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Adoption drivers of the sustainable land management measures by women farmers in the South-Center of Benin Republic

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ABSTRACT

In Benin, 62% of agricultural land is moderately or severely degraded and this makes soil restoration and protection a major challenge to achieve sustainable development and ensure food security. To help overcome these challenges, several NGO and projects have brought innovations to farmers through Agricultural Advice with the aim of improving agricultural productivity. Hence, this study aimed to highlight the socio-economic factors influencing the adoption of Sustainable Land Management (SLM) measures by agricultural women in the in the South-Center of Benin Republic. Data were collected through socio-anthropological surveys among 89 women farmers. The data collected were analyzed qualitatively. The results showed that women farmers prefer SLM measures that are easy to apply and whose adoption does not lead to an increase in production costs, nor require having a large area of land. Such measures include valorization of harvest residues, crops association, as well as the cultivation of edible legumes such as pigeon. In contrast, they avoid SLM measures which require more investment in labor and/or other production factors or which require large area of land such as the use of animal dungs, mucuna, and crops rotation. Furthermore, socio-demographic factors such as low level of education, time dedicated to housework and sociological barriers are also decisive in the adoption of SLM measures by women farmers. Taking these factors into account by Agricultural Advice support NGO and projects would encourage the adoption of these SLM measures by the women farmers.

Keywords: Sustainable Land Management (SLM), Socioeconomic Factors, Adoption of Innovation, Women Farmers, South of Benin Republic.

INTRODUCTION

Agriculture is of capital importance for achieving development goals in Africa (World Bank, 2018). According to this same source: “because 80% of the world's poor population lives in rural areas and remains mainly employed in agriculture, this sector can play a determining role in reducing poverty, increasing incomes, and improving food security”. The Benin agricultural sector contributes to around 33% of the Gross Domestic Product (GDP), providing around 75% of export revenues, and employs around 70% of the active population (MAEP, 2017). However, this agriculture is increasingly facing progressive and continuous land degradation, under the effect of unsuitable agricultural practices, deforestation, and climate change

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(ProSOL, 2016a). As a result, 62% of agricultural land is moderately or severely degraded, and related to this situation, soil restoration and protection represent a major challenge to achieve sustainable development and ensure food security (Stiem-Bathia et al., 2017). For instance, Adebiyi et al, (2019), estimated that one of the major problems affecting agricultural production in northern Benin is the decline in soil fertility. For Adegbola and Adekambi (2006), such continued declines in soil fertility have adverse effects on agricultural productivity, household food security, and rural poverty.

For Etene (2020), poor communities are the most vulnerable due to their limited adaptation capacities and their great dependence on highly climate-sensitive resources such as water and agricultural production systems. As a result, the poor and particularly women in developing countries are the most affected by the decline in agricultural productivity, because they have a lower capacity to adapt to agricultural technologies and insufficient access to other means of production (Fahad and Wang, 2018). As a result, farms managed by women have, on average, lower yields than those operated by men (World Bank, 2012). Thus, gender inequalities constitute an obstacle to effective decision-making and improved productivity, and thus compromise business opportunities within agricultural value chains (Senders et al., 2010; FAO, 2012). At the same time, several authors estimate that if women had the same access as men to productive resources, they could increase the yields of their farms by 20 to 30%. These authors further estimate that this would increase the total agricultural production of developing countries, such as Benin, by 2.5 to 4% and, ultimately, this increase could result in a reduction of 12% to 17% of the number of hungry people in the world (World Bank, 2012; FAO 2012a; Mohammed, 2013). For Stiem-Bathia et al. (2017), to improve women's situation, important measures are being put in place by both public and private actors to encourage the adoption of Sustainable Land Management (SLM) measures by producers and women farmers in several areas of the country. However, the adoption of these measures by farmers remains very mixed (Adégbola et al., 2010; Vidogbena et al., 2016; Adjiba et al., 2021). Thus, despite the considerable efforts deployed by NGOs and projects, the situation continues to deteriorate due to a multitude of constraints and complex factors that it seems appropriate to understand in order to reverse current trends (Baba et al., 2016). On the other hand, Stiem-Bathia et al. (2017), through field observations, a baseline study, and multi-actor workshops on SLM experiences in Benin, noted that despite numerous SLM initiatives, there remain numerous gender gaps regarding the application of SLM practices. For Adjiba et al. (2021), understanding the different parameters relating to this situation proves crucial to increase the adoption rate of SLM technologies and allow the formulation of agricultural policy options to improve the well-being of rural populations. It is in light of all of the above that the present study relating to the analysis of the important drivers of the adoption of sustainable land management (SLM) measures by women farmers was initiated. This study intended to contribute to the success of efficient and sustainable agriculture by women farmers in rural areas in the South-Center of Benin Republic.

