



## Socio-Economic Factors and Their Influence in Adoption of Agricultural Technologies Under Subsistence Economy; A Case of Tissue Culture Banana in Uganda.

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### Abstract

Uptake of improved agricultural technologies like banana tissue culture still remains low despite the efforts that have been put in place to enhance its adoption. A survey was carried out on 115 small holder farmers in central Uganda to establish the influence of various socio-economic factors on the adoption of tissue culture banana between January and July 2018. Findings from the study revealed that respondents' main occupation ( $P = 0.028$ ), market accessibility ( $P = 0.006$ ) and proximity to source of planting materials ( $P = 0.000$ ) were the major drivers to adoption of tissue culture banana. The study thus recommended establishment of regional distribution centers for tissue culture banana plantlets, increased investment in extension in order to strengthen the farmer-researcher linkage and increased market access.



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### Introduction

Governments world over have used improved technologies as a major strategy towards increased agricultural productivity; promotion of food and livelihood security; employment creation and poverty alleviation.<sup>1</sup> However, uptake of such improved technologies in many developing countries has been influenced by various of socio-economic factors such as age, gender among other farm and farmer characteristics. This is in relation to the findings

of Langat who notes that farmer characteristics such as; gender, employment status, family size, education level and age, while farm characteristics which include; farm size, land tenure, off-farm income, distance to the nearest market, income diversification and access to extension service have had a great impact on the adoption of tissue culture banana technology amongst many farming households in Western Kenya.<sup>2</sup> Further studies done in Kenya reveal that access to tissue culture

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banana plantlets increases the likelihood of farmers to adopt the technology while age is also important, with younger farmers more likely to adopt.<sup>3</sup> They further state that farmers who engaged in off farm occupation are likely to intensify tissue culture banana production by expanding banana acreage using the superior tissue culture banana plantlets for enhanced production which is in line with economic theory that more income means higher purchasing power for consumers. Labour availability, family size and contact with government extension agents were equally crucial in enhanced investment in tissue culture banana technology.

Banana and plantain (*Musa spp.*) commonly called banana is an important world food crop that is important to food security and livelihoods of millions of small holders in many tropical countries<sup>4</sup>. The vast majority of global banana production is for domestic consumption with a high proportion of production coming from small farm and gardens.<sup>4</sup> In Uganda, the largest producer of banana is western region particularly Isingiro district with a production of 204,109 tons/ per year followed by Mubende district

in the Central (204,109 tons/ year), Mbale in the East (99,011tons/year) and lastly Arua in the North (17,106 tons/year).<sup>5</sup> However, banana is under a threat of reduced productivity and sustainability and the actual banana yields on small holder farms are far from the estimated potential yield.<sup>6</sup> The banana bunch weight at farm level has been noted to drop from 60Kg to less than 10Kg and this decline has contributed to food shortages and subsequently putting banana consumers at a risk of food insecurity particularly in areas where banana is considered a staple food crop.<sup>7,8</sup> The reduction in productivity is attributed to a number of biophysical and socio-economic factors, thus the need to adopt of banana tissue culture technology with an aim of increasing food production as well as livelihood security.<sup>9</sup>

Thus, this current study opted to enlist the socio-economic factors and how they affect the adoption of banana tissue culture technology among smallholder farmers in central Uganda. This will accelerate banana production and then offer food and income security for the farmers.

