Rice productivity, Water and Sanitation Baseline Survey Report Western Kenya Rice Irrigation Schemes

Technical Report · January 2012

DOI: 10.13140/RG.2.2.35997.82409

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EXECUTIVE SUMMARY

The rice productivity, water and sanitation baseline survey conducted in the three western Kenya region rice irrigation schemes (Ahero, West Kano and Bunyala) in August 2011 was done first to get information on the target populations to be used to help in defining appropriate strategies for rice crop water management such as the system of rice intensification (SRI) and drinking water treatment technologies for the targeted communities in order to aid the project implementation. The second purpose of the survey was to provide baseline information from which to monitor progress and to evaluate the outcomes of the project.

This population based study focused on households' rice productivity, current health and socio-economic status in addition to information about household water use, water storage, and sanitation. The data collected using questionnaires included-the household characteristics, demographic data, health aspects, water use and availability, latrine use and availability, hand washing, food hygiene, rubbish disposal, disease prevalence and rice production. Observations of the drinking water containers, cleanliness of the compound and latrine were also made. The data collected was analyzed by using the scientific package for social sciences (SPSS) version 11.

The baseline study indicated that most respondents interviewed in the three irrigation schemes are permanent residents having lived in the schemes for more than five years. On average, 57% of the households in Ahero Irrigation Scheme (AIS) are male headed and 41% are female headed. In West Kano Irrigation Scheme (WKIS) and Bunyala Irrigation Scheme (BIS), more households (66% and 70%, respectively) are male-headed while 34% and 30%, respectively are female headed. Over 93% of all the households in the three irrigation schemes primarily depend on rice production as the main source of income. While all households in BIS derive their main income from rice farming only, households in AIS and WKIS supplement their income by exploiting wage labour opportunities (1.2% and 2.5%, respectively), craftsmanship (5% in AIS) and fishing (1.2% in WKIS).

In the three irrigation schemes, malaria is the most prevalent disease affecting 48% of households surveyed in AIS, 40% in WKIS and 45% in BIS. This can be explained by the favourable weather conditions and presence of frequent stagnant water. Diarrhea is more prevalent among households in WKIS (24%) and BIS (29%). Typhoid affects more households in AIS (28%) and WKIS (23%) than BIS (19%). Dysentery is least prevalent in rice irrigation schemes. Other diseases are distributed as follows, WKIS (10.8%), AIS (9.8%), and BIS (4.7%), respectively. Households in AIS and BIS have access to four sources of water for domestic use whereas all households surveyed in WKIS obtain the water used for domestic use from pump boreholes. About 55% and 53% of households interviewed in AIS and BIS, respectively, obtain their water from pump boreholes and lined wells. About 55% and 53% of households interviewed in AIS and BIS, respectively, obtain their water from pump boreholes and lined wells.

Most households surveyed have family latrines. Majority of households (between 77% - 88%) have pit latrines, however, not all family members use them. The respondents in AIS (56%), BIS (78%) and 81% in WKIS make use of latrines whereas 22%, 15% and 2.5% respectively reported the contrary. The reasons for not allowing all family members to use the latrines range from difficulties due to age; preference for open defecation; productive activities that compel some members to work out in the field and the need to avoid bad smell. The implications arising from open defection include; contamination of water sources and contamination of food crops. Whereas most respondents in the three irrigation schemes know the importance of washing hands, there are variations in the understanding of the reasons for doing so. Personal hygiene-washing hands before eating scored 93%-100%. In AIS (91%) and BIS (97%), the need to keep hands clean scored higher than in WKIS (73%). In AIS, 96% respondents reported that they wash hands to reduce chances of contracting diseases and enhance better health.

During the baseline survey, observations were made on the general level of tidiness within the compounds of the selected households. The results indicate that over 87% of respondents live in mud floored houses; over 63% have mud walls and over 62% have roofs made of iron sheets. This implies the respondents hardly use income from rice growing to improve their housing situation, land ownership and land-use characteristics.

Most farmers in AIS (95%) and WKIS (86%) grow rice on less than seven acres of land, most of which is allocated by NIB. In BIS 50% of the respondents cultivated three to five acres of land allocated by the NIB, and less than 8% rent land for rice production. About 8% and 12% of farmers in BIS and AIS, respectively, rent less than three acres of land for rice growing. In WKIS, 16% of the respondents rent up to seven acres of land for rice cultivation. In the three irrigation schemes, 86.2%, 77.5% and 92.5% of the respondents in AIS, WKIS and BIS, respectively, own the land under rice production. Less than 4% of respondents in all the irrigation schemes rent the land cultivated, while about 1% in WKIS lease the land used to grow rice. Production costs vary across the three irrigation scheme. In terms of crop variety, 56% of farmers in AIS prefer IR2793 as compared to 50% of farmers in BIS. In WKIS, 59% of the farmers rank Basmati 317 variety highly. In the absence of IR2793 rice variety, farmers in AIS would cultivate Basmati 317; whereas farmers in WKIS and BIS would replace their highly ranked varieties with IR2793 and BW 317, respectively. The reasons for preference of respective varieties are due to long periods of cultivation and lack of awareness on new improved rice varieties. The baseline study provides an overview of the rice growing practices and lays a firm foundation in understanding the challenges facing farmers in the rice growing schemes in western Kenya.