MATERIALS AND METHODS

Presentation of the study area

This research was carried out in the Zou department and especially in the bar lands area of the Abomey plateau located in the south of Benin. This area brings together the Communes of Abomey, Bohicon, Zogbodomey, Agbangnizoun, Za-kpota, and part of the Commune of Djidja (Figure 1). Likewise, according to National Institute of Statistics and Demography (INStaD, 2023), the Zou department is one of the poorest departments in Benin, showing an increase in the incidence of poverty during the period 2019 to 2022, from 39, 8% to 41.4% and higher than the national average, although agriculture is the main activity of the populations, especially in rural areas. However, the Communes of Bohicon and Abomey are urban with only an

average around 10% agricultural populations while the Communes of Agbangnizoun, Zakpota, Zogbodomey, and Djidja are rural with high rates of agricultural populations respectively of 36.75%; 58.55%, 63.13%, and 68.07% according to data from the (INStaD, 2023). Therefore, only the Communes of Agbangnizoun, Zakpota, Zogbodomey and Djidja were taken into account in this study.

Choice of villages of study

This activity was carried out with the help of certain agents of the Communal Agricultural Development Cells and certain NGOs and Professional Organizations of Agricultural Producers (OPA) which were involved in the implementation of the Soil Rehabilitation and Protection Project and in the popularization of SLM measures during the period from 2016 to 2022. The choice of villages in the concerned Communes was based on the criteria of existence of women farmers who adopted SLM measures, and whose farms are accessible for data collection. The results of this exploratory phase made possible the selection of the following villages: Avlamè in the Commune of Zogbodomey, Sahè-Abigo in the Commune of Agbangnizoun, Hounvi, Sovlègni and Hêvê in the Commune of Djidja, Za-Tanta, and Zakpota- Center in the Commune of Zakpota.

Sampling process and data collection

The study sample was made up of women who adopted SLM measures popularized by 02 NGOs (ALDIPE and The Hunger Project) and a farmers' professional organization (FUPRO) through the soil fertility rehabilitation and protection project. Women farmers were selected using the snowball method. The selection began with a census of women farmers who have experimented with SLM measures in the villages identified above and where practices are being implemented. The selection of women was carried out after visiting the women's farms and the choice was made of those who had implemented at least one SLM measures on their farms. In most of the selected villages, the number of women who met these criteria was not high, they were then all retained for the data collection phase, making a total of 89 women.

For data collection, open individual interviews with the 89 women farmers were conducted, participant observations were also done as well as data triangulation. The data collected were related to the socio-demographic profile of women farmers; the SLM measures popularized and applied on the farm; the reasons for adopting or not the measures; experiences before and after the application of SLM measures; the barriers induced by SLM measures but also to those linked to the socio-economic constraints which influenced the adoption of the measures mentioned. In addition, certain data such as the effectiveness of the implementation of the SLM measures, the size of farms, the agricultural speculations carried out, etc., were collected based on participant observation during field visits and informal exchanges with women farmers. These last data were useful to ensure the reliability of the data collected through the individual interviews and also made it possible to complete certain data from the interviews.

