Journal of Agricultural, Food Science & Biotechnology

JAFSB, 3(1), 92-99, 2025
https://doi.org/10.58985/jafsb.2025.v03i01.69
ISSN (Print): 2959-3417

Research Article

Impact of market information systems on the income of Cowpea farmers in the Senegalese groundnut basin

Mor Ngom*

Economist at the Socio-economic unit of the Senegalese agricultural Researches Institute (ISRA) and member of the institution and growth laboratory of Cheikh Anta Diop University, Dakar, Senegal.

Received: 30 January 2025
Revised: 11 March 2025
Accepted: 17 March 2025
Published: 29 March 2025

Academic Editor
Prof. Dr. Gian Carlo Tenore

Corresponding Author
Dr. Mor Ngom
E-mail:
morngom49@gmail.com,
Tel: +221 774519919

Keywords
Market, positive impact, farmers, income, Senegalese peanut basin.

Abstract

To overcome marketing constraints, farmers are increasingly using the Market Information Systems (MIS). These collect, process and disseminate information on the situation and dynamics of agricultural markets. Despite their importance, MIS is not widely used in the Senegalese agricultural context. This paper aims to evaluate the economic impact of the Market Information System on the income of cowpea farmers in the Senegalese groundnut basin. For this purpose, we conducted a survey of 105 cowpea farmers established in the groundnut basin using *yeugglé* MIS. Also, a group of 120 cowpea farmers who were not using the MIS was included in the study to constitute the counter factual. The results of the average effect of treatment on treaties (ATT) show a positive impact of the use of MIS on the income of cowpea farmers in the groundnut basin. In fact, the use of MIS enabled farmers to improve their income by an additional 28,030 FCFA where the average income is 67,071 FCFA, i.e. an increase of 42% and 46 % compared to untreated. Cowpea farmers, who are users of the MIS therefore earn more income insofar as they are more aware of product prices in different markets. As a result, they make better trade-offs in time (time of sale) and in space (sales market) compared to other farmers not using MIS. Clearly, MIS users negotiate better in the market because of their level of information.

1. Introduction

Incomplete and asymmetric information on prices, quantities offered and demanded and the quality of traded products are situations of uncertainty and risk for market participants [1]. Indeed, information is a fundamental element in the transparency of the markets [2]. and inaccessibility of the various actors to the right information represent dysfunctions that can affect their efficiency. Some authors note, as consequence, a price dispersion which can be reduced by setting up a dynamic information system [1, 3, 4]. According to Jensen [3]. limited or expensive information does not give the various market players the opportunity to make optimal tradeoffs and goods are not allocated efficiently. Most of the time, the right information is held by a minority of actors to the detriment of others. These information asymmetries are also noted in agricultural markets. In fact, small operators are less well informed than larger ones, farmers and consumers being less well informed than traders. According to Spepherd [4], access to reliable and timely information should enable farmers to choose the markets they want to commercialize their products, the timing of sales, and to negotiate with better-informed intermediaries.

In high-income per capita countries, the internet has revolutionized the way goods and services are produced on the one hand. On the other hand, in underdeveloped countries, the production and sharing of information and new knowledge remain the property of a small group of people due to limited

and expensive access okto Information and Communication Technologies (ICT), especially the internet and mobile phones. Hence the need to create formal market information services. The increase of farmers' bargaining power *vis-à-vis* traders, after the introduction of information systems, was mentioned by authors such as Galtier [7] and Svenson and Yanagizawa [20]. According to David Benz et al. [6], there are two ways to improve bargaining power: a change in marketing strategy or a firmer attitude to price negotiation. Beyond improved bargaining power, the accessibility and the availability of information inevitably lead to lower transaction costs (Stiglitz, *op.cit*.). The recognition of the importance of information in the markets and especially in agriculture has led several countries, in particular the Sahel countries, to set up a market information system. In Senegal, cowpea was part of agricultural products followed by first-generation MIS in addition to cereals (millet, maize, sorghum, imported rice, etc.). Indeed, the Office of the Commissioner for Food Security (CSA), supported by the Bureau of Macroeconomic Analysis (BAME) and the regional agricultural and trade inspectorates, broadcasted through radio and newsletters (weekly, monthly and annual) information on the producer price, the wholesale and wholesale price, the retail prices, the quantities present on the rural markets, the days collected and the various information on the affluence, etc. Later, in 2013, under the framework of the Agricultural Sector Support Project (PAFA), a market information system was set up. This system, named *Yeugglé (it means to inform in Wolof, a local language)*, like other second-generation system, collects, process and disseminates weekly information on cowpea prices in reference markets of the groundnut basin. The objective of this paper is to evaluate the impact of the MIS on the income of cowpea farmers in the Senegalese groundnut basin.

