristics are not linked to each other (i.e. large leaves meaning acid fruits). Following, every tree is individual due to its different characteristics.

The present study has shown that the baobab and the tamarind still remain multifunctional used trees by local communities and still play an important role in their daily life. The main function of the baobab and the tamarind is for nutritional purpose. In contrary to literature, the present study has investigated three ethnic groups and analyzed differences and similarities between them. The results have shown that while for the Peulh the main function is for nutritional purpose, the baobab and the tamarind have high cultural value for the Serer in form of ceremonies. The Wolof commonly use both trees in medicine.

In the case of the baobab, the present study has pointed out that some uses seem to disappear or diminuish (seeds as substitute, cordages), while others become more important (fodder, firewood). The increasing trend of the baobab and the tamarind as a cash crop can contribute to household income but at the same time can cause new conflicts and lead to overexploitations of both trees. Furthermore, the fact that people buy baobab and tamarind products more and more on local markets can lead to a loss of traditional management knowledge of local people. This loss of knowledge on traditions can already be seen by the trend of abandon certain beliefs and habits of ceremonies.

Traditional management is often limited to harvest. While the harvest is not clearly associated with gender, the storage remains mainly a women's work. Propagation and cultivation systems do not exist. But humans still have influence on the distribution of the baobab and the tamarind by sowing the seeds (by throwing them away after consumption) and by protecting or eliminating the trees. In contrary to literature, people in the present study do not seem to have own classified and defined types of the baobab and the tamarind, but differentiate different characters such as the taste and the size of the fruit and the quality of the leaves and the bark. These characteristics are not linked with other items or morphological attributes, but stay isolated. Following, this means that every tree remains individual; some are more preferred than others depending on their individual characteristics.

The study has shown that the baobab and the tamarind are still widely used in local communities. Since the tree resources are harvested unsustainably from wild trees and are not yet cultivated, there will be a need in future times to develop cultivation systems adapted to local communities and local conditions for fighting developments of resource pressure and overexploitation.

12. Zusammenfassung

Der Affenbrotbaum und die Tamarinde, zwei Arten der ariden und semi-ariden Regionen Afrikas, werden beide multifunktional von den lokalen Gemeinschaften genutzt. Aufgrund von Klimawandlungen, Bevölkerungswachstum und Intensivierung der Kultivierungssysteme, leiden vegetative Ressourcen, wie der Affenbrotbaum und die Tamarinde, vermehrt an Ressourcendruck. Die Konsequenzen sind Übernutzung und nicht nachhaltiger Gebrauch. Regenerationsprobleme von Affenbrotbaum und Tamarinde wurden bereits in der Literatur zitiert. Um diesen Entwicklungen entgegenzuwirken, müssen neue Strategien nachhaltigen Ressourcenmanagements entwickelt werden um zukünftig gefährdete Arten zu schützen. Um diese Strategien zu entwickeln, ist es notwendig Forschung von traditionellem Wissen und Management-Praktiken lokaler Gemeinschaften zu betreiben um die Art ihres Denkens zu verstehen und mit ihnen adaptierte nachhaltige Management-Strategien zu erarbeiten.

Der Affenbrotbaum ist eine bekannte und gut untersuchte Art, die häufig in der Literatur zitiert wird. *Adansonia digitata*, der „verkehrte Baum“ Afrikas, ist in West-Afrika weit verbreitet. Der Affenbrotbaum erscheint häufig zusammen mit dem Menschen und fungiert als Indikator für ehemalige menschliche Siedlungen. Alle Pflanzenteile werden von den lokalen Gemeinschaften genutzt. Nach Literaturzitaten wird die Frucht in der Ernährung in Form von Brei oder Saft verwendet, und, in der Medizin hauptsächlich im Fall von Diarrhöe angewendet. Die Samen dienen als Ersatzmittel von Erdnüssen und werden in der Medizin unter anderem als Fiebermittel oder im Falle von Zahnproblemen angewendet. Die Blätter werden zu trockenem Pulver verarbeitet, welches in west-afrikanischen Ländern unter dem Namen *lalo* bekannt ist. Die Blätter werden zu Couscous, einer Speise mit Hirse hinzugefügt. Weiters werden die Blätter als Futter genutzt und oft in der Medizin für Asthma, Nieren- und Blasenkrankheiten, Müdigkeit, Fieber, Malaria, Dysenterie und andere Krankheiten verwendet. Die Rinde des Affenbrotbaumes wird geerntet um die Fasern zu gewinnen und diese zu Seilen und Stricken zu verarbeiten. Die Rinde besitzt auch in der Medizin eine Funktion als Fiebermittel, und wird für Zahnfäulnis und Anorexie angewendet. Das spongy Holz wird kaum genutzt, da es qualitativ schlechte Holzkohle abgibt und nicht für Konstruktionen genutzt werden kann. Sogar die Wurzel wird in der Literatur zitiert in der Medizin für Malaria genutzt zu werden, sowie als Färbemittel. Das Harz wird verwendet um Wunden zu reinigen und Zahnprobleme zu mildern. Produkte des Affenbrotbaumes sind sehr gängig auf lokalen Märkten. Des Weiteren besitzt der Affenbrotbaum symbolischen und kulturellen Wert in lokalen Gemeinschaften, indem er Teil zahlreicher Traditionen, Legenden und Glauben ist. Der Baum dient als Treffpunkt, beherbergt Geister, und wird in Speisen für spezielle Zeremonien, wie Hochzeit und Taufe, serviert.

