

Research Article

DETERMINING FACTORS SUSTAINABLE SOYBEAN (*Glycine max Merril*) PRODUCTION IN FAMILY FARMING IN KABINDA, DEMOCRATIC REPUBLIC OF CONGO

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Received 17th November 2020; Accepted 25th December 2020; Published online 20th January 2021

ABSTRACT

Soybean production is an important part of family farming in developing countries. In sub-Saharan Africa, soybean productivity is constrained by climatic hazards, population pressure and declining soil fertility, which is the basis for increasing poverty and food insecurity. To characterize the factors determining soybean production in the Kabinda sector, a survey was conducted among 100 randomly selected soybean producers in the three villages (Kananga, Bena Ngoyi and Kilo 20) using questionnaires followed by individual interviews. Descriptive statistics were used to characterize soybean cropping systems and identify the various constraints to soybean production. The results of this paper show that the characteristics of soil fertility restoration methods, fallow is adopted by a large majority of farmers (69%) while the soybean+arachid combination is practiced in the cropping systems by soybean farmers (62%). Gender, age, level of education, membership in an agricultural association, farming experience, number of years in soybean production, and labor mode used were identified as the factors that determine soybean production in the study area. We suggested active participation of farmers in training workshops through farm families to help accelerate the adoption of innovative methods in soybean production.

Keywords: Productivity, Restoration, Fertility, Innovative methods, Soybean.

INTRODUCTION

In the Democratic Republic of Congo (DR Congo), food production remains insufficient and the country resorts to food imports. Food prices are soaring and undernourishment is a concern in some provinces. The DR Congo is notable for its food deficit, and this calamity is largely due to the lower yields obtained, and also to the use of traditional farming practices in farming areas (SENASA, 2008). Indeed, Congolese agriculture is essentially peasant based, requiring the use of more beneficial and innovative methods (Kasongo *et al.*, 2013). Moreover, in DR Congo, the population is poor and does not have easy access to animal proteins. To address malnutrition and undernourishment of populations living in developing countries where meat consumption remains a luxury, pulses, such as soybean, constitute a substantial palliative in terms of protein intake in human and animal diets in rural areas (Mackinder *et al.*, 2001). Soybean cultivation has great agronomic properties and is particularly well adapted to local climatic conditions (Lares, 2012). This plant needs neither fertilizer nor fertile soil, it is not very demanding but above all it improves soil fertility and reduces its salinity (Houngnandan, 2015). Moreover, it can be grown in the province of Lomami, particularly in the Kabinda sector. In spite of all these potentialities, soybean production in Kabinda is struggling to make itself felt. In the Democratic Republic of Congo, its production and area varied respectively from 14630 and 23000 to 23000 tons and 30000 to 42000 hectares (Kasongo *et al.*, 2013). However, the improvement of crop production systems and particularly soybean production in rural areas is useful and beneficial for increasing their yield. If producers are already using practices other than the use of soil improvers (organic and mineral), these seem to be an asset for further improvements. Information on farmers' perceptions of soybean production and the importance they attach to farmers' related

problems seems to be useful in the search for innovations to address insecurity. Several studies suggest that socio-economic factors are determinants in the adoption of agricultural innovations (Mabah *et al.*, 2013; Mwangi and Kariuki, 2015). The literature shows that socio-economic factors such as gender, age, education level, farming experience, and the labor force used influence farmers' choice to adopt agricultural innovations (Blake *et al.*, 2007; Mabah *et al.*, 2013). The objective of this work is to identify the socio-economic factors that may characterize the soybean cropping and production system and to identify the major constraints that limit soybean production in Kabinda.

MATERIALS AND METHODS

Located in the North East of Kabinda city, the Kabinda sector is bounded to the North by the Ludimbi River, to the South by the Lufu Lomami sector, to the East by the Ludimbi Lukula sector and the Bekalebwe sector and to the West by the Vunayi sector. The Kabinda sector is in the green belt of the city of Kabinda with high legume production of Kabindaise production. This sector of Kabinda hosts the experimental field of the Faculty of Agricultural Sciences of Notre Dame de Lomami University, located 16 km from downtown Kabinda (Mukendi *et al.*, 2017). It is located at an altitude of 843m in the square formed by latitudes 6°11'31 "South and 24°56'17 "East longitude. From the regional climate point of view, the Kabinda sector is characterized by a humid tropical climate of CW3 type according to Koppen classification (Ngoyi *et al.*, 2020a). It is characterized by two seasons with a long rainy season from 15 August to 15 May and a short dry season from 15 May to 15 August. The annual rainfall and temperatures, averages are estimated at around 1200 mm of rainfall is very suitable for the cultivation of soybeans, with 25 ° C as average temperature and relative humidity sometimes reaches 72% (Ngoyi *et al.*, 2020b). In addition to soybean, production is based on cowpea, groundnut and maize supplemented by vande. The backward effects of soybean cultivation improve soil fertility in this area of high land availability, with extensive soil degradation and sustainable

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natural resource management issues caused by charcoal production in the study area. All these characteristics of the area justify its choice for this study.