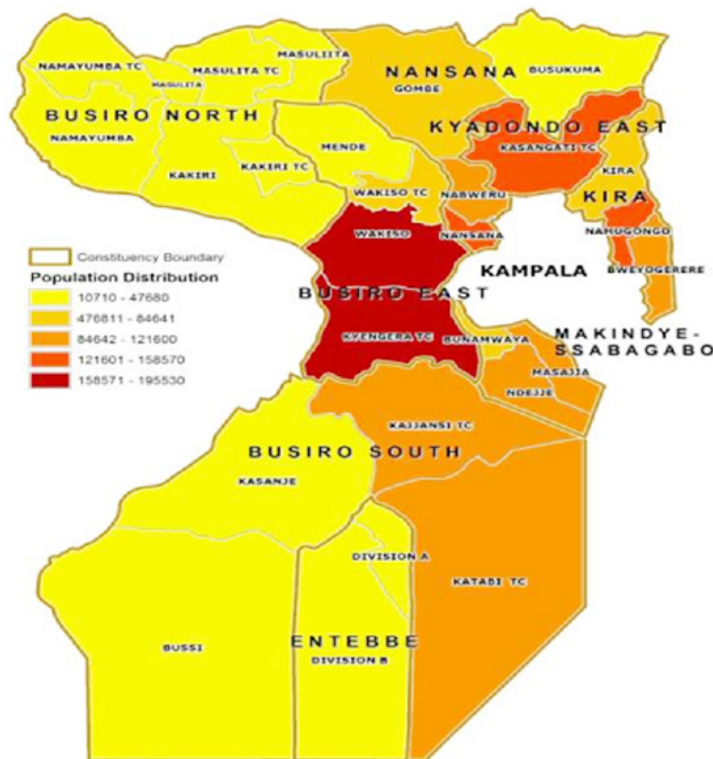


Fig.1: Map showing study area and population distribution: Source UBOS<sup>11</sup>

## Materials & Methods

### Description of Study Area

A survey was carried out amongst smallholder farmers in Wakiso district, central Uganda (Figure 1). The district lies between coordinates 00°24'N and 32°29'E and neighbors Mpigi, Luwero, Nakaseke and Kiboga districts in the North, Mukono in the East and Kalangala to the South. The district covers a total area of 2807.7 square kilometers with lakes and rivers covering 52% of the total area, crop lands covering 42% and forests taking up 4%. The area lies in the Lake Victoria crescent agroecological zone and receives bi-modal rainfall with an annual average of 1320mm received in the months of April, May, October and November. The temperatures vary annually from 19°C to 27°C and relative humidity varies from 57% to 97%. The soils are generally of high productivity and are mainly sandy clay soils. The district is characterized by isolated flat-topped hills with steep slopes often merging abruptly into long and gentle pediments, which are usually dissected by relatively broad valleys. Generally, climate in Wakiso is warm and wet with relatively high humidity which favors rapid plant growth.<sup>10</sup> Wakiso district has a population of 1,997,418 accounting for about 6% of Uganda's population with 69% of the households deriving their livelihood from subsistence farming.<sup>11</sup>

Wakiso District is one of Uganda's major agricultural production areas with 12.1% of its population growing bananas.<sup>11</sup> The study area is also a beneficiary of the National Agricultural Advisory Services program (NAADs) as well as Operation Wealth Creation program (OWC) which are mandated to support management of agricultural input distribution chains and strategic interventions for value chain development focusing on the upper end of the commodity chains. These programs supply selected agricultural inputs to farmers such as seeds, fertilizers, pesticides amongst others. Through these programs, small holder farmers are supplied with tissue culture banana plantlets in a bid to increase banana production. In addition, the farmers receive free agricultural advisory services from the agricultural service providers in relation to banana production.

### Study Design

An explanatory research design was used for this study. This type of approach uses qualitative data to back up explanations on quantitative data. This

research design offers flexibility thus providing an opportunity for considering different aspects of the problem under study.<sup>12</sup> Questionnaires were administered to respondents by the help of enumerators. These were used to obtain information regarding respondents' demographic characteristics, socio-economic aspects involved in banana tissue culture production as well as their influence in adoption.

### Unit of Analysis and Target Population

The unit of analysis for this study was the small holder farmer. Built into the epithet "smallholder" is the connotation of limited land availability.<sup>13</sup> Thus, a small holder farmer according to this research is described as a farmer who is involved in production of tissue culture banana on less than an acre of land for a period of not less than three years under various production systems. The study population was comprised of farmers growing tissue culture banana in Wakiso district while small holder farmers who had obtained tissue culture banana plantlets under NAADs/ OWC programs were highly considered for this study because they could easily be accessed. Extension workers aided in providing information regarding the beneficiaries of tissue culture banana plantlets under these programs.

### Sampling Procedure and Sample Selection

A sample of respondents for the study was obtained using purposive sampling. Purposive sampling is described as a random selection of sampling units within the segment of the population with the most information on the characteristic of interest.<sup>14</sup> Purposive sampling allows the researcher to use cases that have the required information with respect to the objectives of the study.<sup>15</sup> Thus, the researcher obtained lists of farmers who had obtained tissue culture banana plantlets under OWC/NAADS program from various sub counties within Wakiso from 2014 to 2016 with the help of the respective agricultural officers (Table 1).

