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# Common Bean Insect Pest And Disease Identification Techniques And Management Practices By Farmers In Teso North And Bungoma West Of Western Kenya

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***Abstract:*** ***Common bean is the most widely grown pulse, second to maize as major source of food security in East Africa. In Kenya, the per capita consumption is estimated at 14 kg per year but can be as high as 66 kg per year in Western Kenya. In Kenya, common bean yields have remained low with an average of 585 kg/ha. The low yield is attributed to the effects of insect pests and diseases. The main purpose of this study was to improve common bean productivity through improved detection and management of insect pest and diseases. This research was done in Teso North and Bungoma West of Western Kenya. The study adopted an Ex-post facto (Casual Comparative) research design. The target population was (117,947) farmers. Total of (130) farmers were sampled through a proportionate stratified random sampling technique. The research instrument was a questionnaire administered as an interview schedule. Pre-test of the questionnaire was done on 20 farmers in Mumias to establish the level of reliability. The reliability coefficient was then determined using Cronbach's alpha at p≤0.05 which revealed a coefficient of 0.76. The study used both descriptive and inferential statistics performed at p≤0.05 to verify the hypothesis and to establish relationships. On average the leading common bean variety was Rosecoco (30%) which mainly purchased from the open market (28%) and planted on as mixed crop (54%). The major common bean insect pests were Aphids (25%) and Bean Weevil (20%) while ALS (20%) and Virus (26%) were the major common bean diseases. Most farmers confirmed recognising presence of a disease on their farms by use of some ITK such as seeing the plant leaves bending (25%), yellowing of the leaves (14%). The management practices employed were (18%) chemical sprays, (12%) early planting.The analysis on the difference on common bean seed variety source showed a statistical significant difference with a t-value of -13.264; (p<0.000; α=0.05) and mean of (2.41) in Teso North and (5.13) in Bungoma West. The analysis on the difference on common bean insect pest and disease identification techniques showed a statistical significant difference with a t-test value of -10.264; (P≤0.005; α=0.05) and mean of (2.51) in Teso North and (4.10) in Bungoma West. The analysis on the difference on common bean insect pest and disease management practices showed a statistical significant difference with a t-test value of -11.064; (P≤0.009; α=0.05) and mean of (3.10) in Teso North and (5.12) in Bungoma West. Chai squire analysis on gender (calculated=3.71; 1df; critical=3.40; p<0.009), farm size (calculated=40.28; 4df; critical=18.08; p<0.000, land tenure systems (calculated=19.12, 3df; critical=17.22; p<0.009), education level (calculated=15.81 2df; χ2 critical=14.98; p≤0.005) showed statistical significant influence on the common bean insect pest and disease detection techniques. This study aimed at providing a credible feedback to researchers, extension agents and the policy makers on how to improve common bean productivity through improved detection and management of insect pest and diseases. Extension agents will use this information as a diffusion pathway that is crucial for optimizing the uptake of any other agricultural production technologies and management practices among farmers. Farmers be encouraged to use certified seeds to minimize the level of disease incidence and the severities i.e. use varieties that are resistant and tolerant to insect pests and diseases. Need for an evaluation of the effects of the bean integration on insect pest and disease pressure to establish the level of the incidence, severity and distribution. Mapping of common bean disease hotspot areas and non-hotspot areas in the region be carried out because the process of designing an effective breeding program requires precise and accurate knowledge on the spatial and temporal disease distribution. Additional research on the other socio-economic factors that influence the up-take of agricultural technologies be carried out.***

***Keywords:*** ***Adoption, Agricultural Extension service, Agro-Ecological Zone, Diffusion, Disease Distribution, Disease incidence, Disease severity, Farming System, Innovation, Livelihoods, Perception, Sustainable Livelihoods, ELISA, PCR, Plating techniques***

## I. INTRODUCTION

The common bean (*Phaseolus vulgaris L.*) is one of the most important grain legumes producing 876,576 Mt of grain (FAOSTAT, 2014) and ranked 9th for production of beans in the world (Ronner and Giller, 2012). It provides dietary protein for over 100 million people in rural and poor urban communities, with an annual per capita bean consumption in

