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GENDERED MOTIVATION FOR HOME GARDENING AND MAINTENANCE OF AGROBIODIVERSITY: A CASE STUDY IN BENIN, WEST AFRICA

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RÉSUMÉ

Le jardinage de case (home gardening) est une pratique agricole commune à toutes les régions au Bénin. Il consiste à mettre en culture ou à maintenir des espèces d'intérêts sur de petites superficies autour des habitations. Bien que les bénéfices fournis soient largement reconnus, la motivation des propriétaires de jardin de case reste encore mal connue. Cette étude vise à investiguer la motivation des propriétaires de jardin de case notamment sous l'angle du genre et à évaluer son impact sur la capacité des jardins de case à maintenir l'agro-biodiversité. 360 ménages pratiquant le jardinage de case ont collaboré dans le cadre de l'étude notamment à travers des interviews et des inventaires floristiques dans les jardins de case. Des méthodes d'analyses complémentaires ont permis de catégoriser les jardins de case suivant les motivations de leur propriétaire, d'appréhender les différences entre genre et d'établir le lien entre la richesse spécifique et la motivation des propriétaires de jardins de case. Les résultats ont révélé que la production alimentaire et celle des plantes médicinales sont les principales motivations des propriétaires de jardins au Bénin. L'intérêt alimentaire est généralement porté par les femmes tandis que les hommes sont beaucoup plus motivés par la production de plantes médicinales. Les jardins sans motivation précise et ceux motivés par un intérêt médicinal, ou à la fois médicinale et alimentaire maintiennent une plus grande diversité d'espèces. Cette étude suggère que la motivation est un facteur important du maintien de l'agro-biodiversité dans les jardins de case.

Mots clés : Jardin de case ; Motivation ; Agro-biodiversité ; Conservation; Bénin

ABSTRACT

Home gardening is a commonly encountered agricultural practice in Benin, consisting of cultivating or maintaining desired plant around homesteads. While the multiple ecosystem services they provided to population is widely acknowledged, motivation for home gardening is still poorly understood in Benin. This study aims at elucidating the daunting question of motivation for home gardening in Benin focusing on gender and how this motivation affects the capacity of home gardens to maintain agro-biodiversity. 360 households with home gardens participated to the study through interview and garden inventories. Clustering analysis, correlation and regressions were used to distinguish and discriminate home gardens with regard to their driven motivation, explore the discrepancies across gender and assess the relationship between plant species diversity and motivation of gardeners. Findings showed that food and medicinal

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plant production were the main motivations of home gardens in Benin. Food production was the main motivation of women while men were mostly motivated for medicinal plant production. Home gardeners mostly men were also found to have multiple motivations for gardening. Home gardens with medicinal, both medicinal and food and with multiple motivations were found to have higher plant species richness. This study suggests that the motivation of home gardeners is a key driver of the maintenance of agro-biodiversity in home gardens.

Keywords : Home gardens ; Motivation ; Agro-biodiversity ; Conservation, Benin

INTRODUCTION

Home gardens (HGs) are traditional farming systems, presumably the oldest land use system (Pushpakumara *et al.*, 2012) in the world. These cultivation systems are generally adjacent to homestead or slightly further away but easily accessible (Sunwar *et al.*, 2006). They are found worldwide, in both tropical and temperate regions, rural and urban regions, low land and high land altitude, in poor and rich countries. The benefits of home gardens have been widely acknowledged in many domains including for food and nutritional security (Buchmann, 2009; Cabalda *et al.*, 2011; Thompson & Amoroso, 2014), economic hardship, poverty alleviation (Schupp & Sharp, 2012; Smith *et al.*, 2013), ecosystem services provision (Calvet-Mir *et al.*, 2012; Calvet-Mir *et al.*, 2016; Taylor *et al.*, 2016), carbon sequestration (Dey *et al.*, 2014; Mattsson *et al.*, 2015; Kim *et al.*, 2016), socio-cultural preservation (Mazumdar & Mazumdar, 2012; Gray *et al.*, 2013) and in empowerment and social position of women (Oakley, 2004; Howard, 2006; Gray *et al.*, 2013). As unexpected advantage, home gardens were also found to be valuable conservation systems out of protected areas by maintaining important agro-biodiversity (Galluzzi *et al.*, 2010; Calvet-Mir *et al.*, 2012; Amberber *et al.*, 2014; Salako *et al.*, 2014; Heraty & Ellstrand, 2016; Junqueira *et al.*, 2016).