Der Affenbrotbaum wird kaum angepflanzt oder kultiviert, allerdings häufig geschützt, so in der Literatur zitiert. Lokale Gemeinschaften scheinen den Affenbrotbaum als „wilden“ Baum zu betrachten, der im Buschland wächst. Keimt ein Affenbrotbaum aber, kümmern sich die Menschen um diesen. Weiters haben Kultivierungsprogramme in Mali gezeigt, dass Kultivierungstechniken von den lokalen Gemeinschaften akzeptiert wurden. Nach der Literatur haben lokale Gemeinschaften ihre eigenen Volks-Klassifizierungssysteme um Typen des Affenbrotbaumes zu differenzieren. Diese Typen werden vorrangig durch Größe, Geschmack und Farbe der Frucht und der Blätter, sowie durch die Rindenfarbe definiert.

Die Tamarinde, wie der Affenbrotbaum, ist eine gut erforschte Art, nicht nur in Afrika, sondern auch in Asien. *Tamarindus indica* ist Teil des täglichen Speiseplans lokaler Gemeinschaften in West-Afrika. Weiters wird sie häufig in der lokalen Medizin genutzt. Das zugleich säuerliche und süßliche Fruchtfleisch wird zu Saft verarbeitet oder oft zu Speisen hinzugefügt um den Geschmack zu verbessern. Das Fruchtfleisch wird medizinisch lokal für Fieber und als Abführmittel verwendet. Die Blüten werden für Leberinfektionen angewendet.

Nach Literaturzitaten werden die Samen geröstet und unter Speisen gemischt. Die Blätter werden als Ersatzmittel in Saucen oder als Tee verwendet. Zusätzlich wird berichtet, dass die Blätter für Diarrhöe, Malaria, Husten und andere Krankheiten angewendet werden. Das Tamarindenholz wird gewöhnlich als Feuerholz und für Konstruktionen verwendet. Die Rinde wird in Fällen von Husten und Wunden angewendet. Tamarindenfrüchte und –blätter können auf jedem lokalen Markt gefunden werden und haben einen hohen Barwert für lokale Menschen. Schließlich spielt die Tamarinde als Treffpunkt für lokale Menschen eine wichtige Rolle im kulturellen Leben. Sie ist oftmals Teil von medizinisch-magischen Zubereitungen und beherbergt Geister.

Obwohl die Tamarinde geschützt wird, wird sie von lokalen Gemeinschaften in Afrika selten gepflanzt oder kultiviert. Traditionelles Management ist auf die Ernte reduziert. Nach Literaturangaben sind mögliche Hindernisse die Unregelmäßigkeit der Fruchtproduktion und die langsame Wachstumsrate der Tamarinde.

Die gegenwärtige Studie deckt Fragen bezüglich der Form der Nutzungen und Verarbeitungen, symbolischem und kulturellem Wert, Ernte-Management, Vermehrungs- und Kultivierungssysteme und Schutzmanagement von Affenbrotbaum und Tamarinde durch lokale Gemeinschaften ab. Zusätzlich werden Unterschiede und Gemeinsamkeiten der drei untersuchten Ethnien (Peulh, Serer, Wolof) hervorgehoben. Die gegenwärtige ethnobotanische Studie kann als angewandte Studie betrachtet werden, da dieses traditionelle Wissen lokaler Gemeinschaften bezüglich Affenbrotbaum und Tamarinde im Senegal dokumentiert. Die gewonnen Daten können als Basis für weitere Studien und Projekte gesehen werden.

Die Feldforschung wurde während der Trockenzeit innerhalb von vier Monaten durchgeführt. Es wurden drei Forschungsregionen in Senegal, definiert durch die drei senegalesischen phytogeographischen Regionen abgedeckt (Sudanische Zone, Guinea-Congolische/Sudanesische Zone und Sahelische Zone). Die studierten ethnischen Gruppen waren die drei dominantesten Gruppen Senegals: Peulh, Serer und Wolof. Neun Dörfer wurden besucht und durch 60 individuelle Interviews, zusätzliche Experteninterviews, Gruppendiskussionen, Einleitungsinterviews bezüglich der sozioökonomischen Daten des Dorfes und Dorfkartierungen untersucht. Die Informanten waren sowohl Männer, als auch Frauen unterschiedlichen Alters. Zusätzliche wurden partizipative und nicht-partizipative Beobachtungen in einem Feldtagebuch notiert. Die gewonnen Daten wurden durch Fotos veranschaulicht und vervollständigt. Die Daten wurden in einer in Microsoft Access entwickelten Datenbank gespeichert und qualitativ, sowie quantitativ durch deskriptive Statistiken analysiert.

Die Ergebnisse haben gezeigt, dass sowohl Affenbrotbaum, als auch Tamarinde häufig von lokalen Gemeinschaften in ganz Senegal nach wie vor genutzt werden. Der Hauptnutzen beider Arten ist nach wie vor für die Nahrung, gefolgt von Medizin und anderen Nutzen. Beide Arten werden als wichtige Arten für lokale Gemeinschaften betrachtet.

Der Affenbrotbaum ist Teil der täglichen Nahrung. Die Frucht wird zu Saft oder Brei (*bouillie*) verarbeitet; die gerösteten Samen werden als Ersatzmittel für Erdnüsse genutzt. Die Blätter werden zu einem trockenen Pulver (*lalo*) verarbeitet, das dann zu Couscous hinzugefügt wird um diesen „schleimiger“ zu machen. Weiters werden die Blätter als Futter genutzt. Früchte und Blätter werden täglich das ganze Jahr hindurch von lokalen Gemeinschaften konsumiert. Weiters sind Früchte und Blätter auf jedem lokalen Markt zu finden und spielen eine wichtige Rolle als zusätzliches Haushaltseinkommen. Die Fasern der Affenbrotbaumrinde werden verwendet um Seile zu fabrizieren, obwohl lokale Menschen immer mehr dazu zu neigen scheinen, anstatt der natürlichen, industriell angefertigte Seile zu kaufen. Das Holz wird selten genutzt, da es bekannt dafür ist von schlechter Qualität zu sein, gewinnt aber dennoch immer mehr an Wichtigkeit als Feuerholz aufgrund der generell

ansteigenden Knappheit an Feuerholz. Die Fruchtschale wird in Serer Gemeinschaften gewöhnlich mit Tabak gemischt.