Eastern Africa (50-60 kg) being the highest in the world and furthermore, common bean consumption reportedly reduces colon and breast cancer, and heart diseases (US Dry Bean Council, 2011). Beyond promoting food, health and nutritional security, beans provide a steady and lucrative source of income for many rural households with the value of bean sales now exceeding US$ 500 million annually (FAO, 2011). However their production and productivity is highly constrained by the effects of several environmental stresses notably biotic (field and post-harvest pests and diseases) and abiotic (drought, excessive rain/flooding, poor soil fertility, heat and cold stress) each of which causes significant reductions in yield. Despite the productivity potential per hectare of common bean in Kenya ranges from 1400 – 2000 kg (Katungi *et al*., 2010), the attainment to this potential is constrained by a number of insect pests and diseases (Buruchara *et al*., 2011). Seed-borne pathogens cause disease outbreaks resulting in huge losses, reduction in production and productivity levels (Dawson and Bateman, 2001). Stresses such as poor soil fertility are long term and predictable while others like drought, some insect pests and diseases spurred by climate change could be short-term, but acute in nature. Soil degradation and drought are serious threats to common bean and, hence, a frequent cause of crop failure and hunger. These threats are exacerbated by the effects of the climate change (Christensen *et al*., 2007) that leads to soil degradation, fertility decline. Although all this information on common bean production and productivity has been there, there are unknown farmer techniques on insect pest and disease identification and management practices. This leads to continued crop failure experienced by farmers because of their inability to identify the insect pests and diseases and growing varieties that are susceptible to insect pests and diseases. However studies have been conducted to address the combined effects of soil fertility and the common bean insect pest and diseases, unfortunately many of them are of limited geographical scope and focus on either a single common bean insect pest or disease (Hillocks *et al*., 2000; Mwang'ombe *et al*., 2007). This study was therefore designed to identify different farmer techniques used for common bean insect pest and disease detection and management practices in Teso North and Bungoma West with the main objective of improving common bean production and productivity through improved detection and management of insect pest and diseases among farmers in Busia and Bungoma farming communities. The specific objectives were to identify the leading common bean varieties grown by farmers in Teso North and Bungoma West, to determine the most common bean insect pest and disease detection techniques and management practices among farmers in Teso North and Bungoma West and to describe the influence of the socio-economic and institutional factors on common bean insect pest and disease detection techniques and management practices among farmers in Teso North and Bungoma West. This study aimed at providing a credible feedback to researchers, extension agents and the policy makers on how to improve common bean production and productivity through improved detection and management of insect pest and diseases. Extension agents will use this information as a diffusion pathway that is crucial for optimizing the uptake of any other agricultural production technologies and management practices among farmers in Teso North and Bungoma West and other parts the world with similar agro ecological conditions. The study focused on determining the leading common bean varieties grown, determining the common bean insect pest and disease detection techniques and management practices as well as establishing the relationship between the farmer socio-economic, institutional factors and the common bean insect pest and disease detection techniques and management practices among farmers. These factors needed to be highlighted to assist the farmers in order to enhance the level of the common bean insect pest and disease detection techniques and management practices in Teso North and Bungoma West farming communities and other parts the world with similar agro ecological conditions.

## II. RESEARCH METHODOLOGY

This study was carried out at Teso North of Busia County (LM3) and Bungoma West of Bungoma County (LM2). The study adopted an *Ex-post facto* (Casual Comparative) research design which uses a sociological enquiry to the effects of the naturally occurring influence of independent variables on the dependent variable Tuckman, (1988). The independent variables were the socio-economic and institutional factors. The dependent variables were the common bean insect pest and disease identification techniques and management practices. A target population of (117, 947) farmers in Teso North and (243, 535) farmers in Bunguma West GOK (2010) were used for the study. A total sample of (130) farmers in Teso North and (270) farmers in Bungoma West were sampled for the study. This study used a proportionate stratified random sampling technique to select the respondents. The research instrument to collect the data was a questionnaire administered as an interview schedule. The head of each household or any other person with a comprehensive knowledge about common bean production technologies and the management practices responded to the questions. Pre-test of the questionnaire was done on 20 farmers in Mumias to establish the level of reliability. The reliability coefficient was then determined using Cronbach's alpha at $P \leq 0.05$ which revealed a coefficient of 0.76 which is above the 0.70 thresholds for accepted reliability (Chronbanch. L. J. L. 1951). Descriptive (frequency distribution and percentages) and the inferential statistics (T-test and Chi-square) performed at $P \leq 0.05$ to verify the hypothesis and establish relationships.