Based on these benefits, their widespread distribution and their role in socio-ecological resilience of household systems (Barthel & Isendahl, 2013; Jones, 2014; Reyes-García *et al.*, 2014), home gardens could represent an affordable food production system with both socio-economic and ecological outcomes. Unfortunately, the ecosystems of home gardens have been poorly investigated in Africa and especially in Benin. Important aspects including the motivation for home gardening still blurred and prevent from deriving scientific principles for sustainable valorization of home gardens.

In Benin, home gardening is encountered in both rural and urban regions and contributes to household food systems (Gerard Grubben & Corrado, 2014;

Perrin *et al.*, 2015) and traditional home care (Quiroz *et al.*, 2014) among other functions. They are practiced by both men and women regardless of their age and socio-economic conditions (Gbedomon *et al.*, 2015).

However the motivation for home gardening is still questionable, and important questions need to be elucidated. For instance, home gardening is practiced in the different agro-ecological zones in Benin (Gbedomon *et al.*, 2015) and provides different services (Idohou *et al.*, 2014; Salako *et al.*, 2014) ; however what is the main motivation for home gardening ? As Women are known to be mostly involved in home gardening (Gbedomon *et al.*, 2015), is there a discrepancy in motivation with regards to gender ? In addition, the choice of species cultivated and maintained in home gardens is under the control of home garden owner and users. Therefore how motivation affects the capacity of home gardens for maintaining agro-biodiversity in home gardens? This paper aims at investigating the motivation for home gardening in Benin. It examines the motivation of gardeners regarding their gender and discusses the effect of the motivation on the capacity of home gardens for agro-biodiversity conservation.

MATERIAL AND METHODS

Study area

The study was carried out in Benin, a West African country of 115,762 km^2 (Hounkpe, 2013), located between 6°25'N-12°30' and 0°45'E - 4°E. It is bordered by Togo to the west, Nigeria to the east, Burkina Faso and Niger to the north and the Atlantic Ocean to the south. Based on days of growing season, Benin is characterized by three contrasting agro-ecological zones AEZ (Jahnke & Jahnke, 1982) ranging from humid to semi-arid.

The rainfall distribution in Benin shows two types of climates with corresponding transitions. In the south Humid and sub humid zones there is a tropical humid climate with two rainfall maxima corresponding to two rainy seasons for which the rainfall varies between 900 mm and 1110 mm: March-July and September-November. The remaining months are dry (Adomou *et al.,* 2005, Neuenschwander *et al.* 2011). The relative humidity varies between 31 % and 98 % and the mean annual temperature varies between 25°C and 29°C. In the Northern part (Semi-arid), the climate is tropical with one rainfall of 1200 mm with maxima in June with a rainy season covering May to October and a long dry season covering November to May (Adomou *et al.,*

2005, Neuenschwander *et al.,* 2011).The relative humidity varies from 18 % to 99 % whereas the temperature varies from 24°C to 31°C.
Benin's native vegetation is composed of fallows and small forest patches in the humid zone, of mosaics of woodlands in sub-humid whereas the semi-arid zone consists of savannas and gallery forests with trees and shrubs slightly covering the ground (Sinsin *et al.*, 2004).