In conclusion the situation in the three irrigation schemes reveals a vicious cycle in which numerous factors contribute to rampant poverty. Living conditions are difficult as witnessed by low purchasing power, high rice crop production costs, low levels of education of women, overcrowded households, and the nature of housing, latrines in poor condition, poor access to safe drinking water, etc. All these factors lead to inadequate hygiene and basic sanitation, resulting in prevalence of waterborne diseases in the communities. The lack of awareness about waterborne diseases and failure of the local population to employ preventative measures increases their vulnerability to preventable common illnesses that play a toll on households. High health care costs and reduced productivity are just two consequences of preventable illnesses. Without an improvement in the returns from the main rice crop and in basic living conditions, households in the three irrigation schemes are at risk of plunging even deeper into poverty.

PROJECT INFORMATION

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Funding

Funded by the National Council of Science and Technology (NCST) through the "*3rd Competitive Science, Technology and Innovation Grant*" (Ref: **NCST/5/003/3rd STI CALL/188)** for the project period 01 January 2011 to 01 January 2014.

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ACKNOWLEDGEMENT

This report was prepared by a team led by Dr. Emmanuel Chessum Kipkorir (Chepkoilel University College, School of Engineering), with substantial assistance from Mr. Phanuel O. Webi (Ministry of Water and Irrigation), Dr. Grace J. Cheserek, Dr. Fatuma Daudi and Mr. Kipkorir K.G. Kiptoo (Chepkoilel University College, School of Environmental Studies), Mr. Edward M. Mugalavai (Masinde Muliro University), Mr. Laban K. Kiplagat (National Irrigation Board, Western Region) and Mr. Charles K. Songok (Koroitiet Community Initiative). The authors gratefully acknowledge the National Council of Science and Technology (NCST) for the financial support, which enabled this research. Thanks are also due to the collaborating institutions, farmers in Ahero, West Kano and Bunyala Irrigation Schemes for their cooperation and providing information, local research assistants who played a key role in field data collection and analysis, as well as the Kenyan Government and non-governmental agencies for the information and data they provided.

LIST OF ACRONYMS

AIS	Ahero Irrigation Scheme
BIS	Bunyala Irrigation Scheme
FFS	Farmers' field school
FHH	Female-headed household
GIS	Geographic Information Systems
HHH	House Hold Head
MHH	Male-headed household
NCST	National Council of Science and Technology
NIB	National Irrigation Board
POU	Point-of-Use
SRI	System of Rice Intensification
WKIS	West Kano Irrigation Scheme

CHAPTER 1: INTRODUCTION

1.1 Overview of the project

Demand for rice in Kenya continues to soar as more people show progressive changes in their eating habits, coupled with urbanization. Rice is currently the third most important cereal crop after maize and wheat. Most of the rice in Kenya is grown in irrigation schemes established by the Government, which include Mwea in central Kenya, three irrigation schemes (Ahero, West Kano and Bunyala) in western Kenya. On the other hand, a smaller quantity of rice is produced along major river valleys, located in the coast and lake basin regions. About 80% of rice in Kenya is grown under continuous flooding as is typified in gravity operated Mwea irrigation scheme, and in the three western Kenya irrigation schemes that are pumps operated (JICA, 1988).

The paddy system of rice production requires a lot of water and production is often affected by water scarcity in times of drought (Gessel, 1982), as was the case in 2009. The present water management in the irrigation schemes creates a regular flow of water in the larger canals and intermittent rotational flows in smaller canals. As a result, the rice farmers and their families who stay in specified villages within the irrigation schemes depend on the irrigation system as the main source to supply them with water for all agricultural and domestic purposes.

Throughout the country, shortage of water and land suited for rice production means that extensive expansion of rice growing is not a likely option. On the other hand access to portable water supply by rice farmers and their families is very low, often forcing them to use contaminated water from irrigation canals for drinking which contribute to high diarrhoea cases that sometimes leads to deaths. Therefore there is need to consider irrigation water saving alternatives alongside point of use (POU) drinking water treatment technologies and any interventions that can increase the water productivity of rice and provide portable water supply are most welcome initiatives.

The System of Rice Intensification (SRI) that involves intermittent wetting and drying of paddies as well as specific soil and agronomic management practices is an alternative system that can be considered to increase crop water productivity (Ceesay, 2002). SRI offers an opportunity to improve food security through increased water productivity of rice, increased smallholder farmers' income and reduce the national rice import bill (Mati, 2010). Moreover SRI makes use of assets already available to rice farmers (Dobermann, 2004). SRI was introduced at Mwea irrigation scheme in August 2009 (Mati, 2010) and to date, very few people know about SRI in Kenya. Biological sand filters are good examples of sustainable POU drinking water treatment technology that can provide portable drinking water to a rural population (Lee, 2001). The filters can operate without the use of electricity or petroleum based fuel and can be made from mostly recycled materials.