Alle Pflanzenteile des Affenbrotbaumes werden medizinisch oder therapeutisch genutzt. Medizinisch wird das Fruchtfleisch oftmals in Serer und Wolof Gemeinschaften verwendet um Diarrhöe, Magenschmerzen und –krankheiten zu heilen. Weiters, wird das Fruchtfleisch, sowie auch die Blätter, für Müdigkeit angewendet. Affenbrotblätter und –rinde helfen gegen Magenschmerzen. Die Wurzel wird oft in der traditionellen Medizin angewendet. Zahnschmerzen und Karies werden mit Affenbrotbaumharz kuriert.

Der Affenbrotbaum wird häufig als heiliger Baum angesehen und ist Ort von Zeremonien in Serer und Wolof Gemeinschaften. Er wird von Geistern bewohnt, was Ernte-Gewohnheiten, zum Beispiel durch Verbote, beeinflussen kann. Das Fruchtfleisch wird ist Bestandteil eines speziellen Breis, der Gästen während Taufen und Hochzeiten serviert wird.

Die Ernte von Affenbrotbaumfrüchten und –blättern ist nicht deutlich mit einem Geschlecht definiert, obwohl die Ernte tendenziell mehr von Frauen und Jungen betrieben wird. Es wird berichtet, dass Frauen eher am Boden bleiben, während Männer und Jungen den Baum hinaufklettern um Früchte und Blätter zu ernten. Das Emporklettern wird aufgrund der zahlreichen Unfälle während der Ernte als gefährlich angesehen. Die Rindenernte ist nach wie vor eine klare Männerdomäne. Lokale Menschen unterscheiden zwischen Bäumen für Blätter- und anderen für Fruchternten. Die Aufbewahrung der Blätter und Früchte ist mehr als Frauendomäne definiert, da es in der Verantwortung der Frau liegt, die Familie zu ernähren.

Die gegenwärtige Studie hat gezeigt, dass keine traditionellen Vermehrungs- oder Kultivierungssysteme von *Adansonia digitata* existieren. Menschen, die Affenbrotbäume pflanzen, pflanzen diese in kleinem Maßstab, indem nur einzelne Bäume gepflanzt werden. Kultivierungstechniken bestehen hauptsächlich aus säen, pflanzen, umpflanzen, wässern und Unkraut entfernen. Selektion kommt nicht vor. Es scheint auch weiter, dass lokale Menschen auch keine unterschiedlichen Affenbrotbaum-typen identifizieren, stattdessen aber verschiedene Charaktereigenschaften, wie den Geschmack der Frucht und die Qualität der Blätter und der Rinde. Lokale Menschen kultivieren oder pflanzen Affenbrotbäume für ihren eigenen Nutzen. Gründe für lokale Menschen keinen Affenbrotbaum zu pflanzen oder kultivieren beinhalten unter anderem, dass die Kultivierung des Affenbrotbaumes nicht in der jeweiligen Kultur verankert ist und dass weiter der Affenbrotbaum als „wilder“ Baum angesehen wird, der in der Natur, im Buschland wächst. Selbst wenn der Affenbrotbaum nicht gepflanzt oder kultiviert wird, so wird er dennoch von der Gemeinschaft und von der Mehrheit der lokalen Menschen geschützt. Lokale Menschen bestätigen zur Mehrheit die zurückgehenden Populationen des Affenbrotbaumes. Diese Beobachtung ist allerdings kein Grund für die lokale Bevölkerung um den Affenbrotbaum zu schützen.

Tamarindus indica ist von lokalen Gemeinschaften häufig genutzt und wird von dieser als wichtige Art betrachtet. Die Hauptfunktion bleibt nach wie vor die Ernährung, gefolgt von der Medizin. Das Fruchtfleisch wird in Form von Saft und Brei (*bouillie*) verwendet und zu Speisen hinzugefügt. Die Serer und Wolof bereiten eine spezielle Mahlzeit (*Thiebo Dienne*) vor. Diese Speise besteht aus Fisch und Reis, gemischt mit Gemüse und Tamarindenfrucht. Blätter, Fruchtschale und Blüten werden als Ersatzmittel in Zeiten, wo kein Fruchtfleisch vorhanden ist, verwendet. Die Tamarindenfrucht wird das ganze Jahr hindurch konsumiert. Das Holz wird häufig als Feuerholz, für Holzkohle und als konstruktionsholz genutzt. Die Tamarinde gewinnt einen zusätzlichen hohen Stellenwert im Sinne von Barwert an lokalen Märkten.

Beinahe alle Pflanzenteile der Tamarinde werden medizinisch genutzt. Das Fruchtfleisch wird oftmals in Peulh und Wolof Gemeinschaften als Abführmittel genutzt und zur

Behandlung von Magenschmerzen und –krankheiten verwendet. Neben dem Fruchtfleisch werden auch die Blätter für Magenschmerzen angewendet. Weiters wird das Fruchtfleisch als Fiebermittel verwendet. Die Rinde wird in Serer und Wolof Gemeinschaften angewendet um Brüche, Wunden und Verletzungen zu behandeln. Die Peulh und Serer verwenden die Tamarindenrinde um Zahnschmerzen zu behandeln. Die Wurzel wird häufig in der traditionellen Medizin benutzt.

In Serer und Wolof Gemeinschaften wird die Tamarinde oft mit Zeremonien assoziiert und es wird berichtet, dass sie von Geistern bewohnt wird. Böse Geister erscheinen öfter als gute Geister. Zusätzlich dient die Tamarinde als Kommunikations- und Treffpunkt.

Die Ernte der Tamarindenfrucht wird nicht klar mit einem Geschlecht assoziiert, während die Blätter vorrangig von Frauen geerntet werden. Die Ernte wird hauptsächlich von Kindern oder Jugendlichen vollbracht. Die Aufbewahrung wird vorwiegend von den Frauen übernommen, da es in der Verantwortung der Frau liegt, die Familie zu ernähren.