## III. RESULTST AND DISCUSIONS

| | **Teso North** | | **Bungoma West** | | | **Analysis** | |
|---|---|---|---|---|---|---|---|
| | **Mean** | **STD** | **Mean** | **STD** | **df** | **t-test** | **P value** |
| **Variety grown** | 4.86 | 2.446 | 4.86 | 2.734 | 348 | -.0004 | 0.997NS |
| **Seed Source** | 2.41 | 1.538 | 5.13 | 1.919 | 348 | -13.264 | 0.000S |
| **Cropping Pattern** | 2.10 | 1.098 | 2.15 | 1.087 | 348 | -.0338 | 0.736NS |

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*Table 1: T-test analysis on difference among farmers on common bean varieties in Teso North and Bungoma West*

The analysis on the difference among farmers on common bean varieties grown showed statistically insignificant difference with a t-test value of -.0004; (P<0.0997; α=0.05) and mean of (4.86) in Teso North and (4.86) in Bungoma West. The leading common bean varieties were Wairimu (20%), KK8 (10%), KK22 (20%), KAT56 (5%), Rosecoco (30%) and others (15%). During this study, it was observed that in some cases some of the other common bean varieties were only known to the farmers by their different names depending on the area of reference and language under consideration. The names of these varieties were often descriptive referring to their key identifiable characteristics such as colour, appearance, growth habit and perceived place of origin.

The analysis on the difference among farmers on common bean seed variety sources found a statistical significant difference with a t-test value of -13.264; (P<0.000; α=0.05) and mean of (2.41) in Teso North and (5.13) in Bungoma West. The major seed sources were from the open market (28%), Agro Input Dealers (15%), Research Institutes (10%), NGOs (15%), farmer saved seed (14%) and others (18%). This indicates that these farmers either grow second or subsequent generation of the common bean seeds. This makes the farmers recycle seeds for a long time. This is due to several reasons including the lack of functional formal seed markets and lack of interest in production of seed by commercial seed sectors.

The analysis on the difference among farmers on common bean CROPPING SYSTEM showed a statistical insignificant difference with a t-test value of -.0338; (P<0.736; α=0.05) and mean of (2.01) in Teso North and (2.15) in Bungoma West. Mixed cropping (54%) sole 20% and intercrop (26%) were the most common cropping patterns used. Common bean is mostly being intercropped with maize.

| | Teso North | | Bungoma West | | Analysis | | |
|---|---|---|---|---|---|---|---|
| | **Mean** | **STD** | **Mean** | **STD** | **df** | **t-test** | **P value** |
| **Insect Pests** | 3.35 | 1.960 | 3.35 | 1.554 | 348 | 2.475 | 0.208NS |
| **Diseases** | 3.62 | 1.971 | 3.67 | 1.883 | 348 | 0.220 | 0.221NS |
| **Identification techniques** | 2.51 | 1.528 | 4.10 | 1.019 | 348 | -10.260 | 0.005S |
| **Management practices** | 3.01 | 1.328 | 5.12 | 1.009 | 348 | -11.064 | 0.009S |

*Table 2: T-test analysis on differences among farmers on the common bean insect pest and disease detection techniques and management practices among farmers in Teso North and Bungoma West*

The analysis on the difference among farmers on common bean insect pests showed statistical insignificant difference with a t-test value of 2.475; (P<0.208; α=0.05) and mean of (3.35) in Teso North and (3.35) in Bungoma West. Aphids (25%), Bean Fly (12%), Ball warm (17%), White Fly (15%), Bean Weevil (20%) and others (11%) were some of the common bean insect pests

The analysis on the difference among farmers on common bean diseases showed a statistical insignificant difference with a t-test value of 0.220; (P≤0.221; α =0.05) and mean of (3.62) in Teso North and (3.67) in Bungoma West. Root Rot (14%), CBB (12%), Rust (18%), ALS (20%), Viral (26%) and others (10%) were some of the common bean diseases.