2. Materials and methods

2.1. Choice of areas and farmers to investigate

We conducted a survey on cowpea farmers in the groundnut basin. This survey involved two types of farmers: those who use MIS *Yeugglé* (the treatment group) and those who do not use it (the control group).

2.1.1. The treatment group

It consists of farmers who use the *Yeugglé* market information system. The latter is managed by the cowpea chain set up by the Agricultural Sector Support Program (PAFA). Like other MIS, cowpea prices are collected weekly at the market (these are mainly the markets of Diourbel, Bambey Serere, Ndiguiraye, Gaouane), and disseminated by telephone messages to the farmers of this sector table which has, indeed, become a national framework for dialogue on the sector.

Three municipalities were chosen. These are Ndinguiraye (Bambey), Ndindy (Diourbel) and Niakhar (Fatick). Overall, 14 villages belonging to these three municipalities benefit from the Yeugglé information system. We adopted a 50% survey rate to randomly select 7 villages through stratification by village. In each village, 15 farmers were randomly selected and surveyed. Thus, the treatment group (beneficiaries of the *Yeugglé* MIS) consists of 105 farmers.

2.1.2. The control group

The choice of the control villages is motivated, first, by their geographical position (not close and not very far from the communes of treatment); this avoids oil spills or contamination between the two groups. Indeed, if the treatment zones and the control zones are close, there can be information sharing, which will lead to selection bias. Second, the same speculations are grown in both areas. Thirdly, the pedoclimatic characteristics in the two zones are identical. These last two criteria are used to ensure that the quality of soil and the pluviometry that falls are almost the same in both zones, which allows us to respect the principle of comparability.

To do this, we randomly choose 4 villages in each commune, which makes an overall of 8 villages. In each village, 15 farmers were randomly selected and surveyed. In overall, we have a control group of 120 cowpea farmers.

2.2. Choosing an evaluation method: propensity score matching (PSM)

After an overview of the different methods of impact evaluation, we have retained in this study, the use of pairing under the propensity score. Indeed, random methods cannot be used; in any case, in our database,

https://doi.org/10.58985/jafsb.2025.v03i01.69

the attribution of the treatment (here the use of the MIS) is not random [13]. Being in the presence of selection bias, it is mandatory to resort to a treatment or even a methodology that would circumvent this problem. Like Mendola, [14], the propensity score procedure seems to be the most appropriate in our case. The interest of this method is not to base the modeling of the selection process in the devices on too heavy assumptions. Propensity score matching (PSM) is also chosen as a method because it removes biases due to observable characteristics of individuals. In addition, this method divides farmers into two groups (control and treatment), ensuring that the result observed in the absence of use of market information in the control group is statistically representative of what would have been observed in the absence of use of market information in the treatment group. This matching technique thus makes it possible to measure the impact on income of the use of the MIS when the information on the pre-treatment situation (before the producer uses the MIS is not available. In the end, the average treatment effect on treaties (ATT) is:

$$ATT = E(Y_{i1} - Y_{i0}|T_i = 1)$$

And the average effect on the whole population is:

$$ATE = E(Y_{i1} - Y_{i0})$$

2.2.1. Principle of the model

The principle is to compare everyone with “his twin”. Basically, the pairing uses statistical techniques to produce an artificial comparison group by looking for, for each participant, an observation (or series of observations) of the non-status group that has the most similar observable characteristics possible.

