# Socio-economic determinants of adoption of improved sorghum varieties and technologies among smallholder farmers in Western Kenya.

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**Abstract**
In many parts of Kenya, sorghum remains an important crop for rural food security. Since many sorghum producing areas still experience periodic food deficits, production must be increased in order to ensure food security. The growing of improved sorghum varieties in Kenya has been promoted by agricultural extension service as one of the ways to achieve this. However, the adoption of technologies associated with these varieties by small scale farmers is still low resulting, probably, in the low production of the crop. Using data collected in Western Kenya in 2007, this study found that resource constraints limit many farmers adoption of improved sorghum varieties and technologies. The household size, household income, the size of farm owned by a household, age, the education attainment and gender of the household head all had a significant positive effect on the likely hood of adoption. These findings raise important questions as to whether improved sorghum varieties and related technologies are really affordable to poorer small scale farmers.

Keywords: Adoption; Improved sorghum varieties and technologies: Smallholder farmers

## *Introduction*

Poor performance in the agriculture sector that has led to decline in agricultural production and overall low economic growth (Food and Agriculture Organization, 1986; Ministry of Agriculture and Rural Development, 2001b; Rosegrant, Paisner, Meijer & Witcovear, 2001) is especially critical in the southwestern Kenya region along Lake Victoria (Government of Kenya, 1993). This has called for the intensification of agriculture through development of improved varieties and production technologies. In many parts of Kenya, sorghum, (*Sorghum bicolor (L) Moench)*, which is an important food and feed crop in the semiarid tropics (Nwanze *& Yuornl*, 1994), remains an important crop for rural food security. Since many sorghum producing areas, including HomaBay, still experience periodic food deficits, the production of the crop must be increased in order to ensure food and income security through the development of improved sorghum varieties and technologies. Increased adoption of these varieties and their associated technologies could be enhanced through the development of institutional strategies.

Sorghum is the fifth leading cereal in terms of world production and one of the coarse grain cereals grown as a rain fed crop in the semi arid areas (Push Pamma, 1993; Dendy, 1995). It is grown in approximately 50 million hectares with a production of 70 million tons (Food and Agriculture Organization, 1994;

National Research Council, 1996). More than 300 million people in more than 30 countries depend on sorghum as the main source of energy and protein (NRC, 1996). Almost 30% of the harvested sorghum area is in sub Saharan Africa (Food and Agriculture Organization, 1993). In eastern Africa, more than 70% of sorghum is cultivated in the dry and hot low lands (Mukuru, 1993). In Kenya, sorghum is an important cereal in the medium and low altitude areas (Enserink, 1995). O'Neill and Kamau (1990) estimated that 52% of sorghum in Kenya is grown in Nyanza and 23% in Western province of the country. Per capita sorghum consumption in Kenya is approximately 3.0 kg per year (Food and Agriculture Organization, 2002). It is an important food crop around Lake Victoria region, an area where maize does relatively poor or fails due to erratic rainfall, pests and diseases (Wanyama, Njue & Kidula, 1995). This is because sorghum has long been recognized as a drought resistant / tolerant crop (Omanya, Nyabundi & Ayiecho, 1996). House (1995) indicated that sorghum will continue to be an important food crop especially in areas where it is better adapted than other cereals, particularly in draught prone areas and under high temperatures and water logging.

Sorghum grain is utilized in preparing foods like "ugali", porridge and for making alcoholic beverages. Sorghum stalks are used as dry season fodders and as fencing materials (House, 1990). Industrial uses of sorghum include use as animal feed, making of industrial starch and for fuel alcohol production (House, 1995). There are good prospects for the expansion of the industrial market for sorghum if its yields can rise fast enough to catch up with yields of competing cereals (Food and Agriculture Organization & International Crops Research Institute for the Semi-Arid Tropics, 1996). Sorghum is mainly grown by small-scale farmers in semi arid areas for subsistence farming (Muriithi, 1990). The majority of these farmers, however, do not produce enough sorghum to meet family requirements in most years. This has been attributed to a number of constrains which include variable rainfall, bird damage, striga weed, disease problems and insect pest damages (FAO & ICRISAT, 1996).