Sampling and data collection

Data considered in this study are part of a larger data set collected in the framework of an ongoing research project on HGs in Benin (Idohou *et al.*, 2014; Salako *et al.*, 2014; Gbedomon *et al.*, 2015). The overall methodology developed for sampling and data collection included a participative diagnosis, field observations (walking and visits of gardens), gardens inventories and individual and group interviews. The sampling design included both probabilistic and non-probabilistic approaches. First, a rapid rural appraisal (RRA) was performed in all three AEZs to identify sites of interest. An exploratory survey was conducted on 100 randomly selected informants in each AEZ and intended to determine the proportion p of household with home gardens and consequently the sample size (n) in AEZ zone using the normal approximation of the binomial distribution. The estimation of n was done using the Normal approximation of the Binomial distribution (Dagnelie, 1998)

$$n = \frac{U_{1-\alpha/2}^{2} \times p\,(1-p)}{d^{2}} \qquad 1$$

In Equation 1, $U_{1-\alpha/2}^{2}$is the value of the Normal random variable at a probability value of 1−α/2. For α=0.05, $U_{1-\alpha/2}^{2}$= 3.84 ; d is the margin error of the estimation of any parameter value to be computed from the survey, and a value of 8 % was chosen (Idohou *et al.*, 2014; Gbedomon *et al.*, 2015); p is the proportion of households practicing home gardening. p was estimated to be 20 % for the humid zone, 31 % for the sub-humid zone and 34 % for the semi-arid zone. The sample size was then n = 96 (humid zone), n = 129 (Sub-humid zone) and n = 135 (Semi-arid zone).
In Agro-ecological zone, the project team visited the villages selected as of high importance for home gardening. In order to capture most of the variation, snowball technique (Albuquerque *et al.*, 2014) was coupled with HGs visits for the selection of households practicing home gardening. 3 to 5 key informants (head of household with HG) were recruited and joined the

team. With their assistance we walked around the village and visited HGs. The list of HGs visited was established and each HG was numbered. Random table was used to select from established list the participating households to the study.

Data were collected between May 2014 and April 2015 and included garden inventories and individual interviews with the assistance of local translators. For all visited HGs, inventoried plants were identified at the species level and named following the botanical nomenclature of Lebrun & Stork (1991). Vouchers of plants that could not be clearly identified were collected and preserved following the Benin's national herbarium guidelines for collecting herbarium specimens, and sent to the national herbarium for identification.

Statistical analysis

In this study, motivation for home gardening was considered at posterior. Then, the motivation was measured as the physical expression rather than the intention. We quantified the different uses of home garden plant species and took them as a proxy of the motivation for home gardening. If a home garden is dominated by food plant species, then the motivation for the home garden is for food production, regardless of the final destination of the food (self-consumption or market). Five categories of uses were defined: food, medicinal, ornamental, fence and miscellaneous (e.g. cultural, religious, insecticide, etc.). A matrix describing the proportions of each motivation in the 360 HGs was submitted to a hierarchical clustering (HC) analysis to define clusters of HGs with similar motivation. A canonical discriminant analysis (CDA) was then performed to test whether the motivation discriminated the clusters of HGs. Therefore, it was possible to make a typology of HGs based on the motivation. A Chi-square test was used to test the dependency between the motivation and the gender.

To assess the effect of the motivation on the overall species richness of HG, a generalized linear model (GLM) with a negative binomial error distribution was used (Crawley, 2007). The HC analysis was performed in SAS software version 9.2. All other analyses were implemented in R software version 3.3.1 (R Core Team, 2016). The CDA was performed using package "Candisc" (Friendly & Fox, 2016). Assumptions for CDA namely multivariate normality and homogeneity of covariance matrices were checked using the Mardia's test in package *MVN* (Korkmaz *et al.*, 2014) and Box's test in package *biotools* (da Silva, 2016), respectively. The GLM with a negative binomial error

distribution was implemented using package "MASS" (Venables & Ripley, 2002).

RESULTS

Motivation for home gardening and gender effect

The clustering analysis on the different uses of plant uses in the 360 visited HGs distinguished seven clusters of multiple gardens and one cluster with a single garden with conservation of 59.7 %. From the canonical discriminant analysis three canonical discriminant axes were retained, and they accounted for 81.9 % of between-HG cluster variations. The likelihood ratio test showed that all three canonical discriminant functions were significant at 1 % significance level. The predominance (49.2 %) of the first canonical discriminant function (Can1) in accounting for uses among HG clusters suggests that food, medicinal and miscellaneous uses are prominent motivation for home gardening discrimination.