2.2.2. Working hypotheses

H1: Differences between beneficiaries and non-beneficiaries capture all the determinants of beneficiary selection. This means that the fact that one individual is treated and not another is not due to expected differences in potential earnings. This assumption is better known under the name of CIA or Conditional Independence Assumption that Y0, and Y1 are orthogonal conditionally to X (vector of variables).

H2: This hypothesis means that for all observable values, treated and untreated individuals can be compared. We speak of common support (or overlap)

Whatever x, 0 <P (D = 1 / X = x) <1

This relationship forces our propensity score to be different from 1 and 0. This improves the quality of matching as the extremes of the P (X) distribution are excluded. However, this is achieved at the cost of reducing our sample. However, non-parametric approaches can only be applied significantly to regions where the condition of the common support (or overlap) is verified [7,12,14, 16, 18].

2.3. The matching

The closest neighbor pairing is probably the most commonly used matching estimator. It is quite simple to implement, its principle is intuitive and unlike variants. Two criticisms can be addressed to it. The first is that we do not control the quality of the pairing, the concept of nearest neighbor is (by nature) relative. Some "closer" neighbors may be distant. However, the nearest neighbor method treats close and less close couples in the same way. The second criticism is that pairing with a single individual deprives the information provided by all the others, which reduces *a priori* the accuracy of the estimate. For example, some beneficiaries may have several very close twins. We can consider that it is a pity to choose (more or less arbitrarily) only one. So, there are several variations, which are the way we build the counterfactual of each beneficiary. In practice, it will therefore be estimated (Y_i0) using more or less people in the control group. The matching method used in this study is with kernels proposed by Heckman et al. [10-12], which are based on non-parametric core regressions of the corresponding regression functions. In other words, this matching method uses weighted averages of all individuals in the control group to construct the counterfactual. It is a question of retaining, for each treated individual, all the untreated individuals, but by assigning them a weight inversely proportional to their "distance" with the treated individual. According to Frölich [17], this method gives the most accurate results, especially since the distance is measured reliably in the process. To analyze the data, we use Stata and the following results have been found.

3. Results and discussion

3.1. Descriptive statistics

The age of cowpea farmers is between 20 and 80 years

https://doi.org/10.58985/jafsb.2025.v03i01.69

Table 1. Descriptive statistics

Variables	Observations	Means	St. dev	Min	Max
Age	225	49.95	11.76	20	80
Cultivated area in hectare	225	1.42	0.77	0.2	4
Number of plots	225	1.27	0.56	1	4
Distance between the field and the flow market in kilometers	225	9.03	6,7	0	30
Income in *CFA*	212	67 070.5	56 446.62	8000	210 900
Number of years spent in cowpea	225	20.25	11.35	0	60
Production in kilogrammes	219	440	294	45	1700

Source: ISRA/BAME, 2016

old. Their average age is 50 which means that cowpea production is generally practiced by adults and reflects some experience of cowpea farmers in this activity.

The areas planted with cowpea are estimated at an average of 1.4 ha with a minimum of 0.2 ha and a maximum of 4 ha. Cowpea production is estimated at an average of 440 kg per hectare with a minimum of 45 kg and a maximum of 1700 kg. The average distance between the flow market and the field is 9km with a maximum of 30km. The average income from the sale of production is estimated at 67, 070 FCFA.

The number of years spent growing cowpea is different from one farmer to another. It turns on average around 20 years. The least experienced is in his first campaign and the most experienced has spent 50 years there (Table 1).

Nearly 47% of cowpea farmers in our sample use MIS. The farmers are composed of 60% men and 40% women. The proportion of farmers who have no education in French is high (83%). Only a small proportion of farmers have a primary education. Regarding membership in a farmers' organization, the results show that 30% of farmers are affiliated with these organizations (Table 2).