Data Collection: The villages that served as the focus of the in-depth survey were Kananga, Bena Ngoyi, and Kilo 20. These villages were selected based on the importance of soybean cultivation, with the support of agricultural extension agents. In addition, these villages are located along the gradient of National Road No. 2 and have hosted some CARITAS, AGRICULTURAL FAMILY of Cap Santé Lomami projects.

Table 1. Distribution of respondents by village

Gender	Kananga	Bena Ngoyi	Kilo 20	Total
Men	30	28	26	84
Women	3	5	8	16
Total	33 (33%)	33 (33%)	34 (34%)	100 (100%)

Source: Results of analysis of survey data, 2019

In the 3 sites, each producer was interviewed individually during the 2018-2019B agricultural season to find out their socio-economic characteristics (gender, age, education level, membership in a farmer group, farming experience, number of years in soybean production, type of labor used to farm soybeans), as well as soil restoration methods and the number of weeding in the field to protect crops from weeds. Interviews with farmers were supported by direct observations during weeding for weed control. The field observations provide a better understanding of the level of knowledge, attitudes and perceptions of agricultural stakeholders with regard to the innovative techniques being disseminated (Munyuli *et al.*, 2017).

Statistical analysis of data: The methods and tools of analysis used are among others: Descriptive statistics and statistical tests through frequency distribution, position parameters (arithmetic mean), dispersion (standard deviation). All these operations were performed using the Statistical Package of Social Science (SPSS) 21 software, word processing with Word 2010. The Ordinary Least Squares (OLS) method was used (Aihounon *et al.*, 2016).

RESULTS

Socio-economic and Demographic Characteristics: The majority of soybean farmers in the study area are men (84%) followed by a few women (16%). Most of these agricultural actors are married (77%), in addition they are from Bena Ngoyi and Kananga (27%) and have 15 years of experience in crop production. The majority of the producers surveyed have a secondary school education (76%). The large number of these producers has agriculture as their main activity (95%) and their experience in agriculture is between more than 10 years (58%). Labor is a major challenge for about 93% of the families, although the majority of these farmers (41%) have 4 years of experience in soybean production. As for the age of farmers, the average age is (38.52 ±5) in the study area (Table 2).

Problems related to soybean production and farming practices

Problems in production: Table 3 shows the different problems faced by soybean farmers in the study areas, the biggest problem is disease in the soybean field. It follows from this table that there are no significant differences in the observed variable (Tab.3). However, farmers' fields in the Bena Ngoyi zone are much more prone to disease (23%) than those in Kananga (16%).

Cultivation practices: In the study areas, our analyses show that fallow land is more adopted by producers (69%) for soybean cultivation. 25% of respondents produce soybeans on fallow land in the villages of Kananga and Bena Ngoyi. On the other hand, farmers in Kilo 20, where fallow land is used on a smaller scale, are more likely to add organic matter to the soil. The results also show that after the input of organic matter by agricultural stakeholders, 93% are satisfied with the quality of the soil and 7% are not satisfied with the input of organic matter. With regard to the crop association system in the different study areas, 92% of respondents felt that this system was beneficial because it is easy to practice and helps to control certain soybean diseases in their fields (68%). Farmers in Kananga and those in Kilo 20 are more likely to adopt the practice of using soybeans with other crops such as groundnut, cowpea and maize.

Table 2. Socio-economic characteristics of the farmers surveyed (n = 100)

Qualitative variables		
Variables	Terms	Absolute frequencies (%)
Gender	Women	16
	Men	84
Family status	Single	9
	Married	77
	Divorced	14
	None	1
Level of study	Primary	20
	Secondary	76
	University	3
Main activity	Agriculture	95
	commerce	5
Membership in an association	Yes	65
	No	35
Experience in agriculture	0 to 5 years	9
	5 years to 10 years	33
	More than 10 yearsold	58
Number of years of soybean growing practice	2 years	18
	3 years	19
	4 years	41
	Others	22
	Family	93
Labour input used	Paid	6
	Traction	1
Quantitative Variables		
Age	Average	38, 52
	Standard deviation	±8,354