Ndhiwa is among the six divisions in Homabay district and lies in lower midland (Lm3) agro-ecological zone. It is situated at an altitude of 1200-1400m above sea level. The mean rainfall is about 1300mm received in a bimodal pattern. Long rains starts from February to June with peak occurring in March – April, while short rains starts from August to November with its peak in October. The division has three types of soils; black cotton soil (vertisols), silt loam, and clay loam (luvisols) with drainage being poor in some of the soils (Jaetzold & Schmidt, 1982). The vegetation is mainly savanna type with thick bushes and open grass. Trends over the past 50 years indicate a continuous decrease in vegetation cover due to increased agricultural activity.

## RESEARCH METHODOLOGY

### *Research Design*

The study employed an *ex-post-facto* survey design. This type of design involves data collection after a naturalistically occurring event (Fraenkel & Wallen, 2000; Casely & Kumar, 1992). It involves collection of information from a sample that has been drawn from a population that has received a natural treatment not designed by the researcher (Fraenkel & Wallen, 2000). In this study the introduction of sorghum varieties and technology were not introduced by the research as treatment but by KARI. The study will attempt to describe the institutional factors in relation to adoption of these varieties and technologies in retrospect (*after-the-fact*). This design is appropriate for the study since it facilitates the collection of information from a sample of a population in order to describe their characteristics as they relate to the "fact". In this study, the characteristic of sampled sorghum farmers has been described and their influence on the adoption of improved sorghum varieties and recommended technologies analysed. Though non-response has been found to be a problem in surveys, according to (Fraenkel & Wallen, 2000), appropriate techniques were used to help reduce its problem including calling back on absentee respondents and random replacement where necessary as well as using large samples. Surveys are cost-effective and exploratory enabling the researcher to make inferences (O'Connor, 2002).

### *Study Location*

The study was carried out in Ndhiwa Division of Homabay District. It is one of the six divisions in Homabay District, located in the southwestern part of Kenya along Lake Victoria. It is located between longitude $34^0$ 12' and $34^0$ $40^{'}$ east and latitudes $0^0$ 28' and $0^0$ 40' south (G.O.K, 2001). The Division is further sub divided into 4 locations and 11-sub -locations. It has a population of 43,231 and a density of 182 persons per square kilometer (G.O.K, 2001). According to Jaetzold and Schmidt (1982), the division lies in lower midland (lm3) agro-ecological zone. It is situated at an altitude of 1200-1400m above seal level. The mean rainfall is about 1300mm received in a bimodal pattern. The Division has three types of soils; black cotton soil (vertisol), silt loam, clay loam (luvisoils) with drainage being poor in some of the soils.