Table 2. Other important descriptive statistics in terms of frequencies

Do you use market information?	Numbers	Frequency in %
Yes	105	46.67
No	120	53.33
Overall	225	100
Sex of cowpea famers		
Men	134	59.56
Women	91	40.44
Overall	225	100
Level of education in French		
No level	187	83.11
Primary	32	14.11
Secondary	4	1.78
Superior	2	0.89
Overall	225	100
Belonging to a peasant organization		
Yes	156	30.67
No	69	69.33
Overall	225	100

Source: ISRA/BAME, 2016

3.2. Impact of using MIS

The results of the average effect of treatment on treaties (ATT) show a positive impact of the use of MIS on the income of cowpea farmers in the groundnut basin. In fact, the use of MIS enabled farmers to improve their income by an additional 28,030 FCFA where the average income is 67,071 FCFA, i.e. an increase of 42% and 46 % compared to untreated (Table 3). Cowpea farmers, who are users of the MIS therefore earn more income insofar as they are more aware of product prices in different markets. As a result, they make better trade-offs in time (time of sale) and in space (sales market) compared to other farmers not using MIS. Clearly, MIS users negotiate better in the market because of their level of information. In fact, the improvement of bargaining power can go through two channels: a change in marketing strategy or a firmer attitude when negotiating prices.

Studies by Subervie and Galtier, Svenson and Yanasizawa, Aker and Jensen [1, 3, 5, 20,], show that the use of MIS has an impact on the reduction of price dispersion on the market, increases the farmers' bargaining power vis-à-vis traders and creates a positive effect on the sales price received by farmers. For Kpenavoun and Gandonou [2], and Subervie and

https://doi.org/10.58985/jafsb.2025.v03i01.69

Table 3. The real impact of treatment on treaties

Variable	Sample	Traited	Controls	Difference	S.E.	t-Stat
Income	Unmatched	90120.7865	49520.6522	40600.1343	7510.76282	5.41
	ATT	88963.7931	60933.8249	28029.9682	18700.6359	1.50

Source: ISRA/BAME, 2016

Galtier [1, 19], the use of MIS by farmers has a positive effect on the reduction of transaction costs. According to Jensen [3], when information is limited or expensive, economic agents are not able to make optimal tradeoffs. Market price dispersion can increase, and goods are no longer efficiently allocated. In this case, information technology can improve market performance and well-being. He criticizes advocates of the thesis that low-income farmers need more help like nutrition, health, education and information.

Jensen's [3] idea is widely shared by Subervie and Galtier [1, 19], and Aker [1], who also showed in their respective researches a reduction of the price dispersion following an improvement of the information even if the adopted methodologies are different.

Jensen [3] retorts that they forget that the post-harvest activities play an important role in determining the income of households that are active in agriculture, fishing and forestry. Jensen's study area is Karela, a state of India with many fishmongers, where mobile telephony was introduced between 1999 and 2001. He used the gradual widening of the GSM network coverage as a natural experience to estimate many effects with microeconomic data by comparing the markets of the regions covered with the markets of the regions not yet covered. Thus, 20 individuals were interviewed in 15 markets every Thursday, between September 1996 and May 2001, for a total of 74,700 observations. The analysis showed that the adoption of mobile phones by fishermen and traders led to a drastic reduction of price dispersion, an elimination of the loss, a very strong adherence to the law of the single price. The well-being of farmers has increased as well as that of consumers.

Aker [1], meanwhile, evaluated the impact of mobile phones on markets in Niger. He noted between 2001 and 2006, a development of cell phone service throughout Niger. This offers a cheaper alternative and search technology for grain traders and other market players. He first exploited the quasi-experimental nature of mobile phone coverage to estimate the impact of the introduction of information technology on market performance. The results provide evidence that cell phones have reduced the dispersion of market grain prices by a minimum of 6.4% and reduced intra-year price variations by 12%. Cell phones have a greater impact on price dispersion for markets that are further away and for those with poorer road quality.

These results of the Aker [1] study are like those of many other authors [7, 9, 21, 22]. The latter also highlighted, as Aker [1]. The reduction of the commercial margins when there is a setting up of an informational device on the prices.