Theoretical framework

Several theories have been developed to understand the factors determining the adoption and the diffusion of technological packages for stakeholders in the agricultural world (Yo et al., 2020). The first theories are those known as "the diffusion of innovations" whose best-known author is Everett Rogers (1983 and 1995). According to Rogers (1995), the adoption of an innovation is linked to certain factors intrinsic to the innovation itself. For him, the adoption of an innovation depends on the advantages, compatibility with beliefs and norms, the level of complexity of the innovation, the possibility of being tested, and a high degree of observability of its advantages. But, for his part, Davis (1989) through the technology acceptance model, unlike Rogers, emphasized on the individual factors of potential adopters of an innovation that can influence the decision to adopt or not an innovation such as the usefulness and the ease perceived in the innovation use. These two

beliefs play a key role in explaining users' attitudes and intentions towards adopting or not adopting new technologies and innovations. However, Rogers (1995) and Davis (1989) agree on the level of complexity which refers to ease of use, and the level of advantage and utility as key drivers. As part of this study, Rogers (1995) and Davis (1989) theories guided the data collection and analysis. Thus, based on this theoretical framework, the intrinsic factors of the SLM measures promoted in the sample villages, the socio-economic factors linked to the living and working environment of women farmers that affected the adoption of the SLM measures, but also the perceptions (in terms norms and beliefs) of women on these SLM measures promoted for them were highlighted. Finally, the resources access and control analytical framework of Moser (2013) for the data analysis regarding gender aspects were used. This approach helped to see in which conditions the women farmers have access to land and the SLM measures in comparison to men.

Data analysis

The method used for data analysis was essentially qualitative. This is a content-based illustrative analysis approach. It made it possible to bring together and interpret the data collected according to meaningful categories. In this context, the different types of SLM measures adopted, the factors favorable and unfavorable to their adoption, as well as the perceptions relating to the application of the measures mentioned by each interviewee in their responses were extracted from each interview and grouped according to the types of SLM measures. These were combined with information extracted from the informal interviews from the field visits to ensure their relevance and reliability. Subsequently, each category of measures adopted and factors extracted served as a variable to which we assigned the numbers of respondents for calculations of averages and percentages. These data, thus stripped and processed, were used to produce tables and figures, the contents of which were subsequently analyzed and then discussed.

RESULTS

Sustainable land management measures promoted in the study area

The SLM measures popularized by the NGO in the study area are the following: crops rotation, crops association, spreading of animal dungs, perpendicular plowing to slopes, crop residues management, direct sowing, sowing spread over time, full moon technique, half-moon techniques, use of household waste and agroforestry. Among the SLM measures linked to the use of legumes, these are: mucuna, pigeon pea, soya, cowpea, and peanut planting. The results showed that the women farmers generally adopt on their farms, a combination of the SLM measures popularized. In addition, several factors determine the adoption or not of these SLM measures popularized in the area.

Adoption drivers linked to the sociodemographic characteristics of women farmers

As part of this study, the socio-demographic data taken into account were the following: level of education, marital status, land access mode, size of the agricultural farming (Table 1), and the number of years of experience of the women farmers in agriculture and their relationship with the adoption of SLM measures.

Level of education

The results showed that most women farmers (76.40%) are uneducated and also illiterate. The results of the surveys also revealed that it is only somewhat educated women farmers who spread animal dungs. According to the respondents, this is explained by the fact that this measure requires knowledge of the dosage levels required per cultivated area, which would not be easy to do by women with little non-scholarized women. The low level of education would therefore be a factor negatively affecting the adoption of spreading animal dungs in agricultural production farms.

Marital status

The survey revealed that 90.82% of the women surveyed are married. According to the interviewees, on a customary level, a married woman is required to be heavily involved in agricultural activities on her husband's farm. As a result, this situation, according to the interviewees sometimes leads to a delay in meeting the dates required for carrying out their agricultural activities such as plowing, sowing, maintenance, and harvesting. In consequence, this negatively affects their yields and sometimes demotivates them in the SLM measures adoption. In addition, most of the women pointed out that, beyond the help they provided to their husbands' farms, the constraints linked to their household well-being (housework) and sometimes the community work, sometimes prevent them from fully participating in the training organized by the extension agents or facilitators on SLM measures.