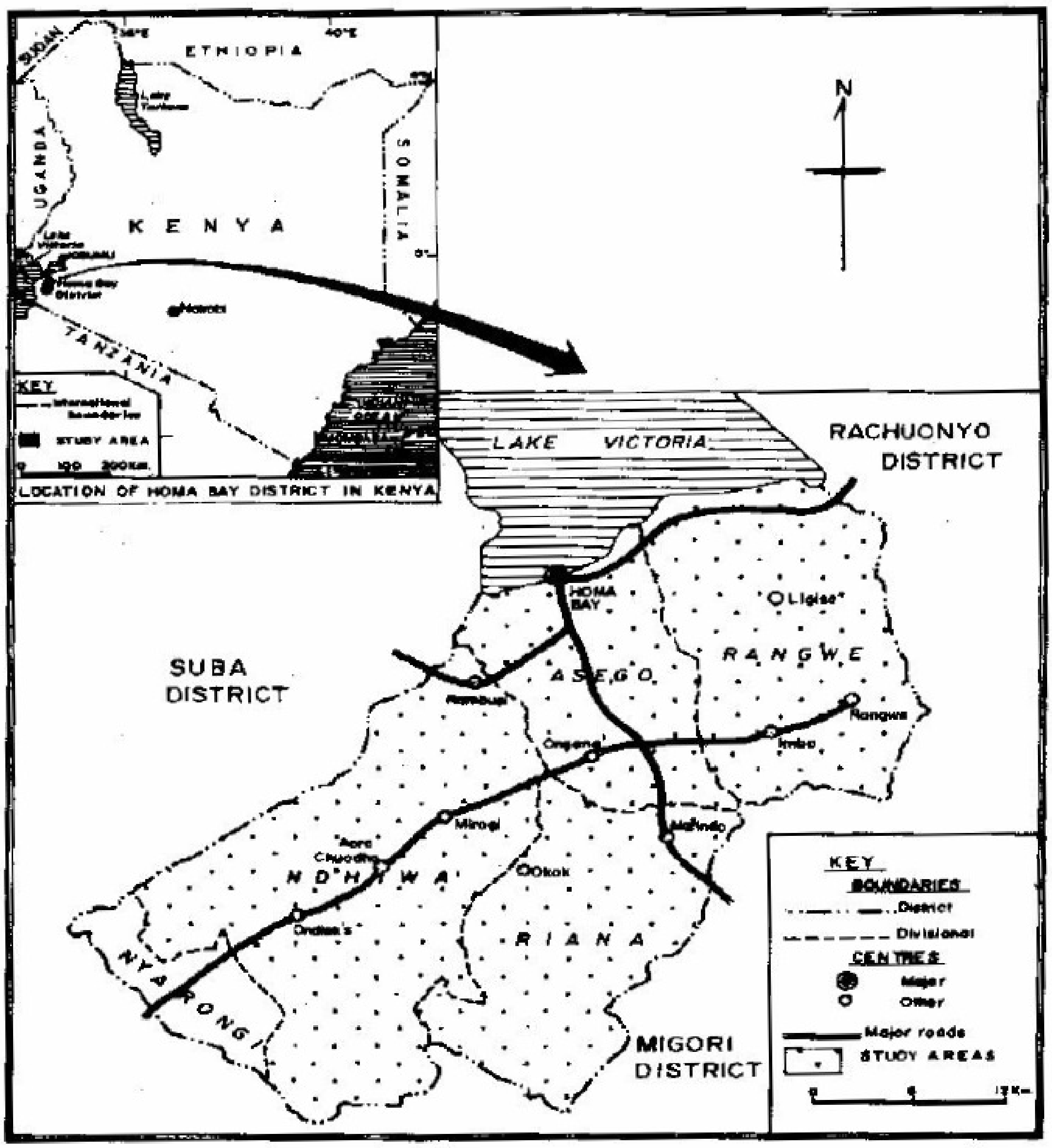


**Figure 3: Location map of the study area**

Sorghum is a significant food security crop in the study area and efforts by KARI to introduce sorghum in the district were concentrated in the division, which is a representative of the population (G.O.K, 2002). Figure 3 shows the location map of the study area.*4 Population proportion*

The target population was all small-scale sorghum farmers in Ndhiwa division. Ndhiwa division has a population of 7,202 small-scale sorghum farmers distributed in the 4 locations and 11 sub locations (G.O.K, 2004).

## Sample size and Sampling Procedure

A sample of 105 farmers was used in the study. According to Kathuri and Pals (1993), a minimum of 100 is recommended for a survey research. This gives a reasonable unit for analysis. This gave a reasonable number for analysis from each location for the study. The sample was obtained using stratified proportionate random sampling to select respondents. This gave a reasonable number from each location of the study. The location of the small-scale farmers was used as the criterion for proportionate random sampling. All the small-scale farmers in the four locations were used to enable random selection of farmers to be included in the study. A computer random number generator was used to select the number of households in each stratum.