In the current study funded by National Council for Science and Technology (NCST), the research team has identified the potential for SRI and Bio-sand filters strategies for promoting and determining the cost-effectiveness of these technologies in increased rice production and reduced diarrheal disease among farmers in western Kenya irrigation schemes. It is assumed that the bio-sand filters will mitigate the risks associated with drinking polluted water as well as SRI will increase crop-water productivity in the study area. To achieve the study results, the team undertook a baseline survey to understand the current situation, identify knowledge gaps, attitudes and practices of farmers on rice production as well as water and sanitation. The findings of the baseline survey are discussed in detail in chapter three, four and five of this report.

1.2 Objectives of the survey

The primary purpose of the baseline survey was to gather and make available information on the situation analysis of target population in order to help determine appropriate technologies for rice crop water management and drinking water treatment. The second purpose of the survey was to provide baseline information from which to monitor progress and to evaluate the outcomes of the project. Increase in knowledge and attitude change in respect to drinking water treatment and agricultural water management are anticipated by the end of the project as a result of the project interventions.

1.3 Study area

Three irrigation schemes that specialize in rice growing in Western Kenya (Ahero, West Kano and Bunyala) and which are managed by the National Irrigation Board (NIB) were considered in the study. The rainfall pattern of western Kenya region, where the schemes are located, is generally characterized by bimodal rainy season, governed by the passage of the sun across the equator and the associated movement of the Inter-Tropical Convergence Zone (ITCZ). Also it is characterized by isolated heavy storms due to the influence of Lake Victoria. The irrigated fields in the three schemes are underlain by deep black cotton soils (Vertisols) (Sombroek et al., 1982). According to Jaetzold (1983), black cotton soils are heavy soils with very high clay content that swell or shrink and crack accordingly when they are hydrated or dried.

Ahero Irrigation Scheme (AIS) is located in Kano Plains, close to Lake Victoria, in Kisumu County (Figure 1) and draws water from river Nyando using pumps. The average annual rainfall in AIS is approximately 1175 mm, of which 39% is received during the long-rains period (March to May) and 29% of which is concentrated in the short-rains period (August to November) (Noij and Niemeijer, 1988). The temperature at AIS ranges from a monthly mean of 22.1 ^{0}C in June to 23.5 ^{0}C in March. AIS was commissioned in 1969 and supports approximately 520 tenant farmers on a net irrigated area of 840 ha.

West Kano Irrigation Scheme (WKIS) occupies the major part of Kano Plains, on the shores of Lake Victoria in Kisumu County. It is located between longitudes 34^{0} 48' East and 35^{0} 02' East and between latitudes 0^{0} 04' South and 0^{0} 20' South (D'Costa, 1973). The scheme receives a mean annual precipitation of 1100 mm, reference evapo-transpiration of 2200 mm per annum, mean diurnal temperature of 23^{0}C, and a relative humidity of 68-70 %. Water for irrigation is drawn from Lake Victoria using pumps. The scheme was commissioned in 1975 and supports approximately 550 tenant farmers on a net irrigated area of 900 ha, at an altitude of 1137 m above sea level (D’Costa, 1973). The scheme lies in a depression and water is pumped in and out of the depression during a crop cycle. The scheme is protected by dykes to keep away the floodwaters. The soils in WKIS are fine textured, dark, blocky soils low in organic matter which shrink and crack appreciably with the changes in moisture content and commonly lack distinct horizons (D’Costa, 1973; Sombroek et al., 1982).

Bunyala Irrigation Scheme (BIS is located in Budalangi division, Siaya County (Figure 1). Physiographically, the scheme falls within the lake lowlands region overlying granite bedrock and surrounded by Nyanza Low Plateau topography, and bordering the north shore of Winam Gulf of Lake Victoria. Total annual rainfall averages 1400 mm per year and daily temperatures range from 25.5°C to 33.0°C (Ojany, 1996). The scheme is located at the old stage of river Nzoia on the shores of Lake Victoria and draws water from river Nzoia using pumps. Bunyala is a flood plain with poorly drained alluvial sediments composed of deep, grayish brown to very dark grey, mottled, very firm, saline and sodic, cracking clay soils (Jaetzold and Schimdt, 1983). The scheme was commissioned in 1968 and supports approximately 300 tenant farmers on an irrigated area of approximately 500 ha.