In der gegenwärtigen Studie wurden keine traditionellen Vermehrungs- oder Kultivierungssysteme vorgefunden. Menschen, die Tamarindenbäume pflanzen, tun dies in kleinem Rahmen, indem nur einzelne Bäume gepflanzt werden. Kultivierungstechniken sind limitiert auf säen, pflanzen, umpflanzen, wässern und Unkraut entfernen. Selektion wird nicht praktiziert. Weiters differenzieren lokale Menschen nicht zwischen unterschiedlichen Tamarindentypen, unterscheiden stattdessen aber verschiedene Charaktereigenschaften, wie den Geschmack und die Größe der Frucht. Menschen, die Tamarinden pflanzen oder kultivieren, tun dies für ihren persönlichen Nutzen. Gründe, keine Tamarinden zu pflanzen oder kultivieren, beinhalten unter anderem die Tatsache, dass die Kultivierung der Tamarinde nicht Teil der jeweiligen Kultur ist und dass die Tamarinde als „wilder“ Baum angesehen wird, der in der Natur, im Buschland wächst. Obwohl die Tamarinde eben nicht kultiviert wird, so wird sie doch von der Gemeinschaft und den lokalen Menschen geschützt.

Die gegenwärtige Studie hat gezeigt, dass Affenbrotbaum und Tamarinde immer noch multifunktional von den lokalen Gemeinschaften genutzt werden und auch heute noch eine wichtige Rolle im täglichen Leben dieser Gemeinschaften spielen. Die Hauptfunktion von Affenbrotbaum und Tamarinde ist für den Ernährungszweck. Im Gegensatz zur Literatur, hat die gegenwärtige Studie drei unterschiedliche ethnische Gruppen untersucht und deren Unterschiede und Gemeinsamkeiten analysiert. Die Ergebnisse haben gezeigt, dass während für die Peulh die Hauptfunktion der Bäume in der Ernährung liegt, Affenbrotbaum und Tamarinde in Serer Gemeinschaften einen zusätzlichen hohen kulturellen Wert besitzen, der in Form von Zeremonien deutlich wird. Die Wolof wiederum nutzen beide Bäume in vielseitiger Weise in der Medizin. Im Fall des Affenbrotbaumes, hat die gegenwärtige Studie demonstriert, dass die Arten der Nutzungen sich verändern, während manche Nutzen zu verschwinden oder zumindest zu vermindern scheinen (Samen als Ersatzmittel für Erdnüsse, Seile aus den Fasern), werden andere immer wichtiger (Blätter als Futter, Feuerholz). Der ansteigende Trend von Affenbrotbaum und Tamarinde als Arten mit hohem Barwert kann durchaus zum Haushaltseinkommen beitragen, kann allerdings auch gleichzeitig neue Konflikte verursachen und zu Übernutzung der beiden Bäume führen. Weiters kann die Tatsache, dass Menschen Affenbrotbaum- und Tamarindenprodukte immer häufiger am lokalen Markt kaufen, kann zu einem Verlust des traditionellen Wissens über das Management der beiden Bäume führen. Dieser Verlust an Wissen bestimmter Traditionen zeichnet sich auch bereits in der Aufgabe gewisser Glauben und zeremonieller Gewohnheiten ab.

Traditionelles Management ist oftmals limitiert auf die Ernte. Während die Ernte nicht klar mit einem Geschlecht identifiziert wird, wird die Aufbewahrung vorwiegend als Frauendomäne angesehen. Vermehrungs- und Kultivierungssysteme sind in der gegenwärtigen Studie nicht vorgefunden worden. Der Mensch hat jedoch Einfluss auf die

Verteilung und Ausbreitung von Affenbrotbaum und Tamarinde, indem er die Samen sät oder sie einfach nach der Konsumation des Fruchtfleisches wegwirft, beziehungsweise zeigt sich der Einfluss auch durch die Entscheidung einen Baum zu schützen oder zu eliminieren. Im Gegensatz zur Literatur, schienen die lokalen Menschen in der gegenwärtigen Studie keine eigenen Klassifizierungssysteme oder definierte Affenbrotbaum- oder Tamarindentypen zu haben. Stattdessen unterschieden sie zwischen unterschiedlichen Charaktereigenschaften, wie zum Beispiel den Geschmack und die Größe der Frucht und die Qualität der Blätter und der Rinde. Diese einzelnen Charaktereigenschaften werden nicht mit anderen Eigenschaften oder morphologischen Attributen verbunden und stehen somit unabhängig und isoliert voneinander. Folglich bedeutet dies, dass jeder Baum individuell ist; manche werden mehr als andere bevorzugt, abhängig von deren individuellen Charaktereigenschaften.

Die Studie hat gezeigt, dass Affenbrotbaum und Tamarinde nach wie vor von den lokalen Gemeinschaften weitreichend genutzt werden. Da diese Ressourcen unnachhaltig und wild von den Individuen in der Natur geerntet werden und weiters auch nicht kultiviert werden, wird es in Zukunft einen hohen Bedarf geben, Kultivierungssysteme zu entwickeln. Diese Kultivierungssysteme müssen an die lokalen Gemeinschaften und Gegebenheiten adaptiert werden um eine Akzeptanz zu garantieren. Dies soll dazu beitragen, dem Ressourcendruck und der Übernutzung entgegenzusteuern.