**Table 1: Sampling by location in Ndhiwa Division, HomaBay District.**

| Locations | Farmers | Population | Sample |
|---|---|---|---|
| North Kanyamwa | 1800 | 0.25 | 25 |
| South Kanyamwa | 2010 | 0.28 | 25 |
| Central Kanyamwa | 1390 | 0.19 | 20 |
| West Kanyamwa | 2002 | 0.28 | 35 |
| Total | 7202 | 1.00 | 105 |

## Instrumentation

A questionnaire was used in the collection of information from the farmers to be involved in the study. The tool was used to collect data required to achieve the study objectives. A questionnaire was chosen because of the ease of administration and scoring of the instrument besides the results being readily analyzed (Ary, Jacobs & Razarieh, 1979; FAO, 1990c). The items on the questionnaire were developed on the basis of the objectives of the study. Appendix A consists of part (A) which elicits data on selected socio-economic and personal characteristics of the respondents; Part (B) are information on adoption levels of improved sorghum varieties and technologies. The instrument was administered to the farmers by the researcher himself in order to facilitate elaboration of any aspects that may not be easily understood by the respondents.

## Validity

The questionnaire was tested in order to check its content, construct and face validity. Content validity was to ensure that the content that the instrument contains is an adequate sample of the domain of content it is supposed to represent. Face validity delt with format of the instrument and includes aspects like clarity of printing, font size and type, adequacy of workspace, and appropriateness of language among others. Construct validity determined the nature of psychological construct or characteristics being measured by the instrument. Experts, supervisors and peers from the Department of agricultural education and extension, Egerton helped in the review to ensure the instrument accurately measured the variables it intended to measure in the study.

### *Reliability*

The instrument was pre-tested with a sample of 20 households similar to the study area and. This was done in the neighboring division, Rangwe that has similar characteristics to the study area. The number 20 was chosen for pre-test because according to Kathuri and Pals (1993) it is the smallest number that can yield meaningful results on data analysis in a survey research. The results of the pilot-test indicated a reliability coefficient of 0.7 for the whole instrument using the cronbach's alpha coefficient. More items were added into the questionnaire to improve its reliability.

### *Data Collection Procedures*

An appointment for administration of questionnaires to the respondents was prepared with the assistance of divisional extension coordinator, frontline extension workers and the village headmen. The instrument was then administered to sorghum farmers to collect the required data in face-to-face interview and their responses recorded accordingly. The study focused mainly on household heads for interview schedule to cater for uniformity of data collection process. Male and female small-scale farmer were interviewed because gender was not taken as an independent variable in the study. In case the farmer was absent, then the most responsible member was interviewed. This was a member who at one time w had been entrusted with the responsibility of overseeing the sorghum production activities for a period spanning one year or more.

### *Data Analysis*

After data collection, the questionnaires were cleaned for errors made during data collection. Summarized and coded data were into the computer after which analysis of quantitative data was done using the Statistical Package for Social Sciences (SPSS). For objectives 1 and 2 descriptive statistics, namely percentages, means, and standard deviations were be used. For hypothesis 1 and 2, chi-square was used to determine the relationship between the independent variables and the dependent variable. The hypotheses were tested at 0.05 significance level Table 2: Summarizes the specific data analysis procedures that will be used to analyze the objectives of the study and statistical procedures to be used to test the hypotheses.

## RESULTS AND DISCUSSION

### *General characteristics of farmers*

The farmers were asked to respond to a set of questions on their characteristics that have influence on adoption of improved sorghum varieties and production technologies. The characteristics include age distribution of the farmers, the estimated size of farmland used for agriculture, gender distribution among farmers, level of education of the farmers, and approximate level of gross monthly income for the framers. The general characteristics are discussed in relation to how they influence level of adoption of improved sorghum varieties and technologies.

### *Age distribution of the farmers*

The farmers were asked to indicate the category of their age. Forty-five out of one hundred and five farmers (42.9%) interviewed indicated that they were between the ages of 31-40 years. Table 2 presents the frequencies and percentages of age group of the farmers interviewed.