The first canonical axis (Can1) was correlated positively with food motivation and negatively with medicinal and miscellaneous motivation. Therefore, food motivation was negatively correlated to non-food motivation. The second canonical axis (Can2) was correlated positively to ornamental motivation and the third canonical axis (Can3) was negatively correlated to fence motivation.

The projection of canonical scores for motivations and clusters (Figure 1a) indicated that the HGs of clusters 1, 7 and 3 were primarily for food motivation and significantly different from the HGs of clusters 6 and 2, which were primarily for non-food motivation, and to a lesser extent were different from the HGs of clusters 4 and 5, which were for both food and no-food motivation. The HGs of cluster 5 were associated to the ornamental motivation and were significantly different from the HGs of clusters 1, 2, 3, 4, 6 and 7. Finally, the HGs of cluster 7 were associated to the fencing function and were significantly different from the HGs of clusters 1, 2, 3, 4, 5 and 6 (Figure 1b).

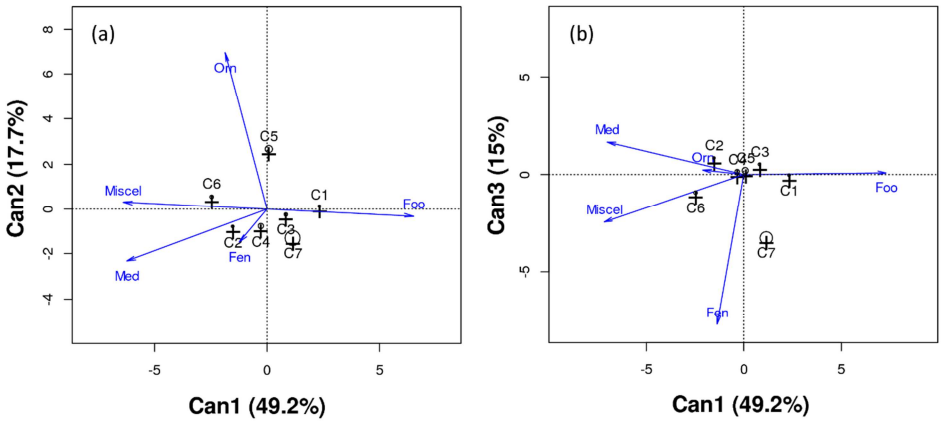

Figure 1. Projection of the motivations and HG clusters in two systems of canonical discriminant axes: Can1-Can2 and Can1-Can3

Foo = Food; Med = Medicinal; Miscel = Miscellaneous; Orn = Ornamental; Fen = Fencing

From this assemblage we distinguished:

- HGs with motivation for food production (MF), comprising of the HGs of cluster 1 with an average 88.64 % ± 1.25 of their species devoted to food production.
- HGs with motivation for medicinal plant production (MM), comprising the HGs of cluster 2 with an average of 83.55 % ± 1.27 of their species devoted to medicinal purposes.
- HGs with motivation for food and medicinal production (MFM), comprising the HGS of cluster 3 and to a lesser extent those of cluster 7 with, respectively, an average of 82.51 % ± 1.35 and 70.07 % ± 3.64 of their species devoted to food production and 66.88 % ± 1.49 and 55.44 % ± 5.55 of their species devoted to medicinal uses.
- HGs with multiple motivations (xM) which in addition to for food and/or medicinal purposes also included miscellaneous, ornamental and fencing motivations. Within this assemblage, we distinguished the HGs of cluster 4 for which, in addition to food and medicinal uses, miscellaneous motivations accounted for 32.42 % ± 1.87; HGs of cluster 5 for which, in addition to food and medicinal motivations, ornamental motivation accounted for 35.25 % ± 2.90 and HGs of cluster 6 for which, in addition to food and medicinal purposes, miscellaneous uses accounted for 50.50 % ± 2.02.