13. Resumée

Le baobab et le tamarinier sont deux espèces des régions arides et semi-arides d'Afrique. Ces deux arbres sont utilisés par des populations locales de manière multifonctionnelle. Du fait des changements climatiques, de l'expansion démographique et de l'intensification des systèmes de culture les ressources végétales, comme le baobab et le tamarinier, subissent de plus en plus de pressions et souffrent de surexploitation et d'une utilisation non durable. Les problèmes de régénération du baobab et du tamarinier étaient déjà cités dans la littérature. Pour combattre ces tendances il faut développer de nouvelles stratégies de gestion durable des ressources afin de protéger les espèces menacées. Le développement de ces stratégies nécessite d'abord une recherche du savoir traditionnel et des pratiques de gestion communautaire pour comprendre la manière de penser et d'agir des populations locales et finalement créer avec eux des stratégies de gestion durable et adaptée.

Le baobab est une espèce bien connue et étudiée, qui est souvent cité dans la littérature. *Adansonia digitata*, l'« arbre tête-bêche » d'Afrique, est largement distribué en Afrique de l'Ouest. Le baobab apparaît souvent avec l'homme et indique des habitations humaines abandonnées. Toutes les parties de la plante sont utilisées par les communautés locales. Selon des citations bibliographiques, le fruit est utilisé dans la nourriture sous forme de bouille et jus, et dans la médecine, dans le traitement de la diarrhée. Les graines servent comme produit de substitution en remplacement des arachides. Elles sont appliquées en médecine en outre comme fébrifuge et en cas de problèmes dentaires. Les feuilles sont réduites en poudre sèche, connue sous le terme de *lalo* dans tous les pays d'Afrique de l'Ouest. La poudre est mélangée avec du couscous- un repas avec de la semoule de mil. En plus les feuilles sont utilisées comme fourrage et souvent appliquées dans la médecine pour traiter l'asthme, les maladies rénales et de la vessie, la fatigue, la fièvre, le paludisme, la dysenterie etc. L'écorce du baobab est récoltée pour obtenir des fibres, qui sont travaillées en cordes. L'écorce a aussi une fonction médicinale comme fébrifuge, et est appliquée pour soigner les caries et l'anorexie. Le bois spongieux est rarement utilisé, car il donne un charbon de mauvaise qualité et n'est pas utilisable en construction. Même la racine est citée dans la littérature, et est utilisée en cas de paludisme où peut servir de colorant. La gomme est appliquée pour nettoyer les plaies et calmer les douleurs dentaires. Les produits issus du baobab sont bien connus sur les marchés locaux. En plus, le baobab a une valeur symbolique et culturelle dans les communautés locales. Il fait partie des traditions nombreuses, des légendes et des croyances. L'arbre sert comme endroit de réunion, héberge des génies et des esprits et est en plus utilisé dans des préparations culinaires pour certaines cérémonies, comme le mariage et le baptême.

D'après la littérature, le baobab est rarement planté ou cultivé, mais souvent protégé. Les populations locales semblent de considérer le baobab comme un arbre sauvage, qui pousse dans la brousse et donc n'est pas cultivable. Mais une fois germé, les populations locales s'occupent de l'arbre. Des projets de culture initiés au Mali ont montré que des techniques de cultures étaient acceptées par les communautés locales.

Selon la littérature, les populations locales ont leurs propres systèmes de classification concernant les différentes variétés de baobab. Ces variétés sont définies par leur taille, leur goût, la couleur du fruit et des feuilles et par la couleur de l'écorce.

Le tamarinier est, comme le baobab, bien étudié, pas seulement en Afrique, mais aussi en Asie. *Tamarindus indica* fait partie de la nourriture quotidienne dans les communautés locales en Afrique de l'Ouest. La pulpe, à la fois acide et sucrée, est transformée en jus et souvent ajoutée aux repas. En plus il est utilisé dans la médecine locale pour traiter les fièvres et comme laxatif. Les fleurs sont utilisées en cas d'infections du foie. Selon des

citations, les graines peuvent être grillées ou bouillies et mélangées avec les repas. Les feuilles sont utilisées dans les sauces ou en tisane. En plus, les feuilles peuvent traiter la diarrhée, le paludisme, la toux etc. Le bois du tamarinier est utilisé couramment comme bois de chauffage et en construction. L'écorce est appliquée en cas de toux, de plaie etc. Le fruit et les feuilles de tamarinier sont trouvés sur chaque marché local et ont une haute valeur pécuniaire. Finalement le tamarinier joue un rôle important dans la vie culturelle locale. Il sert de lieu de réunion et fait souvent partie des préparations médicinale et magique et héberge des génies et des esprits.

Bien qu'il soit protégé, le tamarinier est rarement planté ou cultivé par des communautés locales en Afrique. La gestion traditionnelle est limitée à la récolte. Selon la littérature, les contraintes de culture pourraient être l'irrégularité de production des fruits et le faible taux de croissance du tamarinier.

L'étude présente traite des questions des formes d'utilisation de ces espèces végétales, de leurs valeurs symboliques et culturelles, de la gestion des récoltes, des systèmes de plantation et de culture, et de la protection par les communautés locales. De plus, les différences et les similarités entre les trois groupes ethniques (Peulh, Sérer, Wolof) sont identifiées. Cette étude ethnobotanique peut être considérée comme une étude appliquée qui documente le savoir traditionnel sur le baobab et le tamarinier des communautés locales au Sénégal. Les données récoltées constituent base pour des études à venir.

Le travail de recherche a été mis en place pendant la saison sèche pour une durée de quatre mois. Trois territoires ont été étudiés au Sénégal. Chacun correspond à une région phytogéographique du pays (la zone soudanienne, la zone guinéo-congolaise/soudanienne et la zone sahélienne). Les groupes ethniques étudiés sont les trois groupes dominants au Sénégal : Peulh, Serer et Wolof. Au sein de neuf villages, soixante personnes ont été interrogés à l'aide de questionnaires individuels. Par ailleurs, des enquêtes additionnelles ont été réalisées auprès des informateurs clés, des discussions de groupe et des enquêtes d'introduction par village ont été organisées, et les villages ont été cartographiés. Les personnes interviewées étaient des hommes et des femmes d'âge différent. En plus, des observations participatives et non participatives étaient recensées dans un carnet. Des photographies ont été prises afin de complémenter et de visualiser les données récoltées. Les informations ont été sauvegardées au sein d'une banque de données développée sur Microsoft Access et analysées quantitativement à l'aide des statistiques descriptives et qualitativement par description.