Simple random sampling was then applied in order to eliminate bias and a total of 115 respondents were obtained. A sample size of 10%-30% is considered adequate for a descriptive study.<sup>16</sup> Therefore, considering the upper limit of 30% against the accessible population of 380, a sample size of 115 respondents is obtained.

**Table 1: Number of beneficiaries of tissue culture banana in Wakiso District.**

SUBCOUNTY	POPULATION	SAMPLE
Division A-Entebbe	34	10
Division B-Entebbe	40	12
Busukuma S/C	33	10
Kyengerera Town Council	51	16
Katabi Town council	49	15
Kasanje Town council	18	6
Kasangati Town Council	43	12
Namayumba S/c	65	20
Wakiso Town council	30	9
Kajjansi Town council	17	5
<b>Total</b>	<b>380</b>	<b>115</b>

Source: Office of the subcounty Agricultural Officers.

#### Data Collection

Household surveys and general observation were used to collect data from small holder farmers in Wakiso district, central Uganda between January and July 2018 from ten sub-counties in Wakiso district. Purposive sampling was used followed by simple random sampling and a total of 115 farmers were interviewed for the study. Both primary and secondary data was collected for analysis. Primary data was obtained through a household survey by use of a questionnaire and data as obtained directly from the farmers while secondary data was obtained through review of various documents and research papers. Questionnaires play a central role in data collection during surveys, census, case studies, experiments and document analyses.<sup>17</sup> The questionnaires therefore enabled the researcher to collect in-depth information and as well allow for further probing and building rapport with the respondents.

#### Data Analysis

The data collected was processed manually, edited, coded and entered in to Microsoft excel spread sheets. The data was then subjected to analysis using Statistical Package for Social Sciences (SPSS Ver.16.0)<sup>18</sup> and Microsoft Excel (Ver. 2013).<sup>19</sup> Excel was used to obtain frequencies of various demographic characteristics. Regression analysis was done to obtain levels of tolerance of various socio-economic factors, variation Inflation factors

and P values. The relationship between various socio-economic factors and adoption of banana tissue culture was also obtained and results were considered significant at  $P > 0.05$ .

The study revealed that 55.7% (n=64) of the respondents were male while 44.3% (n=51) were female which implied that more men took on tissue culture banana as compared to women. (Table 2). This is attributed to increased access to information as well as various production resources by men as compared to the women. Despite women being the main food producers, their lack of access to and control over the means of production such as secure land tenure, information, credit and control of labour could result in limited uptake of agricultural technologies.<sup>9</sup>

Gender variations cut across different age groups with majority (29.6%) of the respondents aged 36-55 (Table 2). Despite younger farmers being typically less risk-averse and more willing to try new technologies,<sup>20</sup> these findings showed that respondents aged between 36 and 55 years were more interested in TC banana technology adoption as compared to other age groups. This is attributed to their enhanced knowledge and experience in banana farming and specifically banana tissue culture. Older farmers are equally presumed to have gained knowledge and experience over time and are

better able to evaluate technology information than younger farmers.<sup>21, 22</sup>

Further analysis showed that the majority of the respondents had attained some degree of education with the majority having attained a minimum of secondary education (53%) (Table 2). This implies that adoption of TC banana is highly influenced by level of education of the respondent. The

attainment of secondary education by most of the respondents is attributed to the increased access to free education through the universal primary and secondary programs in Uganda. Educated farmers were more likely to adopt banana tissue culture and education level of a farmer increases the ability to obtain; process and use information relevant to adoption of a new technology.<sup>23,20</sup>

**Table 2: Demographic characteristics of tissue culture banana farmers in Wakiso District.**

Research Parameter (n=115)		Frequency	Percentage
Gender	Male	64	55.7
	Female	51	44.3
Age	15-25	14	12.2
	26-35	29	25.2
	36-55	34	29.6
	56-65	26	22.6
	Above 65	12	10.4
Education background	No formal training	1	0.9
	Primary level	20	17.4
	Secondary level	61	53.0
	Tertiary level	33	28.7
Main occupation	Farming	62	53.9
	Business	30	26.1
	Civil service	17	14.8
	Other (student)	6	5.2
Household headship	Male headed	89	77.4
	Female headed	26	22.6

Farming is the major economic activity of the people of Wakiso (53.9%) followed by business (26.1%), then civil service (14.8%) and other who mainly constitute of students (5.2%), (Table 2). This implies that respondents whose major occupation was farming had higher chances of adopting TC banana. This is because farmers can easily experiment new agro-technologies like banana tissue culture as compared to other respondents who are preoccupied with other activities.