Studies have also shown that the use of price information across different delivery channels has a positive impact on the commercial performance of farmers regardless of the channel of diffusion and the mode of transaction (Kpenavoun and Gandonou, [23].

Subervie and Galthier [15, 19], estimated the impact of a mobile phone-based MIS (Esoko) in Ghana. This private MIS managed by a company based in Accra distributes to its subscribers, the price of the main agricultural products in local and distant markets through SMS. They also assessed the impact of a radio program called Soko Hewani, intended to provide Kenyan farmers with price information collected by MIS KACE.

Regarding the study on mobile telephony in Ghana, original data was collected from a group of four hundred service users (from the farmers and members of the NGO SEND-Ghana) and from two hundred non-user farmers, distributed in four districts of the Northern Region and the Volta.

For the Soko Hewani radio program in Kenya, the proposed empirical analysis is based on original data collected from a group of 1,500 maize farmers in four districts of the Rift Valley and Nyanza provinces, where access to the SIM service is variable since it depends on the radio coverage.

https://doi.org/10.58985/jafsb.2025.v03i01.69

To evaluate the impact of these two programs, the analysis method used is based on a matching procedure that consists of a comparison of the commercial performances of the users and those of non-users of MIS having similar characteristics.

The results lead to a significant effect of SIM Esoko on the commercial performance of users up to 10% in the increase in the selling price of maize and groundnuts. Compared to the Soko Hewani radio program in Kenya, the impact on estimated selling prices is imprecise in the case of maize (an increase of 6% selling price) as in the case of beans (an increase of more than 20% in the sales price, significant effect at the 15% threshold) and we cannot exclude a null effect of the service studied.

Svenson and Yanagizawa [20], assessed the impact of a market information system in Uganda. They took the case of maize, which is the most important cereal in Uganda, and an information system that collects weekly market-level data on different agricultural products and disseminates it through local radio. They applied the double difference between the farmers of the villages having access to the radio and the farmers without access to the radio. The analysis of the results shows that access to market information is correlated with a high selling price which confirms the assumption that market information improves the bargaining power of farmers *vis-à-vis* merchants of the locality.

Kpenavoun and Gandonou [23], studied the effects of the information system on prices received by farmers. That's why they used a stratified random sample of 124 market-oriented corn farmers whose transactions are tracked for one year.

They used multiple linear regression as a model of econometric analysis with the price received by the producer for the transaction as a dependent variable. The results show a positive effect on the price received by the maize producer regardless of the chosen transaction mode (contract sale, remote market sale and village sale without a contract). The average difference in maize price per kg between farmers using the Public Market Information System (SPIM) and the others is 23%.

However, the work of Fafchmps and Minten [8], resulted in an insignificant impact. Indeed, they evaluated the benefits that Indian farmers derive from market and weather information delivered to their mobile phones by a commercial service called Reuters Market Light (RML). Conducting a controlled, randomized experiment in 100 villages in Maharashtra. They found that the treatment affected the spatial tradeoffs of farmers, but the magnitude of these effects is small. They also found no statistically significant effect of treatment on the price received by farmers. This result is explained by the fact that most of the farmers interviewed in this study sell their products at auction on the wholesale market. This suggests that the relevance of MIS to farmers depends in part on how they sell their production and the degree of competition in the markets.

However, it should be noted that the impact studies made with robustness are few as we know. Indeed, in most cases, impact assessment methods with treatment groups and control groups are not widely used. In addition, the methodologies adopted for measuring well-being from information received in the markets are debatable, leaving aside other variables that are "explanatory of well-being" [1, 3]. Farmers, on whom the impact is measured, receive information about other markets and relocate their place of sale, this raises the problem of the isolation of treatment on treaties [8]. Added to this is the sharing of information that can skew the results of the impact assessment. Indeed, some farmers in the treatment group, members of NGOs or mainstream organizations, also benefit from other programs likely to increase their commercial performance [1, 15]). Some results found are not transferable as contexts are often specific to the study. However, most of these results deal with what we found in our research. Indeed, the use of market information system has a positive impact on the incomes of cowpea farmers in the Senegalese peanut basin and increases their bargaining power. This allows users the possibility to make better trade-offs regarding time and space. Although the authors do not have the same outcome variables and the same area of intervention, they found results attesting to the positive impact of using information systems.