Les résultats obtenus ont montré que les deux espèces, le baobab et le tamarinier, sont toujours bien utilisés par les communautés locales au Sénégal. La fonction principale reste l'alimentation, suivie par la médecine et par d'autres utilisations. Ces deux arbres sont considérés comme des espèces importantes pour les communautés locales.

Le baobab fait partie de la nourriture quotidienne. Les fruits sont transformés en jus ou en bouillie. Les graines grillées sont utilisées comme produit de substitution en remplacement de l'arachide. Les feuilles sont réduites en poudre sèche (*lalo*), qui est mélangée avec du couscous rendu gluant*. Lalo* et feuilles fraîches peuvent aussi être ajoutés aux sauces. Les feuilles sont utilisées comme fourrage. Dans les communautés locales, ces deux sous-produits, fruits et feuilles sont consumés chaque jour pendant toute l'année. En plus, ils se trouvent sur chaque marché local et constituent un revenu supplémentaire pour les ménages. Les fibres de l'écorce du baobab sont utilisées pour fabriquer des cordes, même si les populations locales semblent aujourd'hui avoir une tendance à préférer des cordes industrielles à place. Le bois est rarement utilisé, il est considéré de mauvaise qualité, mais gagne de plus en plus d'importance comme bois de chauffage. Les Serer mélangent souvent la capsule du baobab avec du tabac.

Au Sénégal, toutes les parties du baobab sont utilisées pour des traitements médicinaux ou thérapeutiques. La pulpe est souvent utilisée par les Serer et les Wolof pour guérir de la diarrhée, les douleurs et maladies de l'estomac. En plus, la pulpe, comme les feuilles, sont appliquées contre la fatigue. Feuilles et écorce du baobab aident contre les douleurs d'estomac. La racine est souvent utilisée dans la médecine traditionnelle. Douleurs dentaires et caries sont guéries grâce à la gomme du baobab.

Le baobab est souvent considéré comme un arbre sacré et sert lieu de cérémonies dans les communautés Serer et Wolof. Il est habité par des esprits et génies, qui peuvent influencer les habitudes de récolte par interdictions et autres mesures. La pulpe est préparée en bouillie particulière et servie aux hôtes à l'occasion de mariages et baptêmes.

La récolte du fruit et des feuilles du baobab n'est pas clairement associée à un sexe, mais elle a tendance à être réalisée par des femmes et des garçons. Les femmes restent à terre pendant que les hommes et les garçons grimpent à l'arbre pour la récolte. Cette opération est dangereuse et il se produit de nombreux accidents pendant la récolte. La récolte de l'écorce est considérée comme un domaine réservé aux hommes. Les gens distinguent des arbres pour la récolte des feuilles et d'autres arbres pour la récolte des fruits. Le stockage est associé à la femme, car il est de sa responsabilité de nourrir sa famille.

L'étude présente a montré qu'il n'y a pas de systèmes traditionnels de multiplication ou de culture *d'Adansonia digitata*. Les personnes qui plantent des baobabs, le font à petite échelle en plantant des arbres uniques. Les opérations de culture incluent principalement le semis, la plantation, la transplantation, l'arrosage et l'élimination des herbes. Il n'y a aucune sélection active. Les populations locales n'ont même pas l'air d'identifier différents types de baobab. En revanche, elles différencient des caractéristiques diverses comme le goût du fruit et la qualité des feuilles et de l'écorce. Les baobabs sont cultivés ou plantés pour les propres bénéfices du planteur. Une des raisons qui explique que baobab n'est ni planté, ni cultivé, est qu'il s'agit d'activités qui ne font pas partie de la culture des populations, qui le considèrent comme un arbre sauvage, qui pousse dans la brousse. Bien que non planté et non cultivé, le baobab est protégé par la communauté et par la plupart des habitants. La majorité des populations locales confirment la décroissance des populations de baobab, mais cette observation n'a aucune influence sur la gestion de sa conservation.

Tamarindus indica est souvent utilisé par les communautés locales et considéré comme une espèce importante. Sa fonction principale est l'alimentation, suivie par la médecine. La pulpe est utilisée sous forme de jus ou de bouillie et incorporée dans les repas. Les Serer et les Wolof préparent un repas particulier (*Thiebo Dienne*), composé de poisson et de riz mélangé avec des légumes et de la pulpe de tamarinier. Les feuilles, capsules et fleurs sont utilisées comme produits de substitution en absence de pulpe. Les produits issus du tamarinier se consomment toute l'année. Le bois est souvent utilisé comme bois de cuisson, pour la fabrication de charbon et comme bois de construction. Le tamarinier est une culture à haute valeur ajoutée et possède une valeur monétaire importante sur les marchés locaux.

Quasiment toutes les parties du tamarinier sont utilisées dans la médecine. La pulpe est souvent utilisée dans les communautés des Peulh et Wolof comme laxative. Elle traite des douleurs et maladies de l'estomac. Hormis la pulpe, les feuilles aussi présentent le même usage. De plus, la pulpe est utilisée comme fébrifuge. L'écorce est appliquée par les Serer et Wolof pour traiter des fractures, plaies et blessures. Peulh et Serer utilisent l'écorce pour traiter les douleurs dentaires. La racine est souvent utilisée en médecine traditionnelle.

Dans les communautés Serer et Wolof, le tamarinier est souvent associé aux cérémonies. Il héberge des génies et des esprits. Des génies mauvais apparaissent plus souvent que les bons. En plus, le tamarinier sert comme lieu de communication et de réunion.