Land access mode

The analysis of Table 2 reveals that 56.18% of respondents have access to land by donation, in most cases from their spouses. The reality behind this fact is that women exploit the land of their spouses or their in-laws and do not have agricultural land of their own. This is not a donation but a disguised loan according to them. Thus, they say they are in a form of insecurity because, in the event of divorce or dissatisfaction of the husband, the latter can take away this portion of land from the woman at any time. It was also revealed that women generally only access poor land and that they also run the risk of losing it at any time when the fertility of this land is regenerated. To this reality, one of the women interviewed said the following:

"*Before your husband gives you a portion of land, this must be very poor and it is up to you, to invest now in rehabilitating the land so that it becomes fertile. Once the land becomes fertile, the husband will come and recover the land but under these conditions, the woman does not make a return on her investments and she becomes even poorer*," comments Béatrice, a resident of the Zakpota.

Alongside these, there is another category of women (23.89%) who have access to land through renting. In the study environment, land rental is done by a local surface unit called "Kantin". 16 "Kantin" are equivalent to 1ha. The "Kantin" is rented at 2000 FCFA per unit per year, or 32,000 FCFA per ha per year. According to the information collected, even in the case of renting land, women say they often do not have any guarantee or delegated use of right paper legitimizing their property rights over this land. Then, women who access land by renting are reluctant, to adopt the spreading of animal waste and legumes such as mucuna to fertilize the soil. The women concerned say they find themselves in land insecurity which slows down the adoption of SLM measures. According to them, after having restored the fertility of these lands, they are dispossessed by the owners. In most cases, this expropriation negatively affects the production of the women concerned while they have no means to claim what is rightfully theirs, as shown by the words of a woman farmer:

"*In our village here, when you rent or lend someone's land, you have to be prepared for the fact that it can be taken away from you at any time. In other words, when we rehabilitate the soil and it becomes fertile and our productivity increases, automatically the owner becomes jealous and takes his land away from us. Even our husband forbids our access to those lands every time you have conflicts with him.*", comments of Cécile, a resident of the Zogbodomey

However, Table 2 shows that 8.99% and 11.24% of women farmers have access to land through inheritance and purchase respectively. According to the respondents, it is the latter who truly enjoy a certain land security and who calmly commit to the adoption of SLM measures such as the application of animal dung and the use of certain improving legumes such as mucuna which require investment and/or time to apply for positive results in the medium and long-term.

This survey helped also to understand that in the study area, the right to land ownership is exclusively reserved for men

according to traditional norms. The information collected revealed that the popular thinking in the area is that as a girl and future wife, her family is always reluctant to allocate her land knowing that when she gets married, all her property including land will benefit her in-laws to the detriment of her family of origin. Furthermore, most women believe that they do not have enough money to buy land, while some interviewees said that even when the woman has the means to buy land, the seller requires the approval of her husband and sometimes, it is the husband's name that is put on the sales agreement. This also explains the low rate of women having access to land through inheritance and purchase, which also has an impact on the adoption of SLM measures.

Agricultural farming size

From this survey, it appears that 54.30% of the respondents' farms have a size between 5 kantins (approximately 0.31 ha) to 1 ha. As result, 45% of respondents believe that certain SLM measures (animal excrement and mucuna) require leaving the land to rest, which would prevent them from producing food crops that constitute their basic foodstuffs if they adopted them.

Number of years of experience of farmers and SLM measures adopted

In this section, Table 3 shows the types of SLM measures experienced by women in the study area. The results also showed that the number of years of experience of women as farmers constitutes an important factor in the adoption of SLM measures.

From the Table 3, it appears that approximately 37% of the respondents have only one year of experience in the adoption of SLM measures. The latter have only experimented 02 measures and according to all of the respondents, these are the oldest measures popularized in the field and the most commonly adopted by all women farmers. Indeed, according to investigations, young and less experienced producers are reluctant to take more risks than more experienced women farmers. Furthermore, the results showed that 45% of them already knew the use of pigeon peas, household waste, crop association, and rotation techniques before their popularization by the projects.