4. Conclusions

Ultimately, it was expected that the use of MIS, increase the welfare of farmers and consumers and

https://doi.org/10.58985/jafsb.2025.v03i01.69

better manage public and private stocks (Inter-networks, CTA, 2008). This paper aimed to assess the impact of the use of the market information systems on the incomes of cowpea farmers in the Senegalese groundnut basin. It was conducted using a database from a survey of two groups of cowpea farmers: one uses MIS and the other does not. The chosen methodology is propensity score matching. The results of estimates of the average effect of treatment on treaties (ATT) show a positive impact of 42% on the treaties. In other words, the use of the MIS enabled cowpea farmers to improve their income by 28,030 FCFA. This result shows the importance of MIS in the marketing of agricultural products insofar as it brings to the attention of actors in the agricultural sectors, in general, and cowpea farmers, in particular, the situation of agricultural markets. The latter thus become better informed; this not only increases their bargaining power vis-à-vis traders but also allows them to make better tradeoffs in time and space.

These results allowed us to formulate the following economic policies:

- ✓ Implement training programs for agricultural actors, especially farmers, on agricultural information systems in general and market information systems in particular.
- ✓ Establishment of market information systems in all accessible agro-ecological zones where farmers can provide feedback and be linked to other systems that disseminate climatic and agronomic information, enabling farmers to reduce the risk and uncertainty they face.
- ✓ Considering market information systems as an instrument to fight dispersion and price volatility in agricultural markets.
- ✓ The integration of agronomic, meteorological and even livestock information and MIS would further improve farmers' incomes and others actor(s) too, and in turn help to achieve food security.
- ✓ The main limitation of this paper lies in the method used to select the groups. The results would be more robust if the two groups had been randomly selected before the start of the intervention. This would have enabled us to use the randomized controlled effect. As we were unable to do this, we resorted to propensity score matching. But the results remain interesting.

Authors' contributions

It is not applicable because a single author constructed this manuscript.

Acknowledgements

The authors don't have anything to acknowledge.

Funding

This research received no external funding.

Availability of data and materials

All data will be made available on request according to the journal policy.

Conflicts of interest

The authors declare no conflict of interest.

References

1. Aker, J.C. Does digital divide or provide? The impact of cell phones on Grain Market in Niger, Center for Global Development Working Paper No. 154, 61 pages. 2008. https://doi.org/10.2139/ssrn.1093374
2. Caliendo, K. Some practical guidance for the implementation of propensity score matching. 2005. https://doi.org/10.2139/ssrn.721907
3. Jensen, R. The digital provide; Information (technology), Market Performance and welfare in south Indian Ficheries sector. *Quart.* J. Econ. 2007, 122(3), 879–924. https://doi.org/10.1162/qjec.122.3.879
4. Stiglitz, J.E. 2001. Information and the change in the paradigm in economics. Am. Econ. Rev. 2002, 92(3), 460–501. https://doi.org/10.1257/00028280260136363
5. Subervie, G. Estimation de l'impact de SIM basé sur la téléphonie au Ghana page 31-54, Rapport d'étude pour le projet « système d'information de marché de 2ème génération en Afrique Sub-saharienne : Innovation et Impact », 78 pages, 2012. https://agritrop.cirad.fr/568967/1/document_568967.pdf
6. David, B. et al. Les systèmes d'information sur les marchés agricoles en Afrique Subharienne, de la première à la deuxième génération, 2012. https://agritrop.cirad.fr/564805/
7. Galtier. F.; Egg, J. Le paradoxe des systèmes d'information de marché, Économie et Société. 2003. https://agritrop.cirad.fr/525875/
8. Fafchmps, M.; Minten, B. Impact of SMS-Based Agricultural Information on Indian Farmers: World Bank Econ. Rev. 2012, 26(3), 383–414. https://doi.org/