La récolte du fruit du tamarinier n'est pas associée avec un sexe, alors que les feuilles du tamarinier sont plus souvent récoltées par les femmes. La récolte est principalement pratiquée par les enfants et adolescents. Le stockage est normalement fait par la femme, car il est de sa responsabilité de nourrir la famille.

Dans l'étude présente il n'y avait pas de systèmes existants de multiplication ni de culture du tamarinier. Les personnes qui plantent des tamariniers, le font à petite échelle en plantant des arbres uniques. Les techniques de culture de limitent au semis, à la plantation, la transplantation, l'arrosage et à l'élimination des herbes. La sélection active n'est pas pratiquée. Les populations locales n'identifient pas de types de tamarinier, mais font des différences entre des caractéristiques diverses, comme le goût et la taille du fruit. Le tamarinier est planté pour les propres bénéfices des planteurs. Une des raisons qui explique que tamarinier n'est ni planté, ni cultivé, est qu'il s'agit d'activités qui ne font pas partie de la culture des populations, qui le considèrent comme un arbre sauvage, qui pousse dans la brousse. Bien que non planté et non cultivé, le baobab est protégé par la communauté et par la plupart des habitants.

L'étude présente a montré que le baobab et le tamarinier aujourd'hui sont toujours utilisés d'une façon multifonctionnelle par des communautés locales et jouent toujours un rôle important dans leurs vies quotidiennes. La fonction principale du baobab et tamarinier est la nourriture. Encore peu présent dans la littérature, cette étude est une recherche sur trois groupes ethniques et analyse leurs différences et similarités. Les résultats ont montré que pour les Peulh la fonction principale des arbres est la nourriture, alors que pour les Serer le baobab et le tamarinier ont une haute valeur culturelle au cours de leurs cérémonies. Quant aux Wolof, ils utilisent souvent les deux arbres dans la médecine.

L'étude présente a démontré que les formes d'utilisation du baobab ont l'air de changer. Pendant que quelques utilisations disparraissent (graines comme produit de substitution, cordes), d'autres deviennent plus importantes (fourrage, bois de feu).

La valeur ajoutée monétaire croissante du baobab et du tamarinier peut contribuer au revenu des ménages, mais en même temps cette tendance peut aussi introduire des nouveaux conflits et mener à une surexploitation de ces deux arbres. De plus, le fait que les populations locales achètent de plus en plus des produits du baobab et du tamarinier sur le marché local peut conduire à une perte du savoir traditionnel en matière de gestion. Déjà l'abandon observé de quelques croyances et habitudes de cérémonies peut indiquer cette tendance.

La gestion traditionnelle est souvent limitée à la récolte. Alors que la récolte n'est pas associée clairement à un sexe, le stockage est un domaine réservé aux femmes. Il n'y a pas de systèmes de multiplication ni de culture, mais l'homme a toujours une influence sur la distribution du baobab et du tamarinier en jetant des graines après la consommation des fruits et en protégeant ou en éliminant des arbres.

Contrairement à ce que l'on peut lire dans certains ouvrages, cette étude montre que les populations locales n'ont pas l'air d'avoir des systèmes de classification des types de baobab ou de tamarinier. Ils font bien des différences entre des caractéristiques diverses comme le goût et la taille du fruit ou encore la qualité des feuilles et de l'écorce. Ces caractéristiques ne sont pas corrélés à d'autres éléments ou propriétés morphologiques, mais sont observées et identifiées isolément. Cela veut dire que chaque arbre est un arbre individuel avec ces propres caractéristiques ; quelques-uns sont préférés à d'autres, tout dépend de leurs caractéristiques individuelles.

L'étude a montré que le baobab et le tamarinier sont toujours largement utilisés dans les communautés locales. Du fait que le baobab et le tamarinier sont récoltés de manière non durable sur des arbres sauvages et ne sont pas encore cultivés, il sera nécessaire de

développer des systèmes de culture adaptés aux communautés locales et à la diversité des milieux. Cette stratégie doit servir à combattre la pression croissante sur ces ressources et de la surexploitation.

14. Abstract

The use and management of Baobab (Adansonia digitata) and Tamarind (Tamarindus indica) by three ethnic groups (Peulh, Serer, Wolof) in Senegal - An ethnobotanical study.

Baobab and tamarind are two multifunctional used trees in Western Africa and play an important role in daily life of local communities. Both wild trees suffer from regeneration problems due to overexploitation and unsustainable harvesting methods. This study has researched the intensity and forms of traditional utilisations of baobab and tamarind by local communities. In addition, local knowledge on management strategies (harvest, propagation, cultivation, conservation) was documented throughout the study. An ethnobotanical study was undertaken in three areas of Senegal, by investigating three different ethnic groups with a sample of 60 individual interviews. Used methods (questionnaires, group discussions, village mapping etc.) were analyzed quantitatively through descriptive statistics and qualitatively through descriptive analyses.

The results have shown that baobab and tamarind are still a part in the daily life of local communities in the sense of alimentation, medicine, symbolic and cultural values, domestic purpose and commerce. Baobab is mainly used for porridge, sauces, juice, in couscous meals and for cordage. Adansonia spp. is applied against diarrhoea, stomach pains and diseases as well as tiredness. Tamarind is added to sauces, porridge and juice, serves as fire and construction wood and is applied against constipation, wounds, injuries and fractures. Both trees are connected with ceremonies and spirits.

68% of local people (n=60) protect and care for baobab and tamarind trees, but traditional propagation or cultivation systems have not been found. In the case of baobab, 15% of all respondents (n=60) do plant single baobab trees and 17% of informants (n=60) cultivate baobab trees. 18% of informants (n=60) plant single tamarind trees and 18% of respondents (n=60) do cultivate tamarind. Main cultivation techniques are planting, sowing, transplanting and watering. Due to the importance of baobab and tamarind and the risk of resource shortage of these trees, there is a high potential for prospective developed propagation and cultivation systems adable to local communities.