Women's perceptions of the intrinsic factors of SLM measures adoption

This section presents the women's perception of the factors linked to the SLM measures themselves. Table 4 below presents the level of adoption of each SLM measure as well as the factors favorable and unfavorable to their adoption in the study environment.

The analysis of Table 4 shows that the most adopted measures are: crop association, half-moon techniques, management of crop residues and the use of pigeon peas. According to the respondents, the cultural association and the use of pigeon peas are old practices known in their environment well before the arrival of projects to promote SLM measures. Having already known these techniques, the farmers said they had no difficulty in applying them while renewing the cultivation systems. In addition, all the farmers surveyed use harvest residues since the agents of the structures in charge of extension trained them on the harmful effects of slash-and-burn agriculture and its long-term impacts, they said. However, they mentioned that most of these techniques do not entail financial costs for them but on the contrary allow them to reduce investment in the purchase of chemical fertilizers and in labor, except the half-moon technique practiced around plants of perennial crops, especially citrus plants. Furthermore, they underlined the importance of agricultural diversification that the technique concerned allows, as is the case for cultural associations. The weakest practiced measures according to the results were: the use of mucuna, animal dungs, direct sowing, crop rotation and, plowing perpendicular to the slopes. According to the respondents, most of these measures pose constraints that are sometimes out of their reach. Indeed, they stressed that measures such as crop rotation and the use of mucuna are more suited to producers who have large areas while most of them have small farms (less than 1ha). Regarding mucuna, they also stated that its seeds are difficult to obtain in the area of study and are not edible and this limited their interest in its

adoption. Furthermore, they also mentioned that mucuna is a legume whose biomass is very appreciated by the transhumant cattle which they have difficulty keeping away without the help of men. From the women farmers cattle transhumance seems to be a real constraint for the adoption of mucuna. Thus, transhumance remains a challenge for agriculture innovation adoption in the research area with its corollaries of recurring conflicts between farmers and breeders. Regarding animal waste, the respondents particularly highlighted the difficulties in knowing its dosage and the fact that the waste is not sufficiently available in their environment as limiting factors in its adoption. Regarding perpendicular plowing, those who have applied this innovation testify its beneficial effects on production. But, the interviewees believe that it is unlikely that the majority of women will continue to apply it because it is restrictive in terms of labor costs. Finally, for the respondents, the low adoption of the direct seeding technique could be linked to the fact that in the area, the practice of plowing has been very widespread since ancient times. This technique is mainly practiced by farmers of "Adja", a neighboring area.