The analysis on the difference among farmers on common bean insect pest and disease identification techniques showed a statistical significant difference in Teso North found that the average means of the common bean diseases with a t-test value of -10.264; (P≤0.005; α =0.05) and mean of (2.51) in Teso North and (4.10) in Bungoma West. Most farmers confirmed recognising presence of a disease on their farms by use of some ITK such as seeing the plant leaves bending (25%), Yellowing of the leaves (14%), Development of holes on the leaves (10%), Low podding (18%), wilting of the crop (18%) and (15%) confirmed their in ability in identifying most of the diseases by their scientific symptomps.

The analysis on the difference among farmers on common bean insect pest and disease management practices showed a statistical significant with a t-test value of -11.064; (P≤0.009; α=0.05) and mean of (3.10) in Teso North and (5.12) Bungoma West. The management practices employed were (18%) chemical sprays, (12%) early planting, (14%) crop rotation, (12%) intercrop, (15%) planting of tolerant varieties, (12%) early weeding, (29%) who do not apply any control measures.

| **Category** | **Sub counties** | | | | **Analysis** | | | |
|---|---|---|---|---|---|---|---|---|
| | Bungoma West | | Teso North | | df | χ2 cal. | χ2 Crt. | P-Value |
| **Gender** | Percentage | Frequency | Percentage | Frequency | | | | |
| Male | 32% | 42 | 41% | 111 | **1** | 3.71 | 3.40 | 0.009S |
| Female | 68% | 88 | 59% | 159 | | | | |
| **Age** | | | | | **4** | | | |
| 15-25 | 5% | 6 | 8% | 22 | | 12.93 | 21.03 | 0.097NS |
| 26-35 | 24% | 31 | 27% | 73 | | | | |
| 36-45 | 33% | 43 | 34% | 92 | | | | |
| 46-55 | 29% | 38 | 21% | 57 | | | | |
| 55 above | 9% | 12 | 10% | 27 | | | | |
| **Education** | | | | | **2** | | | |
| None | 21% | 27 | 14% | 44 | | 15.81 | 14.98 | 0.005S |
| Primary | 41% | 53 | 59% | 153 | | | | |
| Secondary | 38% | 49 | 27% | 73 | | | | |

*Table 3: Chai squire analysis on the influence of gender, age and education level, land size, land tenure and extension services on the common bean insect pest and disease detection techniques among farmers in Teso North and Bungoma West*

The analysis on the statistical significant relationship between gender and the common bean insect pest and disease detection techniques confirmed that common bean insect pest and disease detection techniques and management practices depends on gender with χ2 calculated=3.71; 1df and χ2 critical=3.40; P≤0.009 at α=0.05. This result concurs with (Ilahi, 2000) who asserted that across regions, women work significantly more than men if care-giving is included in the calculations. It also concurs with (Singh, 2003) who found that women work longer hours than men in farming schemes controlled by male farmers in the Indian Punjab.

The analysis on the statistical significant relationship between age of the farmer and the common bean insect pest and disease detection techniques found out that correct use of common bean insect pest and disease detection techniques and management practices is independent of the age group of the farmer with χ2 calculated=12.93; 4df χ2 critical=21.03; P≤0.097 at α=0.05. This contradicts with (Edwards, 2010) who found that old age has influence on food insecurity that has been associated with a wide array of negative health outcomes both among the young and old ageing people.

The analysis on the statistical significant relationship between education level of the farmer and the common bean insect pest and disease detection techniques found that the rate of agricultural technology up take depends on education level with $\chi2$ calculated=15.81; 2df $\chi2$ critical=14.98; P≤0.005 at α=0.05. This result concurs with (Ani, 2007) who found a positive correlation between education and human survival. This is because adult education becomes a relevant tool for agricultural development process. Although farmers usually have rich knowledge of local conditions and valuable practical knowledge or experience of how best to successfully exploit their environment, they require innovation information generated from research and development to boost their productivity.