At present, rice production in the three schemes mainly involves the *Sindano* (IR2793) variety and each farmer is licensed to cultivate 1.6 ha of irrigated rice in four fields, each of 0.4ha. Some of the major challenges that the three irrigation schemes face are:

(i) Lack of cost-effective water supply system (pumping vs. gravity),
(ii) Lack of water storage to guarantee adequate supply during the dry spell,
(iii) Slow adoption of participatory irrigation management by the farming community,
(iv) Combating of water-borne and other related diseases,
(v) Ensuring environmental stability,
(vi) Lack of clean drinking water, among others.

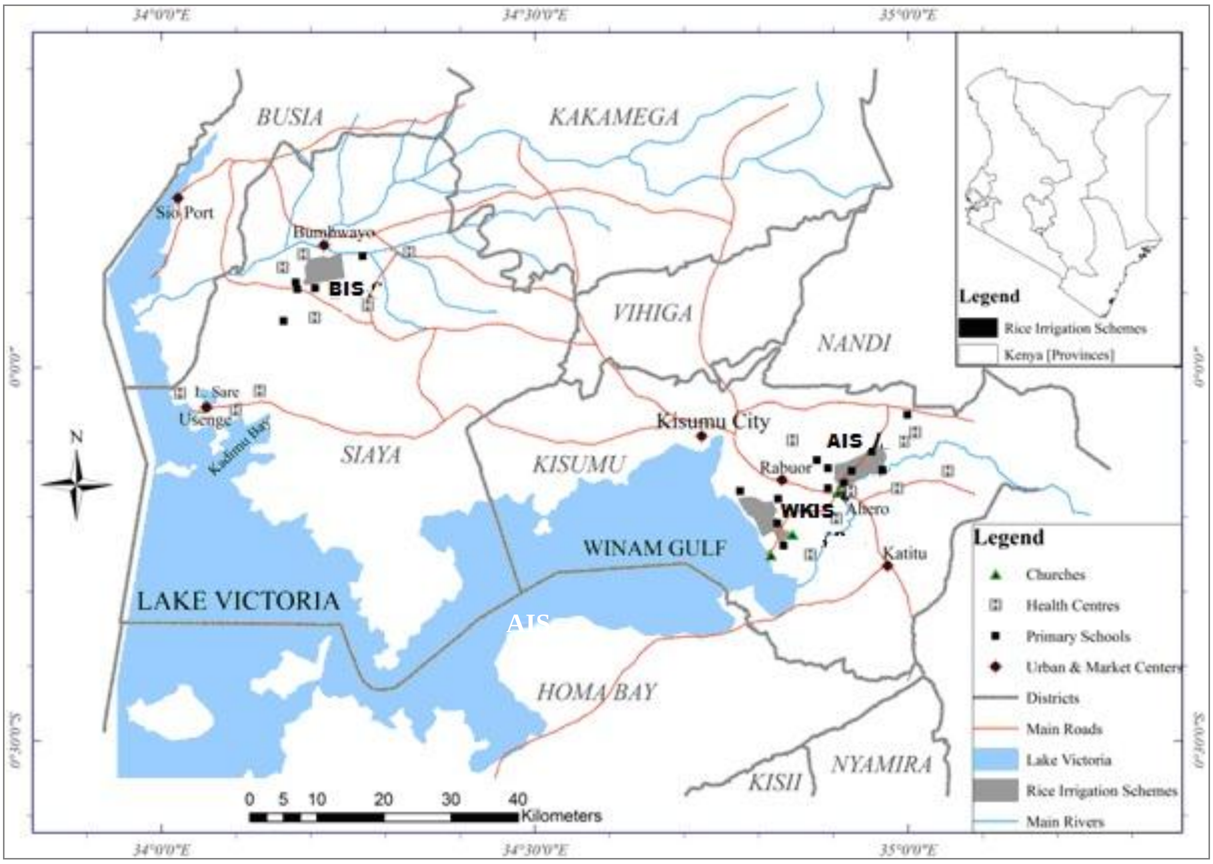


Figure 1: Location of the three irrigation schemes under study in the western part of Kenya

CHAPTER 2: METHODOLOGY

2.1 Survey instruments

The survey instruments used in the three rice irrigation schemes consisted of a household questionnaire divided into twelve sections (Appendix A). The first section requested information on the location of the household. Nine of the following sections required probing of the respondent on various topics including: demographic information, health aspects, water use and availability, latrine use and availability, hand washing, food hygiene, rubbish disposal, diarrhoea disease and rice production. All the responses were unsolicited and most of the questions included a space for “other” responses. Observations of the drinking water containers were made. The last two sections of the questionnaire required the enumerator to record observations on the cleanliness of the compound and latrine, if one was present.

The survey instrument required twenty to thirty minutes to administer, depending on the patterns, speed and comprehension and clarity of responses. The enumerators involved had past experiences and were selected from the respective communities for ease of the exercise and to avoid the need for translation for some few cases. The questionnaires were first field-tested in Ahero Irrigation scheme by the enumerators in the presence of researchers and subsequently revised to eliminate problems in language comprehension. The sample questionnaire is attached in Appendix A.