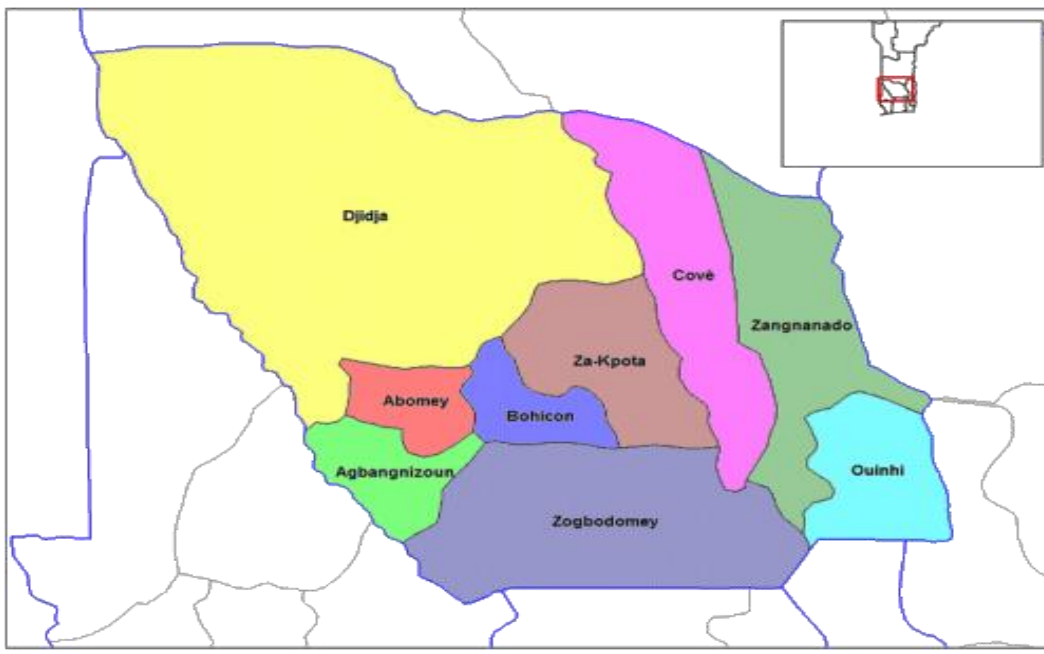

Figure 1: Map of the Zou department.
Source: INStaD, 2023.

Table 1: Distribution of women farmers surveyed per Commune.

Communes	Number of women surveyed
Agbangnizoun	35
Djidja	14
Zakpota	30
Zogbodomey	10
Total	**89**

Source: Field data, 2023

Table 2: Socio-demographic profile of the women farmers interviewed.

Variable	Modality	% of respondents
Marital status	Married	90.82
	Widowed	9.18
Education level	Non-scholarized	76.40
	Scholarized at the primary level	13.48
	Scholarized till secondary level	10.12
Land access mode	Donation	56.18
	Inheritance	8.99
	Purchase	11.24
	Renting	23.59
Agricultural farming size	Less than 1 ha	54.3
	Between 1 to 3ha	39.1
	More than 3ha	6.6

Source : *Field data, 2022*

Table 3: SLM measures adopted by farmers according to the number of years of experience in agriculture.

Number of years of experience	% of respondents	Number of SLM measure adopted	Type of SLM adopted
1	37.09	2	Crops residues and crops association
2	17.98	4	Crops rotation, use of pigeon peas, harvest residues, household wastes
3	22.47	4	Crops residues, animal dung, crops rotation and pigeon peas, household waste
4	11.23	5	Crops residues, animal dung, mucuna, perpendicular plowing, and pigeon peas
6 and more	11.23	8	Mucuna, crops rotation, animal dung, crops residues, pigeon peas, full moon technique, perpendicular plowing, direct sowing.

Source : Field data, 2022

Table 4: Women farmers' perceptions of the favorable and unfavorable factors intrinsic to SLM measures adoption.

SLM measures adopted	Adoptant (%)	Favorable adoption factors	Unfavorable adoption factors
Crops residues burying	53.93	Helps restore soil fertility; does not require a financial cost	Difficulty burying residue; generates more difficult operations for producers; lack of adequate tools for burying
Direct sowing	11.24	Does not require much effort; reduces the labor and energy required for sowing; preserves natural soil organisms	Water infiltration much longer than expected; rapid invasion of plots by weeds
Crop rotation	37.08	Improves soil structure; control of harmful organisms; facilitates soil work; requires little investment	Requires good knowledge of the crops to be rotated; Better suited to those with a large surface area
Crops association	79.77	Limits pest pressure on main crops; allows to have safe food resources available at all times; facilitates the diversification of production and income; improves the rational management of inputs (seeds and fertilizers); optimizes the use of space	Causes delay in sowing periods for the associated crop May cause crop cycles to overlap
Spreading animals dungs	33.34	Maintain soil fertility over the long term; Economical for farmers and breeders	Slow decomposition; unavailability of dungs; limited knowledge of dosages by many farmers
Half-moon technique	86.39	Reduces loss of water and fertile soil layers; contributes to the recovery of land and its protection; protects young plants against wind and erosion; increases and promotes infiltration and optimum use of water; reduces the volume of land carried away by runoff water;	Risk of flooding; Requires significant work during installation and significant need for organic fertilizer, suitable for fruits' plants
Perpendicular plowing	33.71	Increases and promotes infiltration and optimum use of water from fallen rain; reduces the volume of land carried away by runoff water; allows water conservation in the soil	Risk of ridges breaking causing sliding; dependence of women on their husbands for plowing.
Use of mucuna	28.09	Easy to produce; less demanding in terms of mineral fertilizers; weed control; protects against erosion	Difficulty to access the seeds; difficult management of biomass; fodder is highly appreciated by transhumant cattle, seeds inedible; invasive plant that does not tolerate association with other crops; suitable for those with a large farm size
Pigeon pea plantation	76.16	Edible and helps improve nutrition; helps restore soil fertility through nitrogen fixation	Stems difficult to degrade; animal damage to biomass; multi-year crop