Males dominated household headship (77.4%, Table 1). This implies that majority of the households

that adopted TC banana were male headed which is attributed to increased access to resources such as land, credit, information and extension services which are vital in adoption of agro-technologies. Male headed households equally have mobility, participate in different meetings and have more exposure to information related to tissue culture banana.<sup>24</sup>

#### **Influence of Socio-Economic Factors on Adoption of Banana Tissue Culture**

The findings of this study reveal that main occupation of the respondents was highly significant in the adoption of banana tissue culture ( $P < 0.05$ , Table 3).

Respondents whose main occupation was farming were most likely to adopt banana tissue culture at a percentage of 53% with an actual count of 61 against the expected count of 57.7 (Table 4). Similarly, respondents who mainly engaged in business, civil service and other occupations had rates of 23.5%, 13.9% and 2.6% respectively with higher expected counts of 27.9, 15.8 and 5.6 respectively

as opposed to their actual counts of 27, 16 and 3 respectively (Table 4). This implies that the people of Wakiso District adopted TC banana because they were farmers and thus could experiment new agro-technologies. Occupation of the respondent was equally significant in the adoption of land race ( $P < 0.05$ ) and hybrid banana ( $P = 0.05$ ).

**Table 3: Regressed demographic factors for TC banana adoption**

Coefficients <sup>a</sup> Model	Unstandardized Coefficients		Standardized Coefficients	T	Sig.	Collinearity Statistics	
	B	Std. Error	Beta			Tolerance	VIF
	1	(Constant)	-.105			.220	
	age of the respondent	-.022	.022	-.117	-.998	.321	2.137
	education level of the farmer	.036	.032	.097	1.099	.274	1.223
	main occupation of the respondent	.063	.028	.224	2.232	.028	1.565
	estimated land size of respondent	.017	.009	.200	1.866	.065	1.789
	major markets where bananas are sold	.072	.026	.239	2.817	.006	1.119
	Proximity to Source of TC banana plantlets	.204	.049	.365	4.183	.000	1.181

**Table 4: Cross tabulation between TC banana adoption and respondents' occupation**

Response factor			main occupation of the respondent			
			farming	business	civil service	other
yes	Count	61	27	16	3	
	Expected Count	57.7	27.9	15.8	5.6	
	% of Total	53.0%	23.5%	13.9%	2.6%	
No	Count	1	3	1	3	
	Expected Count	4.3	2.1	1.2	.4	
	% of Total	.9%	2.6%	.9%	2.6%	

**Effect of Proximity to Source of Planting Materials in Adoption of TC Banana**

Proximity to source of planting material according to this study is defined as the distance to the source of planting material. Proximity to source of planting

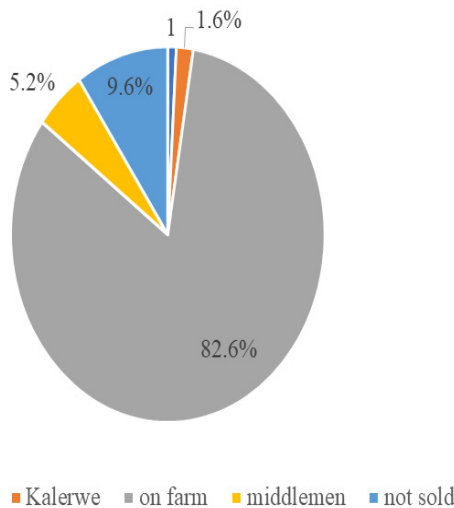
materials significantly determines the adoption of TC banana ( $P < 0.01$ , Table 3). 71.1% (n=91, Table 5) of the respondents obtained TC banana plantlets under the NAADS/ OWC government programs, 10.4% (n=12, Table 5) from private

commercial nurseries like Agro-Genetic Technologies and only 0.9% (n=1, Table 5) from government multiplication sites like namely National Agricultural Research Laboratories (NARL) located at Kawanda. Much as NARL provides TC banana plantlets at subsidized prices, farmers were not aware of it being a source of planting materials and the distance to the institute was equally a barrier to many farmers as compared to planting materials which were supplied

to their various sub-counties in which they resided. This implies that enhanced access to source of planting material played a great role in adoption of TC banana by the people of Wakiso District. This agrees with the findings of Wanyama *et al.*,<sup>3</sup> who states that enhanced access of farmers to Tc banana technology increased the demand for TC banana plantlets against the low supply.