With regard to the prevalence of motivation based home gardens groups, 59 % had distinctive motivation, among which 21 % were for food production, 19 % for medicinal production and about 24 % for both food and medicinal purposes. The remaining HGs (36 %) were used for multiple motivations (xM).

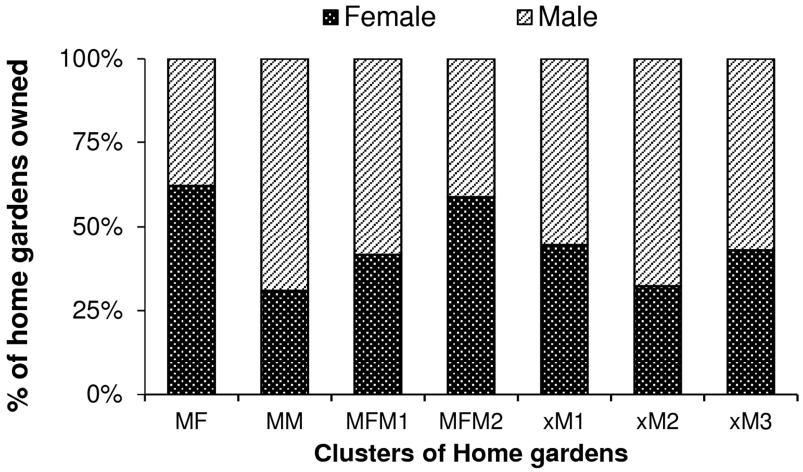

Figure 2. Possession of home gardens typical gardens in Benin with regards to gender

MF = Motivation for food ; MM = Motivation for Medicine ; MFM1 = Motivation for both Food and Medicine 1 ; MFM2= Motivation for both Food and Medicine 2; Xm1 = Multiple Motivations1 ; Xm2 = Multiple Motivations2 ; Xm3 = Multiple Motivations3 ;

Gender was significantly associated to the motivation for home gardening (Chi-sq = 18.05, DF = 6, *p*-value < 0.01). Women owned 62.16 % of home gardens for food production (Figure 2) and owned 45.12 % of home gardens for both food and medicinal plant production (Figure 2). Men owned 69.12 % of home gardens for medicinal plant production; 54.88 % of home gardens for both food and medicinal plant production (Figure 2). Similarly men owned about 60 % of home gardens with multiple motivations.

Motivation for home gardening and conservation of agro-biodiversity

The GLM describing the relationship between the species richness of gardens and the clusters based on motivation showed a significant effect of motivation on the plant diversity of HGs (*p*-value < 0.001). HGs with medicinal and/or

food motivation and HGs with multiple motivations recorded the highest species richness (Figure 3).

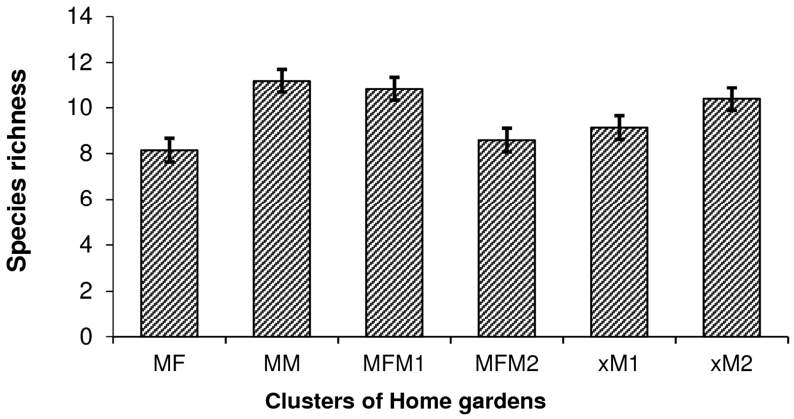

Figure 3. Plant species diversity of the clusters of home gardens

MF = Motivation for food ; MM = Motivation for Medicine ; MFM1 = Motivation for both Food and Medicine 1 ; MFM2= Motivation for both Food and Medicine 2 ; Xm1 = Multiple Motivations1 ; Xm2 = Multiple Motivations2 ; Xm3 = Multiple Motivations3 ;

DISCUSSION

This study assessed the motivation for home gardening in Benin, focusing on gender effect and explored its effect on the capacity of home gardens to maintain agro-biodiversity.