Source: Field data, 2022

DISCUSSION

As shown in the results, the adoption of SLM measures by farmers is influenced by several factors both intrinsic to the technologies promoted and extrinsic to these technologies and linked to several socio-demographic and economic factors in the study area.

Adoption of SLM measures by women farmers attributable to technical-economic factors intrinsic to the technologies themselves

The results of the study showed that there are favorable and unfavorable factors for the adoption of popularized SLM measures in the three study villages. As an illustration, the results showed that women farmers prefer SLM measures which are easy to apply and whose adoption does not lead to an increase in production costs. On the other hand, they avoid SLM measures which require more expenditure on labor, as well as the availability of large areas of cultivable land. This is the case, for example, of crop association techniques, the management of harvest residues, the use of household waste, the use of pigeon peas and the half-moon technique which is practiced more around perennial crop plants. These results are consistent with those of Adékambi et al. (2021) who revealed that soil regeneration with legumes and crop residues remained the main measures of integrated soil fertility management (ISFM) most practiced in the northern Benin area. However, they are somewhat in the opposite of the results of Assogba et al. (2017) who highlighted a low level of adoption of crop residues in the southern and central zones of Benin, due to the difficulties, according to these authors, of burying residues because of its additional work, lack of adequate tools, and destruction residues for fear of damage from transhumant animals. Regarding legumes, the results showed a low level of adoption of mucuna by women farmers, which is consistent with several results of previous work including those of Assogba et al. (2017) who concluded that there was a very low level of adoption of mucuna in the southern and central zones. The constraints that these authors revealed were among others: the difficult management of biomass (difficult burial for farmers), the fact that the seeds are not edible by humans, the loss of the short growing season on the plots on which they are installed, and the fact that it would be a preferred shelter for rodents and reptiles. Then, the one new constraint added by this study is that the mucuna plants are well appreciated by transhumance cattle which is very hard to combat by the women farmers without the help of their husbands or a man. Another constraint relating to the low adoption rate of mucuna would be that it is an invasive plant that does not tolerate association with other crops, and also because of its dry and very flammable biomass as revealed by the present results. The results also revealed a low rate of adoption of animal dung. Beyond the dimension of knowledge of dosages mentioned by women, these results somewhat confirm those of Adékambi et al. (2021) who emphasized that the possession of a large livestock would facilitate the adoption of organic fertilizers.

Adoption of SLM measures attributable to socio-demographic and cultural factors linked to the living environment of women farmers

The present results showed several socio-demographic and cultural factors that influenced the adoption of SLM measures by women in the study area. The first, was the socio-demographic profile of the women. The results clearly showed that age, marital status, level of education and, number of years of experience of women in agricultural activities are important in the adoption of SLM measures. Regarding women's experience in agriculture, young and less experienced women farmers are reluctant to take more risks than more experienced men farmers. These results confirm those of Adégbola and Adékambi (2006) who showed that more experienced producers adopt innovations more easily than young people. Regarding the level of education, according to the results of a study carried out by the Food and Nutrition Council (CAN) in 2016, it was revealed that women

who are "literate" have aspirations for a change in their current conditions, including reducing their tasks, including reproductive ones, and improving production techniques.