**Table 5: Cross tabulation of Source of TC banana plantlets and its adoption**

			Source of TC banana plantlets				
			NARL-Kawanda	Private commercial nursery	OWC	others	Total
TCB adoption	yes	Count	1	12	91	3	107
		Expected Count	.9	11.2	87.5	7.4	107.0
		% of Total	.9%	10.4%	79.1%	2.6%	93.0%
	no	Count	0	0	3	5	8
		Expected Count	.1	.8	6.5	.6	8.0
		% of Total	.0%	.0%	2.6%	4.3%	7.0%



**Fig. 2: Markets for TC banana**

**Influence of Markets on Adoption of TC Banana**  
 Availability of markets for the tissue culture banana was highly significant in its adoption (P=0.006), (Table 3). 82.6% of the respondents sold their bananas on farm, 5.2% through middlemen, 9.6%

of the respondents never sold their banana because these were retained for home consumption while the rest sold to nearby local markets (Figure 2). This implies that 82.6% of the respondents in Wakiso sold their banana on farm because only surplus was



sold but most of the bananas were retained for home consumption, therefore because of limited harvest left for sale, it was cost effective to sell on the farm as opposed to nearby local markets.

The results of this study agree with the findings of Kinyangi<sup>25</sup> who reveals that market availability is significant in the adoption of agricultural technology. The more the distances to the product market the less likelihood of TC banana intensification because the longer the distance the more the transaction costs and the less the profit that accrue to the farmer.<sup>3</sup> Qaim<sup>26</sup> equally reports that productivity growth through TC technology directly contributes to better food availability at the household level.

### Conclusion

Adoption of banana tissue culture is affected by numerous factors among which include main occupation, proximity to source of planting materials and market accessibility. Thus, in a bid to increase its adoption, the government of Uganda and other

stakeholders ought to invest more in extension so as to create a stronger linkage between the farmer and the researcher. This will aid in agro-technology dissemination of information to local farm communities and consumers. There is also need to establish regional supply centers for tissue culture banana plantlets to increase their accessibility to the farmers.

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### Conflict of Interest

The authors declare no conflict of interest.

### References

1. Ndungu T. C., Nguluu S., Kisangau P. Factors Affecting Adoption of Tissue Culture Bananas in the Semi -Arid Areas of Lower Eastern Region of Kenya. *International Journal of Recent Research in Life Sciences*; 2017; 4(3): 1-26.
2. Langat B. K., Ngéno V.K., Nyangweso P.M., Mutwol M. J., Kipsat M.J., Gohole L., Yaninek S. Drivers of Technology Adoption in a Subsistence Economy: The case of Tissue Culture Bananas in Western Kenya. Invited paper presented at the 4<sup>th</sup> *International Conference of the African Association of Agricultural Economists*; 2013: 1-17
3. Wanyama J.M., Obare G. A., Owuor G., Wasilwa L. Factors Influencing Adoption of Tissue Culture Banana in Western Kenya. Invited paper presented at the 4<sup>th</sup> *International Conference of the African Association of Agricultural Economists*, Hammamet, Tunisia; 2013.
4. Lorenzen J., Tenkouano A., Bandyopadhyay R., Vroh B., Coyne D., Tripathi L. Overview of Banana and Plantain (*Musa spp.*) Improvement in Africa: Past and Future. *Acta Horti*; 2008: 201: 595-604
5. UBOS. Uganda Bureau of Statistics; Statistical Abstract. 2016. Adapted from <http://www.ubos.org>.
6. Nyombi K. Towards Sustainable Highland Banana Production in Uganda: Opportunities and Challenges. *African Journal of Food, Agriculture, Nutrition and Development*; 2013; 13(2).
7. Barekye A. Breeding investigations for Black Sigatoka Resistance and Associated Traits in Diploids, Tetraploids and the Triploid Progenies of Bananas in Uganda. Unpublished Ph.D. thesis in Plant Breeding, University of KwaZulu-Natal, Durban, South Africa; 2009.
8. Akankwasa K. Evaluating Farmer's and Consumer's Acceptance of New Cooking Banana Hybrids in Uganda: Micro-economic Analysis and Policy Implications. Unpublished Ph.D. thesis in Agribusiness. University of KwaZulu-Natal, Durban, South Africa; 2014.
9. Nguthi F.N. Adoption of Agricultural innovations by smallholder farmers in the context of HIV/AIDS: The case of tissue-cultured banana in