https://doi.org/10.58985/jafsb.2025.v03i01.69

10.1093/wber/lhr056

9. Goossens, F.; Minten, B.; Tollens, E. Nourrir Kinshasa, l'approvisionnement local d'une métropole africaine. 68 pages, 1994. https://search.worldcat.org/fr/title/31677893
10. Angrist, J.D.; Imbens, G.W.; Rubin, D. B. Identification of causal effects using instrumental variables. J. Am. Statis. Assoc. 1996, 91(434), 444–455. https://doi.org/10.1080/01621459.1996.10476902
11. Heckman, J.J.; Ichimura, H.; Todd, P.E. Matching as an econometric evaluation estimator: Evidence from evaluating a job training programme. Rev. Econ. Studies. 1997, 64, 605–654. https://doi.org/10.2307/2971733
12. Heckman, J.J.; Ichimura, H.; Todd, P. Matching as an econometric evaluation estimator. Rev. Econ. Studies. 1998, 65(24), 261-294. https://doi.org/10.1111/1467-937x.00044
13. Rubin, D. Estimating causal effects of treatments in randomized and non-randomized studies. J. Edu. Psychol. 1974. 66, 688-701. https://doi.org/10.1037/h0037350
14. Mendola, M. Agricultural technology adoption and poverty reduction: A propensity –score matching analysis for rural Bangladesh. Food Policy. 2006, 32. https://doi.org/10.1016/j.foodpol.2006.07.003
15. Subervie, G. Estimation de l'impact de SIM basé sur un programme radio au Kenya, page 55-73, Rapport d'étude pour le projet « système d'information de marché de 2ème génération en Afrique Sub-saharienne : Innovation et Impact », 78 pages, 2012. https://agritrop.cirad.fr/568972/1/document_568972.pdf
16. Dehejia, H.; Wahba, S. Propensity score-matching methods for nonexperimental causal studies. Rev. Econ. Statis. 2002, 84(1), 151-161. https://users.nber.org/~rdehejia/papers/matching.pdf
17. Frolich, M., Propensity score matching without conditional independence assumption with an application to the gender wage gap in the United Kingdom. Econ. J. 2007, 10, 359–407. https://doi.org/10.1111/j.1368-423x.2007.00212.x
18. Rosenbaum, P.R.; Rubin, D.B. The central role of the propensity score in observational studies for causal effects. Biometrika. 1983, 70(1), 41-55. https://doi.org/10.1093/biomet/70.1.41
19. Gertler, et al, L'évaluation d'impact en pratique, 2011. https://www.eval.fr/wp-content/uploads/2018/12/e%CC%81valuation-dimpact-eval.fr_.pdf
20. Svensson. J.; Yanagizawa, D. Getting Price Right: the impact of the market information service in Uganda. J. Eur. Econ. Assoc. 2009, 7(2-3), 435–445. https://doi.org/10.1162/JEEA.2009.7.2-3.435
21. Tollens, E. Market Information Systems in sub-Sahara Africa Challenges and Opportunities. Paper prepared for International Association of Agricultural Economists Conference, Gold Coast, Australia, August, 12-18, 2006. https://ideas.repec.org/p/ags/iaae06/25590.html
22. Wade, Système d'information de marché, coordination et gestion des risques dans les filières agricoles : cas des produits maraichers au Sénégal, 277 pages, 2009. https://www.bameinfopol.info/IMG/pdf/These-IWADE_20-01-09_complete.pdf
23. Kpenavoun, G. Effet du système public d'information sur les marches (SPIM) sur les prix reçus par les producteurs de maïs au Bénin, 13 pages, 2013. https://orbi.uliege.be/bitstream/2268/163776/1/Article%205%20BRAB%20N%2073_juin%202013_Kpenavoun%20et%20Gandonou_Effet%20du%20SPIM.pdf

https://doi.org/10.58985/jafsb.2025.v03i01.69