2.2 Sample selection

The target population of rice farmers in Ahero, West Kano and Bunyala irrigations schemes is 1380 and therefore Equation 1 for finite population was used to compute the sample size.

$$n = \frac{Z^2 . p.q.N}{e^2 (N-1) + Z^2 . p.q} \text{ .... (Equation 1)}$$

Where n is size of sample, Z is standard variate at a given confidence level, p is sample proportion, q = (1-p), N is the size of population and e is acceptable error (the precision).

Using Equation 1 with N=1380, e = 0.02, Z=1.96 (as per table of area under normal curve for the given confidence level of 95%), the p value is assumed to be equal to the precision p=0.02 and q = 0.98, the sample population n is computed as 166.

The computed sample size was proportionally distributed to each scheme based on respective individual scheme population of 530, 550 and 300, giving the individual sample sizes of: Ahero (64), West Kano (66) and Bunyala (36). This values were scaled up to Ahero (80), West Kano (80) and Bunyala (40) giving a total of 200 rice farmers from the three irrigation schemes being interviewed. The respective farmer registers with known number of farmers was used to select the sample using systematic sampling with the start being randomly selected. This resulted in a 95% confidence level and at least 2% precision. The probability of selection in the three cases was proportional to the population, therefore the two larger schemes, Ahero and West Kano, generally contained double the sample size compared to Bunyala. The required sample sizes for each scheme are as computed in Annex 2.

2.3 Selection and training of enumerators

A total of six enumerators were involved in the surveys and were distributed equally in the three irrigation schemes. All the six enumerators had prior experience as survey enumerators and were fluent and literate in Dholuo language, the predominant local language of the community in the three irrigation schemes, as well as English. The project researchers facilitated a one-day training program for the six enumerators prior to the survey in each scheme. The program included sessions on the purpose of the survey, the role and responsibilities of the interview, interviewing techniques, importance of randomness and minimising bias.

The bulk of the training was devoted to reading and familiarizing the enumerators with the questionnaire in English. First, the purpose of each question was explained. Then instructions on how to fill out the questionnaire were reviewed to familiarize the interviewers with skip patterns and open-ended questions. After the procedure to select households was explained, a simulation exercise was performed. Interviewers worked in teams, selected households and conducted interviews in a village in Ahero irrigation scheme the venue of the training.

2.4 Survey procedure

During the actual survey, interviewers paired and alternated in conducting interviews. Although local authorities had been informed prior to the survey, the enumerators reiterated the purpose and procedure of the survey to village elders and requested to be led to the selected households based on the register of farmers in the irrigation schemes. In the selected house, the interviewers ascertained if an adult member was present and, if so, his or her willingness to be interviewed sought. In case where no adults were present, the team moved to the next closest house and conducted interviews following the same procedure. The pair of enumerators later returned to houses where adults were absent, and if available, interviews were conducted. This procedure was repeated until all randomly selected houses were surveyed. While one team member conducted the interview, the other observed and provided assistance to make sure that, questions were not skipped and that the questionnaire form was completed. Where logistical constraints necessitated, great distance between households, interviews were conducted by only one team member.

2.5 Data analysis

Upon completion of the interviews in the field, the questionnaires were brought to Ahero where an experienced person was hired to enter data using SPSS version 11 software in close supervision by the research team. This program was also used for data analysis. Frequency tables were used to discern tendencies, and cross tabulations were used to compare sub-groups.

2.6 Data quality

An attempt was made to enhance memory reliability by asking questions about recent behaviour. For example, questions concerning drinking water were asked only about water fetched on the day of the interview. Questions about diarrhoea were posed only where a person had experienced diarrhoea within seven days prior to the interview. To further ensure quality, all questionnaires were checked on daily basis by co- principal investigators and gaps were filled on the spot.

CHAPTER 3: HOUSEHOLD SOCIO-ECONOMIC CHARACTERISTICS

3.1 Demography and socio-economic characteristics

All respondents interviewed in Ahero and Bunyala irrigation schemes are permanent residents in the schemes. In West Kano, 86.3% respondents are permanent residents while the rest have stayed in the scheme for between six months (2.5%) and 5 years (Table 1).

Table 1: Residence in the irrigation schemes

Residence	Ahero		West Kano		Bunyala	
	Frequency	%	Frequency	%	Frequency	%
Less than 6 months	0	0.0	2	2.5	0	0.0
1-2 years	0	0.0	8	10.0	0	0.0
3-5 years	0	0.0	1	1.3	0	0.0
Permanent resident	80	100.0	69	86.3	40	100.0
Total	80	100.0	80	100.0	40	100.0

On average, 57% of the households in AIS are male headed and 41% are female headed. In WKIS and BIS, more households (66.2% and 70%, respectively) are male-headed while 33.8% and 30% respectively are female headed (Table 2).