Findings revealed that food and/or medicinal plant production are the main motivation for home gardening in Benin. Food production was the main motivation of women while men were mostly motivated for medicinal plant production. In lesser extent, both women and men were motivated for both food and medicinal plant production. Home gardeners (mostly men) were also found to have multiple motivations for gardening. Home gardens with medicinal, both medicinal and food and with multiple motivations were found to have higher plant species richness.

Home gardens in Benin are either inherited or installed by the owner (Gbedomon *et al.*, 2015). In both cases, cultivation and maintenance of a given plant species are motivated by expected services. The food production

as a main motivation for home gardening as revealed by our findings suggests that home gardening are primarily practiced for subsistence, congruently to (Kumar & Nair, 2004; Pourias *et al.*, 2016), who have established that food production is the basic and the principal function of home gardens. However, inconsistently with conclusion of Skarbø (2014) who stated that "the cooked is the kept", our findings showed that food production is not the only motivation for home gardening in Benin. Indeed, large part of visited home gardens was found to be motivated by medicinal plants production. The gap in motivation across home gardens in Benin as compared to France (Pourias *et al.*, 2016) and Ecuadorian Andes (Skarbø, 2014) suggests that the motivation for home gardening is context dependent. In Benin where traditional medicine play a prominent role in health care (Towns *et al.*, 2014; Yaoitcha *et al.*, 2015), medicinal plants are of high interest for people and provided by both natural vegetation and home gardens (Quiroz *et al.*, 2014; Towns *et al.*, 2014). Regarding home gardens with multiple motivations, they could refers to home gardens with multiple managers and users as commonly encountered in Benin (*Personal observation of the author)*.

The great involvement of women in home gardening (Gbedomon *et al.*, 2015) and mainly for food production as revealed by the findings could be viewed as a strategy to maintain their social role at household and community levels in a context of limited access of women to farmlands (Judex *et al.*, 2009 ; AGVSA, 2014). In regions where farmland is a limited factor due to demographic pressure as in southern Benin or due to large allocation to cash crop cultivation as in northern Benin, home gardens for food production represent a strategic alternative to support households food systems. Unlike women that were motivated for food production, men were found to be mostly motivated for medicinal plant production, congruently to their role of household and communities protection including against diseases. The fact that both women and men were found to be motivated by both food and medicinal plant production could suggest an evolution in social roles due to current social changes or cases of multi-management or multi-users of the gardens.

Finally, as the motivation for home gardening determines the choice of species to be cultivated or maintained, the capacity of home gardens to maintain agro-biodiversity is affected. Home gardens motivated by food production (owned mainly by women) contained less species in comparison to home gardens with medicinal (owned mainly by men), both medicinal and

food or home gardens with multiple motivations. The latters were found to have higher plant species diversity, suggesting that food motivation is not congruent with the conservation benefits of home gardens.

CONCLUSION

In this study we evidenced the main motivation for home gardening in Benin and its effect on agro-biodiversity conservation. Home gardens were very rarely cultivated for only either food or medicinal purposes. Therefore, these different functions, expressing the motivation of gardeners, should be taken as complementary. While acknowledging that the practice of home gardening is a response to a given need food, medicine, ornament etc. , in context of large agro-biodiversity conservation, each type of garden will be useful. For instance home food gardens could be used for the conservation of the plant genetic resources used for food and agriculture (PGRFA) while home medicinal gardens could be used for wild plant species conservation. Nevertheless, there is a need for advanced investigation mainly with regard to the long term capacity of conservation of the different type of home gardens.

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