According to the results of this study, the mode of access to land and the small size of agricultural holdings owned by women are key factors that influence the adoption of SLM measures. These results are consistent with those of Stiem-Bhatia et al. (2017) on gender in northern Benin as well as in the southwest of Burkina Faso who revealed that the mode of access to land and the neglect of the surface area of farms managed by women are major obstacles that affect their ability to invest in SLM. As the present results showed, women only access land through their in-laws, especially the husband in the context of this study environment, and only have access rights use on the land. Likewise, these authors underlined that these lands allocated to women are generally less fertile and the risk of losing this land is even higher when women invest to improve their productivity by planting legumes such as pigeon peas (Stiem-Bhatia and al., 2017). Furthermore, the results of CAN (2016) revealed that, even when women work to develop their land in different ways for many years, they never become owners of it, which makes this donation of land a disguised loan, a source of land insecurity. This situation is more exacerbated in the case of land rental by women. Indeed, once the fertility of the land has been restored, the land owner does not hesitate to recover this land which has become fertile again. These results are similar to the ones of Alokpaï and al. (2023) who concluded that in the Commune of Zakpota in Benin, women generally do not have any guarantee or delegated use right paper legitimizing their property rights over land and for this reason are often exposed to land insecurity and can be victims of unexpected expropriation at any time. This perceived land insecurity for women therefore limits investments in SLM measures by the latter as shown in the results. The results also revealed that the difficulties in accessing labor constitute a barrier to women's agricultural activities in general and to the adoption of SLM measures in particular. The fact that women have to carry out household work in addition to their contributions to the rural activities of their spouses as confirmed by men also constitutes a real obstacle to the adoption of SLM measures. Indeed, sustainable land management is very labor intensive according to Adjiba et al. (2021). Then, the triple roles (productive, reproductive, and community) played by rural women farmers (Moser, 1993), can be a challenge for the SLM measures adoption. These results are also in line with several studies which also indicate that the lack of availability of labor is more restrictive for women than for men about decision-making power over the adoption of certain soil improvement methods (Quisumbing and Pandolfelli, 2010). Thus, Stiem-Bhatia et al. (2017), estimate that with limited time resources are due to difficulties in recruiting additional agricultural labor, women very rarely invest in labor-intensive practices and time-consuming activities that improve the condition of the soil. Finally, it was noted that women's participation in training on SLM measures is dependent on the authorization of their husbands, which would constitute a real obstacle to their adoption of SLM measures. These same observations were made by Adjiba et al. (2021) who highlighted that several studies have confirmed that some husbands prohibit their wives from participating in agricultural awareness and advisory activities, which means that these women participate less in training on soil management due to these perceptions and gender norms established in their environments.

Conclusion

SLM measures guarantee soil regeneration since they are designed to address several problems faced by farmers. These measures are mostly adopted to maximize revenues over several years and reduce the cost of production. To do this, women farmers perceive SLM measures as a solution to their problems of regenerating soil fertility, except mucuna, animal dungs, and the rotational cropping technique. Women farmers prefer SLM measures which are easy to apply and whose adoption does not lead to an increase in

production costs nor does it require a large area of land. There is also the weight of experience in using the measure concerned, as well as the number of years of experience of women in agricultural production which are also important. The measures that have been popularized in the community and to which women farmers have been accustomed for years are the most adopted. This is the case for old practices that they were aware of before the arrival of the project, such as crop association, the use of edible legumes such as pigeon pea. In contrast, women avoid SLM measures that require more investment in labor and/or other production factors or a large area, such as crop rotation and the use of mucuna in their farming system. Finally, other socio-demographic factors such as the level of education, marital status, and the modes of access to land, were noted as important in the adoption of SLM measures as well as the traditional norms. To improve the adoption of SLM measures, it will be necessary to offer technologies adapted to the socio-demographic, socio-economic, and socio-cultural profiles of women farmers. Also improving their socio-economic conditions through the provision of support and adequate extension services can be recommended.

COMPETING INTERESTS

The authors declare that they have no competing interests.

AUTHORS' CONTRIBUTIONS

NA and TAK have contributed to the protocol designing and the paper writing. SDA took part in data collection and processing.

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