Table 2: Household demography and socio-economic characteristics

Variables		Category	Distribution per scheme (Count/%)		
			Ahero	West Kano	Bunyala
Gender of Household Head		Female	43.0	33.8	30.0
		Male	57.0	66.2	70.0
Level of education		Primary school	13.8	12.5	22.5
		Secondary school	60.0	60.0	50.0
		Technical training/College	25.0	18.8	27.5
		University	1.2	8.8	0
Household size		1 - 4	20.0	10.0	10.0
		5 - 9	60.0	56.2	62.5
		10 - 14	16.2	25.0	25.0
		15 - 19	1.2	8.8	2.5
		More than 19	2.5	0	0
Dependants	Children	1-4	56.3	30.0	40.0
		5-9	33.8	52.5	45.0
		10-14	2.5	2.5	5.0
		15-19	1.3	0	0
		Over 19	1.3		
	Grand children	1-4	27.5	21.2	22.5
		5-9	3.8	5.0	7.5
	Others	1-4	10.0	0	0

In AIS, 73.8% of the household heads surveyed and 72.5% of the households in both WKIS and BIS have attained basic (primary and secondary) education. Less than 27% of the respondents in all the schemes have attained technical/college training or university education. From the results in Figure 2, gender disparities exist in the level of education attained between household heads. In all the three irrigation schemes, more female household heads have attained primary education than their male counterparts.

However, progression in education level among female household heads decreases compared to their male counterparts. It is only in AIS that both male and female household heads have acquired basic and tertiary education. In WKIS, male household heads have progressed beyond secondary level and attained tertiary education. In BIS, neither household heads have progressed beyond technical/college. The level of education of the household is a key factor that inhibits the ability to acquire knowledge and skills on agricultural production and basic water and sanitation hygiene. The education level of the household influences the vulnerability of the household to water and sanitation related diseases, especially considering that most of the irrigation schemes are located in areas that easily attract disease causing vectors or predispose households to water related disease risks.

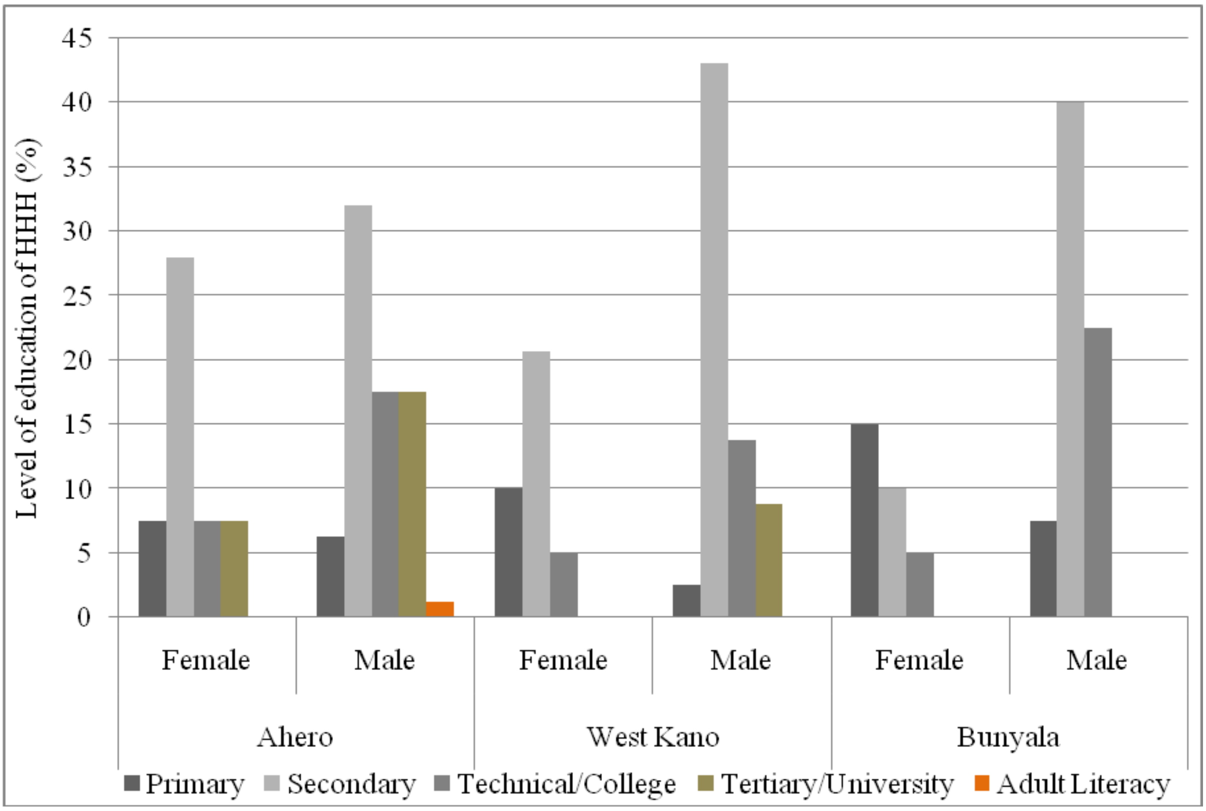


Figure 2: Education level of household heads by gender

More than 55% of the households surveyed in the three irrigation schemes are composed of between five and nine household members. In WKIS and BIS, 25% of the households surveyed, respectively, have between 10 and 14 household members, whereas in AIS 16.2% of the households surveyed have a similar number of household members. A lower proportion of households surveyed in AIS (1.2%), WKIS (2.5%) and BIS (5%) have 15-19 members. Among the dependants, more of the households surveyed in the three irrigations schemes have up to nine children (80% in AIS, 66.2% in WKIS and 72.5% in BIS). However, in AIS 2.6% of the households have 15 or more children dependants (Table 1).