**Table 3: Age of the farmers**

| Age group | Frequency | Percentage |
|---|---|---|
| Below 20 years | 1 | 1.0 |
| 21-30 | 22 | 21.0 |
| 31-40 | 45 | 42.9 |
| 41-50 | 29 | 27.6 |
| Above 50 years | 8 | 7.6 |
| Total | 105 | 100.0 |

As shown above, forty-five out of one hundred and five farmers (42.9%) interviewed indicated that they were between the ages of 31-40 years. This is a prime age when the farmers are very active and ready to risk by adopting technologies delivered to them. Farmers who are within group 18-43 years tend to be more active in practical, “ hands- on” activities as compared to older farmers. Burkey (1996) indicates that groups with majority of members with similar age group are expected to be more effective. This is because individuals of same or similar age groups tend to have similar interests. This study therefore found out that farmers who are young were better adopters than old farmers. Rogers (1983) argued that younger and educated farmers are more inclined to adopt new practices. This was supported by Wasula

(2000), who found that the age of a household head significantly influenced the adoption of contour vegetative strips. However studies by Ndiema (2000), found no relationship between ages and the technology adoption.

### *Gender distribution o f the farmers*

More than half of the farmers interviewed (56.2%) were female compared to 43.8% being male. Table 4 presents the gender distribution of the farmers interviewed.

**Table 4: Gender distribution of farmers**

| Gender | Frequency | Percentage |
|---|---|---|
| Male | 46 | 43.8 |
| Female | 59 | 56.2 |
| Total | 105 | 100.0 |

This is an indication that women handle most of the farm activities. Women also form most of the groups or farmers organizations. This shows that gender was related to sorghum adoption, which concurs with Oywaya (1995) who found significant differences in adoption between the male-headed households and female-headed households in Machakos, Kenya.

### *Levels of education of the farmers*

On the level of education, the farmers were asked to indicate the highest level of education they attained. Table 5 presents the frequencies and percentages of the levels of education of the farmers.

**Table 5: Level of education of the farmers**

| Level of education | F | % |
|---|---|---|
| None | 7 | 6.7 |
| Lower primary | 26 | 24.8 |
| Higher primary | 48 | 45.7 |
| Secondary school | 21 | 20.0 |
| Tertiary | 9 | 2.9 |
| Total | 105 | 100.0 |

Forty-eight out of the one hundred and five farmers interviewed (45.7%) had at least upper primary level of education and 26 farmers (24.8%) had lower primary school level of education. Those with secondary school level of education and above were 22.9%. This is in agreement with Amudavi (1993), Chitere and Dourve (1985), and (2000) who in their respective studies found that education is a significant factor in facilitating awareness and adoption of agricultural technologies. This is so because education enables one to access information needed to make a decision to use an innovation and practice a new technology. Education increases managerial competence and therefore enhances ability to diagnose, assess, comprehend, and respond to financial and production problems. High level of education enhances the understanding of instructions given and should also improve the farmers level participation in agricultural activities.

### *Approximate level of gross monthly income of the farmers*

More than half of the farmers (91.4%) indicated that they get Kshs 3000-6000 as gross income. Nine out of the one hundred and five (8.6%) indicated that there gross monthly income were between Kshs 6,000 and Kshs 10,000. Table 6 presents the levels of gross monthly income of farmers.

**Table 6: Approximate level of gross monthly incomes of farmers**

| Monthly income | Frequency | Percentage |
|---|---|---|
| < 3000 | 46 | 43.6 |
| 3001-6000 | 50 | 47.6 |
| 6001-10000 | 7 | 6.7 |
| > 10001 | 2 | 1.9 |
| Total | 105 | 100.0 |

Household income can be used as a proxy to working capital because it determines the available capital for the investment in the adoption of technologies and it is a means through which the effect of poverty can be assessed. According to the World Bank (2000), poverty is the main cause of environmental degradation. One way of measuring the household's poverty is through income. Household income has a bearing on the socio-economic status of farmers. Farmers from higher economic status have access to resources and institutions controlling resources necessary for the effective adoption of technology (World Bank, 1983). This is in consistent with the findings of Anyango (2000), who found that farm income had a significant relationship with the adoption of soil conservation measures.

## *Summary, conclusions and policy implications*

This study was set to investigate the influence of institutional factors on the adoption of improved sorghum varieties and technologies in Ndhiwa division, Homabay District, Kenya. The study was necessary because the performance of sorghum has remained low even after introduction of improved varieties and technologies. The low adoption levels of the technologies affect the overall production of sorghum in the area. The studies used an *ex-post-facto* research design with a survey methodology. Data was collected from a sample, of 105 farmers from different locations in the area.