Table 3. Problems in the field and cultivation practices used

Variables	Terms and Conditions	Zones d'étude			Total (%)
		Kananga Frequencies (%)	Bena Ngoyi Frequencies (%)	Kilo 20 Frequencies (%)	
Problems in the soybean field	Lack of rain	0	3	3	6
	heavyrain	0	1	0	1
	Insects	15	4	11	30
	Diseases	16	23	20	59
	Others	2	2	0	4
Soil remediation methods	Organic fertilization	8	8	15	31
	Fallow land	25	25	19	69
Soil Satisfaction	Yes	33	29	31	93
	No	0	4	3	7
Cultures in association	Soy+Sour	25	12	25	62
	Soya+ corn	15	10	13	38
Cultural association	Easy	32	24	31	92
	Profitable	0	0	1	1
Satisfaction with the development of the cultural system	Soil quality	1	4	2	7
	Insect	16	2	7	25
	Diseases	17	28	23	68
	Weeds	0	1	0	1
	Rain	1	0	3	4
Number of weedings	soil	0	2	0	2
	Several times	29	27	29	85
	One time	4	6	5	15
Yield is good?	Yes	21	24	24	69
	No	12	9	10	31

Regarding the number of weeding practices in the field, farmers in different villages surveyed adopt weed control by weeding their fields several times. 29% of farmers adopt this innovation more in both Kananga and Kilo 20 villages. With regard to farmers' appreciation of yield, the results show that a large proportion of farmers, nearly 69%, appreciate that their yields are good in the field, compared to 31% who do not.

DISCUSSIONS

Socio-economic and Demographic Characteristics

In the Kabinda sector, agriculture is much more practiced by men at 84%. However, men have more ease in technology transfer and inputs compared to women (Sale et al, 2014). The results of this study corroborate that of Aihounton, (2012) who, in his research on agricultural production in northern Benin found that men (93%) are more agricultural actors than women because of their status as heads of households and access to land which is also facilitated for the latter. This situation is also due to socio-cultural factors, such as the distribution of land resources according to gender with distribution criteria leaning in favor of men. Our results are perfectly related to those of Paraïso et al. (2012) and Yegbemey et al. (2014), who show that agriculture is mainly practiced by men in Benin. According to the analysis of the level of education variable, most of the respondents are young with medium secondary education (77%). The results obtained on association membership are consistent with those of Aihounton (2012) according to which farmers in Benin live in agricultural associations. This has a positive impact in the transfer of new technologies, to benefit from the interventions of development aid structures in order to improve their production. Farmers' associations allow to accompany the adoption and transfer of agricultural innovations, and this beyond technical innovations and farming practices. Our results show that rural labor is a key factor that positively and significantly influences sustainable soybean production.

Adoption of innovative methods

The study shows that fallow land is used more by producers (69%) for soybean cultivation. 31% of the respondents produce soybeans by bringing organic matter into their fields.

The adoption of fallow as a soil restoration technique by farmers is of paramount importance in the sense that the soils in the study area are ferrallitic soils with a very low fertility level characterized by deficiencies in nitrogen, phosphorus and various elements. However, Hounngandan (2015) explains that soybean cultivation requires neither fertilizer nor fertile soil, it is not very demanding but above all it improves soil fertility and reduces its salinity. We also note that the practice of farmers in different villages surveyed is often similar. This is explained by the fact that farmers tend to imitate each other in their choice of speculation and cultivation practices (Balasha and Kesonga, 2019). The study shows that crop association is practiced by a majority (92%) of the farmers surveyed. These soybean farmers who have opted for crop association state that the practice of this system is easy and reduces insect and weed attacks in the fields. It should also be noted that the adoption of the soybean+but+arachid cropping system is beneficial to farmers in the study area because each of these crops benefits from the other. Soybean and groundnut fix atmospheric nitrogen in the soil; and maize is a staple for soybean and benefits from the nitrogen fixed by soybean and groundnut. The crop diversification strategy is adoptable because it helps maintain soil fertility, promotes an enabling environment and provides greater income security for producers (Bonté, 2010). There are several reasons why producers in the study area have adopted this innovative crop association system. These reasons included: the control of soybean diseases (68%), defense and protection of the soybean crop against undesirable insects (25%). The remaining 4% opt for the remediation of the rainfall problem and 2% for the soil quality problem. At the end of the yields obtained in their field some producers (69%) are satisfied with the results and others (31%) are not.

CONCLUSION

Kabinda's agriculture plays a fundamental role in the economy of this population in terms of employment and source of income. It plays an essential role in the process of economic and social development. The soybean sector is a new promising sector for agriculture in Kabinda. Soybeans are mainly used for human and animal food. In the Kabinda sector, few women are involved in agricultural activities. The producers also have an average level of education and the majority of farmers are in contact with the associations that are the

bearers of agricultural innovations. It appears from our study that soybean production is characterized by the combination of crops (soybean + groundnut) and (soybean + maize), the practice of fallow for the restoration of soil fertility, and the use of weeding several times in their fields to control weeds. The main factors that determine soybean yield are: gender, age, level of education, membership in a farmer group, farming experience, number of years in soybean production, and the type of labor used to harvest soybeans. The identification of these factors of production will enable soybean farmers to combat the decline in soybean productivity in order to effectively increase their income while helping the city of Kabinda reduce poverty and ensure food security.

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