The proportion of households with one to four grand-children dependants is high in AIS (27.5%) and decreases towards BIS (22.5%) and WKIS (21.2%). In all the irrigation schemes, between three and four households have five to nine grand-children dependants. Comparatively, more households in AIS have more dependants than the households surveyed in WKIS and BIS (Figure 3).

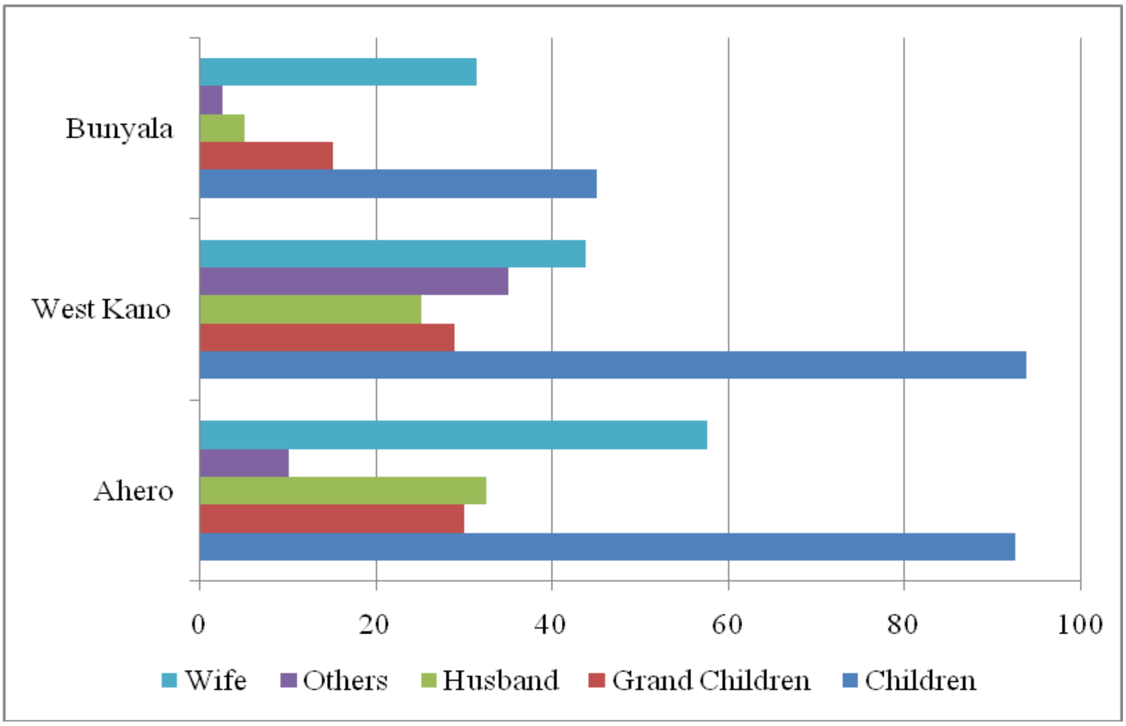


Figure 3: Household composition in the three irrigation schemes

3.2 Livelihood Strategies

Over 93% of all the households (Table 3) in the three irrigation schemes primarily depend on rice production as the main source of income. While all households in Bunyala derive their main income from rice farming only, households in AIS and WKIS supplement their income by exploiting wage labour opportunities (1.2% and 2.5%, respectively), craftsmanship (5% in AIS) and fishing (1.2% in WKIS). These income sources contribute minimal compared to rice production. From these livelihood activities, households earn varying income levels annually (Table 3). In AIS, about 91.3% of the households surveyed generate Kshs. 30,000 – 119,000 annually, mainly from rice production.

A lower proportion of households in WKIS (70%) and BIS (52.5%) earn a similar amount of income annually. It is evident from the findings that more households (47.5%) surveyed in BIS generate lower income levels (less than Kshs. 30,000 annually) from the livelihood activities they engage in. However, it is important to note low number of households in WKIS (17.5%) and AIS (5%) generate more than Kshs 120,000 annually.