Results of data analysis indicated the more than half of the farmers interviewed were female. This is an indication that more women practice agriculture on a day-to-day basis compared to the men. There were younger farmers in the ages between 31-40 years. On education level most farmers were found to be literate. Adoption of improved sorghum varieties was better than the adoption of technologies though the adoption levels of both remained low.

The study confirmed that institution factors such as access to extension, access to market, availability of inputs, access to credit facilities, and means of transport all affected the adoption of improved sorghum varieties and technologies. Farmers belonging to farmer's organization were found to adopt improved sorghum varieties and technologies than those who are not in any organization.

In view of the data analysis and results shown in chapter four it can be concluded as follows:

- Close to 40% of the farmers in the study area had adopted improved sorghum varieties while close to 30 % of the farmers had adopted sorghum production technologies. This was low given that the varieties and technologies have been in existence more than three years.

- The study further concludes that there were more youthful and female farmers who practice sorghum production. Since gender and age influenced adoption, strategies should be developed so as to target more women groups and youth groups for increased production of the crop.

- Farmers education level does influence the use of technologies and varieties and, therefore it is related to adoption of improved sorghum varieties and technologies, a finding which concurs with other studies cited earlier. It requires that farmers are educated new technologies and varieties governing the crops production.

- Farmers mentioned a number of constraints that act as deterrents to adoption of improved sorghum varieties and technologies. These include: Lack of awareness of sorghum technology information, lack of where to secure inputs, high cost of inputs and market. Low level of frequency of extension contacts with farmers was also a common problem, which hindered faster rate of adoption. Others (Amudavi, 19930) have also cited these problems.

- The most dramatic change that will influence adoption of improved sorghum varieties and technologies is the development of institutional strategies that target small-scale farmers so that potential adopters can adopt the varieties and technologies to improve production.

The following recommendations have been suggested from the findings and conclusions of the study.

- Frequency of contact between the farmers and the extension agents was also quite low hence did not seem to influence adoption. However there are a number of institutions dealing with sorghum production that include CARE-Kenya, C- MAD, KARI, Ministry of Agriculture and Diocese of Homabay. These institutions could be encouraged, to step up their extension efforts. There should be a linkage between these institutions, extension agents, farmers and researchers.

- Breeders should encourage multistage development of varieties and technologies that favour small-scale sorghum farmers since they form a large proportion of farmers in Kenya today.

- Institutional strategies should be developed to favour young and women farmers since they are the majority who engage in agricultural activities on the ground.

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Key words: Adoption of Improved wheat variety, Adwa, smallholder farmers, Topit model.Â  Socio-Economic Determinants of Adoption of Improved Sorghum Varieties and Technologies Among Smallholder Farmers in Western Kenya. 18p. Maddala GS (2005). Introduction to Econometrics.3rd edition. Formerly of Ohio State University Press, New York. Matata PZ, Ajay OC, Oduol PA, Agumya A (2010). Socio-Economic Factors Influencing Adoption of Improved Fallow Practices Among Smallholder Farmers in Western Tanzania. This study analyzed smallholder farmersâ€™ socio-economic determinants for inputs use in major rice producing regions in Tanzania. A sample for the study comprised of 842 rice farming households from five major paddy (rice) producing regions of Mbeya, Morogoro, Shinyanga, Mwanza and Tabora.Â  Adoption of farm management practices by smallholder cocoa farmers in Prestea Huni-Valley district, Ghana. 2016 / Dennis Sedem Ehiakpor, Gideon Danso-Abbeam, Judidia Zutah, Alhassan Hamdiyah.Â  In comparison, Kenya and South Africa's fertilizer application rates are 100 kg/ha and 120 kg/ha respectively. On the other hand, there has been a 25% improvement in average yields for maize from 1.2 MT/ha in 2008 to 1.5 MT/ha in 2010.