| **Category** | **Sub counties** | | | | **Analysis** | | | |
|---|---|---|---|---|---|---|---|---|
| | Bungoma West | | Teso North | | df | $\chi2$ cal. | $\chi2$ Crt. | P-Value |
| **Land size** | Percentage | Frequency | Percentage | Frequency | | | | |
| 5-20 | 32% | 42 | 39% | 105 | **4** | 40.28 | 18.08 | 0.000S |
| 21-50 | 26% | 34 | 35% | 96 | | | | |
| 51-100 | 19% | 25 | 11% | 30 | | | | |
| 101-500 | 4% | 5 | 9% | 24 | | | | |
| 501-1000 | 19% | 25 | 6% | 16 | | | | |
| **Land Tenure** | | | | | **3** | | | |
| Personal land | 8% | 10 | 16% | 43 | | 19.12 | 17.22 | 0.009S |
| Rented-In | 34% | 44 | 35% | 95 | | | | |
| Communal | 43% | 56 | 34% | 92 | | | | |
| Family land | 15% | 20 | 15% | 20 | | | | |
| **Source of Extension** | | | | | **2** | | | |
| Research | 53% | 69 | 52% | 140 | | 16.92 | 17.24 | 0.065NS |
| NGOs | 26% | 34 | 25% | 67 | | | | |
| Farmers | 21% | 28 | 23% | 63 | | | | |

*Table 4: Analysis on the influence of land size, land tenure and extension services on the common bean insect pest and disease detection techniques among farmers in Teso North and Bungoma West*

The analysis on the statistical significant relationship between land size and the common bean insect pest and disease detection techniques found that that common bean insect pest and disease detection and management practices is dependent of land size with $\chi2$ calculated=40.28; 4df; $\chi2$ critical=18.08; P<0.000 at α=0.05. This result concurs with Ndiema (2010) who found land size to be a significant factor in uptake of new technology. However contradicts with (Demetriou, 2014) who found that there is an opposite relationship between farm size and productivity; hence, it is possible that smaller land parcels resulting from land subdivision may be more productive than larger, consolidated parcels. This relationship appears to hold true in Rwanda, where small farms were found to be more productive than larger farms, and that other risk coping mechanisms such as internal fragmentation and multi-cropping also tend to improve productivity (Ansoms, Verdoot, & Van Ranst, 2009).

The analysis on the statistical significant relationship between land tenure and the common bean insect pest and disease detection techniques found that land tenure system is an important arrangement and linked closely to diffusion of information of agriculture technology with $\chi2$ calculated=19.12, 3df, $\chi2$ critical=17.22; P<0.009; at α=0.05. This contradicts with (Dawson, Martin, & Sikor, 2015; Huggins, 2014; Kathiresan, 2002) who have argued that land tenure system has a negative effect on individual land use rights and security.

The analysis on the statistical significant relationship between agricultural extension and the common bean insect pest and disease detection techniques confirmed that the rate of uptake of agricultural technology is independent of extension service provision with $\chi2$ calculated=16.92; $\chi2$ critical=17.24; 2df; P<0.065 at α=0.05**.** This contradicts with (Birner et al., 2006) who asserted that agricultural extension encompasses the entire set of organizations that support and facilitate people engaged in agricultural production to solve problems and to obtain information, skills, and technologies to improve their livelihoods and well-being. This was further confirmed by 60% of the farmers expect to be visited visited the agricultural extension service officers to get agricultural information. Only 20% have visited the agricultural extension service officers to get agricultural information and 10% visit and expect to be visited while the rest use other methods of accessing agricultural extension service information. Of those who have ever visited the agricultural extension service offices have on average visited 5 times in the last two years and of those who have ever been visited the agricultural extension service officers have on average received the service providers 7 times in the last two years.

## IV. CONCLUSIONS

The analysis on the difference on common bean seed variety source showed a statistical significant difference with a t-value of -13.264; (p<0.000; α=0.05) and mean of (2.41) in Teso North and (5.13) in Bungoma West. The analysis on the difference on common bean insect pest and disease identification techniques showed a statistical significant difference with a t-test value of -10.264; (P≤0.005; α=0.05) and mean of (2.51) in Teso North and (4.10) in Bungoma West. The analysis on the difference on common bean insect pest and disease management practices showed a statistical significant difference with a t-test value of -11.064; (P≤0.009; α=0.05) and mean of (3.10) in Teso North and (5.12) in Bungoma West. Chai squire analysis on gender (calculated=3.71; 1df; critical=3.40; p<0.009), farm size (calculated=40.28; 4df; critical=18.08; p<0.000, land tenure systems (calculated=19.12, 3df; critical=17.22; p<0.009), education level (calculated=15.81 2df; $\chi2$ critical=14.98; p≤0.005) showed statistical significant influence on the common bean insect pest and disease detection techniques.



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