Key words: baobab, tamarind, traditional knowledge, ethnobotany, Senegal

15. Kurzzusammenfassung

Verwendung und Management von Affenbrotbaum (Adansonia digitata) und Tamarinde (Tamarindus indica) durch drei ethnische Gruppen (Peulh, Serer, Wolof) in Senegal – Eine ethnobotanische Studie.

Affenbrotbaum und Tamarinde sind zwei multifunktionell genutzte Bäume in Westafrika und spielen eine wichtige Rolle im täglichen Leben von lokalen Bevölkerungen. Aufgrund von Übernutzung und nicht nachhaltiger Erntemethoden an wild wachsenden Bäumen, leiden beide Bäume an Verjüngerungsproblemen. Diese Studie hat die Intensität und Formen von lokalen und traditionellen Nutzungen lokaler Bevölkerungen von Affenbrotbaum und Tamarinde untersucht. Weiters wurde durch die Studie lokales Wissen über Management-Strategien (Erntemethoden, Vermehrung, Kultivierung, Konservierung) dokumentiert. Eine ethnobotanische Studie wurde in drei Regionen Senegals durchgeführt, indem drei verschiedene Ethnien untersucht wurden. Durchgeführte Methoden (Interviews, Gruppendiskussionen, Dorfkartierungen…) wurden quantitativ durch deskriptive Statistiken und qualitativ analysiert.

Die Ergebnisse haben gezeigt, dass Affenbrotbaum und Tamarinde nach wie vor am täglichen Leben lokaler Bevölkerungen, im Sinne von Ernährung, Medizin, symbolischen und kulturellen Wert, häuslichen Funktionen und Kommerz, teilhaben. Der Affenbrotbaum wird vorwiegend für Brei, Saucen, Saft, Couscous-Speisen und Seilfabrikation verwendet. *Adansonia digitata* wird für Diarrhöe, Magenschmerzen und –krankheiten, sowie für Müdigkeit angewendet. Die Tamarinde wird für Saucen, Brei und Saft verwendet und dient als Feuer- und Konstruktionsholz. *Tamarindus indica* wird für Verstopfung, Wunden, Verletzungen und Brüchen angewendet. Beide Bäume werden mit Zeremonien und Geistern in Verbindung gebracht.

68% der befragten Personen (n=60) schützen und kümmern sich um Affenbrotbäume und Tamarinden, traditionelle Vermehrungs- und Kultivierungssysteme wurden aber nicht vorgefunden. Im Falle des Affenbrotbaumes, pflanzen 15% aller befragten Personen (n=60) einzelne Affenbrotbäume und 17% aller Befragten (n=60) kultivieren diesen. 18% aller befragten Personen (n=60) pflanzen einzelne Tamarinden und wiederum 18% (n=60) kultivieren diese auch. Hauptkultivierungstechniken beinhalten pflanzen, säen, umpflanzen und wässern.

Aufgrund der Wichtigkeit von Affenbrotbaum und Tamarinde und dem Risiko an Ressourcenknappheit dieser Bäume, besteht ein hohes Potential für die Entwicklung an die lokale Bevölkerung adaptierte Vermehrungs- und Kultivierungssysteme.

Schlagwörter: Affenbrotbaum, Tamarinde, traditionelles Wissen, Ethnobotanik, Senegal

16. Abstract (French version)

L'utilisation et la gestion du baobab (Adansonia digitata) et du tamarinier (Tamarindus indica) par trois groupes ethniques (Peulh, Serer, Wolof) au Sénégal – une étude ethnobotanique.

Le baobab et le tamarinier sont deux arbres utilisés de manière multifonctionnelle en Afrique de l'Ouest. Ils jouent un rôle important dans la vie quotidienne des communautés locales. Ces deux arbres souffrent de problèmes de régénération à cause de la surexploitation et des méthodes de récolte non-durables. Ce travail étudie l'intensité et les formes d'utilisation traditionnelles du baobab et du tamarinier par des communautés locales. De plus, il fournit des informations sur le savoir local concernant les stratégies de la gestion (récolte, multiplication, culture, conservation). Une recherche ethnobotanique a été mise en place dans trois territoires du Sénégal avec trois groupes ethniques et sur un échantillon de 60 enquêtes individuelles. Des méthodes appliquées (enquêtes, discussions en groupe, cartographie de villages etc.) ont été utilisées et les résultats ont été analysés quantitativement par des statistiques descriptives et qualitativement par descriptions.

Les résultats ont montré que le baobab et le tamarinier font toujours partie de la vie quotidienne des communautés locales, en tant que nourriture, dans la médecine, comme valeur symbolique et culturelle, en utilisation domestique et commerciale. Le baobab est principalement utilisé en bouillie, dans les sauces, en jus, dans les repas à base de couscous et pour la fabrication des cordes. Dans la médecine, *Adansonia spp.* est appliqué contre la diarrhée, les douleurs et maladies de l'estomac et la fatigue. Le tamarinier est ajouté aux sauces, sous forme de bouillie et jus, il sert comme combustible et pour la construction. Il est appliqué en cas de constipation, plaies, blessures et fractures. Ces deux arbres sont associés aux cérémonies et aux esprits.

Même si 68% des personnes interrogées (n=60) protègent et s'occupent du baobab et du tamarinier, aucun système de multiplication et culture n'ont été observés. 15% des enquêtés (n=60) plantent des baobabs de manière isolée et 17% (n=60) le cultivent. 18% des personnes interrogées (n=60) plantent des tamariniers isolés alors que 18% (n=60) cultivent le tamarinier. Les techniques principales de culture sont la plantation, le semis, la transplantation et l'arrosage.

Grâce à l'importance du baobab et du tamarinier et à cause du risque de raréfaction de ces arbres, il existe un fort potentiel de développement des systèmes de multiplication et de culture adaptés aux communautés locales.

Mots de clés : baobab, tamarinier, savoir traditionnel, ethnobotanique, Sénégal