- Kenya. Ph.D. Thesis; Wageningen University; Wageningen, The Netherlands;2007.
10. Republic of Uganda . Higher Local Governemnt Statistical Abstarct-Wakiso; 2009
  11. UBOS. Uganda Bureau of Statisitcs; Statistical Abstract ;2017. Adapted from <http://www.ubos.org>.
  12. Kothari C. R. Research Methodology: Methods and Techniques. 2ndEdition. New Delhi; New Age International (P) Publishers Limited; 2004.
  13. Chamberlin J. Defining small holder Agriculture in Ghana: Who are smallholders, what do they do and how are they linked with markets. Ghana Strategy Support Program; 2007 Background paper NO. GSSP0006.
  14. Guarte J.M., Barrios E.B. Estimation Under Purposive Sampling, Communications in Statistics Simulation and Computation; 2006; 35:2, 277-284, DOI: 1080/03610910600591610
  15. Maina J. Qualitative and Quantitative Research Methods Simplified. Nairobi; Frajoba Printers mall; 2012
  16. Mugenda O. M., Mugenda, A. G. Research Methods: Quantitative and Qualitative Approaches. *Nairobi. African Center for Technology studies* ;2003.
  17. Wangusa T. Essentials of Research Methodology in Human and Social Sciences. Kampala; Bow and Arrow publishers Ltd; 2017.
  18. Nguyen V.T., Chinawat Y. Banana Farmers' Adoption of Sustainable Agriculture Practices in the Vietnam Uplands; the case of Quang Tri Province. *Agriculture and Agricultural Science Procedia*; 2015; 5, 67-74.
  19. Nankinga C.K., Magara E., Gold C.S., Kawuki R.S., Erima R., Ragama P., Gowen S.R., Tushemereirwe W. Response of East African Highland Banana to Plant Density in Uganda. *African Crop Science Conference Proceedings*; 2005; 7(pt.03 of 3), 1183-1186.
  20. Mwangi M., Kariuki S. Factors Determining Adoption of New Agricultural Technology by Smallholder Farmers in Developing Countries. *Journal of Economics and Sustainable Development*; 2015; 6 (5).
  21. Mignouna B., Manyong M., Rusike J., Mutabazi S., Senkondo, M. Determinants of Adopting Imazapyr-Resistant Maize Technology and its Impact on Household Income in Western Kenya: *AgBioforum*; 2011; 14(3):158-163.
  22. Kariyasa K., Dewi A. Analysis of Factors Affecting Adoption of Integrated Crop Management Farmer Field School in Swampy Areas. *International Journal of Food and Agricultural Economics*; 2011;1(2): pp 29-38.
  23. Kabunga N., Dubois T., Qaim M. Yield Effects of Tissue Culture Bananas in Kenya: Accounting for Selection Bias and the Role of Complementary Inputs. *Proceedings of the German Development Economics Conference, Berlin*; 2011; No. 43.
  24. Nyang M. N., Webo C., Roothaert R. L. The Power of Farmers Organizations in Smallholder Agriculture in East Africa Working Papers. A review of 5 project initiatives of the Maendeleo Agricultural Technology Fund. *FARM-Africa Working Paper*. London, UK, FARM-Africa:2010; pp 1-44.
  25. Kinyangi A. A. 2014. Factors Influencing the Adoption of Agricultural Technology among Smallholder Farmers in Kakamega North Sub-County, Kenya. Masters' Thesis in Project planning and management; University of Nairobi; 2014.
  26. Qaim M. Evaluating nutrition and health impacts of agricultural innovations. Transformation of Global Agri-Food Systems: Trends, Driving Forces, and Implications for Developing Countries. *Global Food*; 2014; Discussion Papers No. 46