Table 3: Household income sources and average annual incomes

Variables	Category	Distribution per scheme (%)		
		Ahero	West Kano	Bunyala
Main income sources	Fishing	-	1.2	
	Craftsman	5.0	-	-
	Wage labour opportunities	1.2	2.5	
	Farming	93.8	96.2	100.0
Average annual household income	Less than Kshs. 30,000	3.8	12.5	47.5
	Kshs. 30,000 - 59,000	57.5	30.0	40.0
	Kshs. 60,000 - 119,000	33.8	40.0	12.5
	More than Kshs. 120,000	5.0	17.5	-

In addition to the main sources of income, most households surveyed have invested in productive assets (Table 4) that enable them to diversify income options, cushion (form of insurance) themselves against shocks associated with reduced yields or losses of rice produced, enable them to respond to sudden shocks that may affect the productivity of household members like sickness or accidents, supplement household dietary and nutritional needs and assist in meeting other family needs such as education, social obligations (marriages) and investments.

Table 4: Distribution of domestic livestock types owned by households in each scheme

	Numbers of animals owned	Proportion of households in percentage owning different livestock types (%)					
		Cattle	Goats	Sheep	Rabbits	Chicken/Ducks	Other
Ahero	1 – 4	42.5	18.8	16.2	1.2	22.5	
	5 – 9	22.5	17.5	13.8		8.8	
	10 – 14	11.2	1.2	10.0		30.0	0
	15 – 19	6.2			0	6.2	
	20 – 24	3.8	0	0		7.5	
	>25	0				1.2	
	0	13.8	62.5	60	98.8	23.8	
	Total	100	100	100	100	100	
West Kano	1 – 4	35.0	30.0	18.8		28.8	36.2
	5 – 9	20.0	15.0			13.8	5.0
	10 – 14	3.8	6.2	0	0	20.0	
	15 – 19	6.2				8.8	0
	20 – 24	2.5	0	2.5		1.2	
	25 – 29	5.0		0		0	
	0	27.5	48.8	78.7	100	27.4	58.8
	Total	100	100	100	100	100	100
Bunyala	1 – 4	40.0	17.5	2.5		15.0	12.5
	5 – 9	20.0	2.5	12.5		32.5	
	10 – 14	2.5			0	17.5	0
	15 – 19	2.5	0	0		7.5	
	20 – 24	0				10.0	
	0	35	80	85	100	27.5	87.5
	Total	100	100	100	100	100	100

The households surveyed in the three irrigation schemes have on average between one to nine herds of cattle (Plate 1), five goats, two to eight sheep and 10- 14 chicken/ducks. In specific irrigation schemes, the number of livestock units owned vary, with 65%, 55% and 60% of households surveyed in AIS, WKIS and BIS, respectively owning between one and nine cattle.

Regarding small ruminants, a higher proportion of households in AIS (77.5%) and WKIS (70 %) own average 10 goats and 11 sheep, compared to BIS where only 35% of the households surveyed own the same number of sheep and goats. In terms of poultry (chicken and ducks) every household had over 70% by proportion that varied as follows; AIS (78.7%), WKIS (72.6%), BIS (91.5%) respectively with a mean count of between 9-10 in all the three schemes. It was observed that rabbits are not reared by households of the three irrigation schemes surveyed. These results reveal that poultry is a major contributor to household livelihoods in the three schemes.

Plate 1: Cattle returning from grazing (left) and a place within a homestead where cattle are tethered to spend the night (right) in WKIS.

CHAPTER 4: WATER AND SANITATION

4.1 Household health and sanitation

In the three irrigation schemes, malaria is the most prevalent disease affecting 48.2% of households surveyed in AIS, 40.5% in WKIS and 45.3% in BIS (Table 5). This can be explained by the favourable weather conditions and presence of frequent stagnant water. Diarrhoea is more prevalent among households in WKIS (24.3%) and BIS (29.1%). Typhoid affects more households in AIS (28%) and WKIS (23.4) than BIS (18.6%). Dysentery is least prevalent in rice irrigation schemes. Other diseases are distributed as follows, WKIS (10.8%), AIS (9.8%), and BIS (4.7%), respectively.

Table 5: Prevalent diseases in the three irrigation schemes

Diseases	% Respondents		
	Ahero	West Kano	Bunyala
Malaria	48.2	40.5	45.3
Diarrhea	6.7	24.3	29.1
Typhoid	28.0	23.4	18.6
Dysentery	7.3	0.9	2.3
Others	9.8	10.8	4.7
Total	100.0	100.0	100.0

In the three irrigation schemes, over 70% of the households surveyed reported that children below 5 years of age are the most vulnerable to the above stated waterborne diseases (Figure 4). Although the level of vulnerability among children above 5 years of age is higher in WKIS, compared to the other two irrigation schemes, generally, susceptibility to waterborne diseases reduces with increase in the age of a household member. Vulnerability of men and women is below 17%, thus could be attributed to poor hygienic conditions in handling water between the source and the storage places. Data collected shows the main source of drinking water in WKIS is shallow wells and therefore there is possible link with water pollution from farm runoff that may be combined with human excrement.

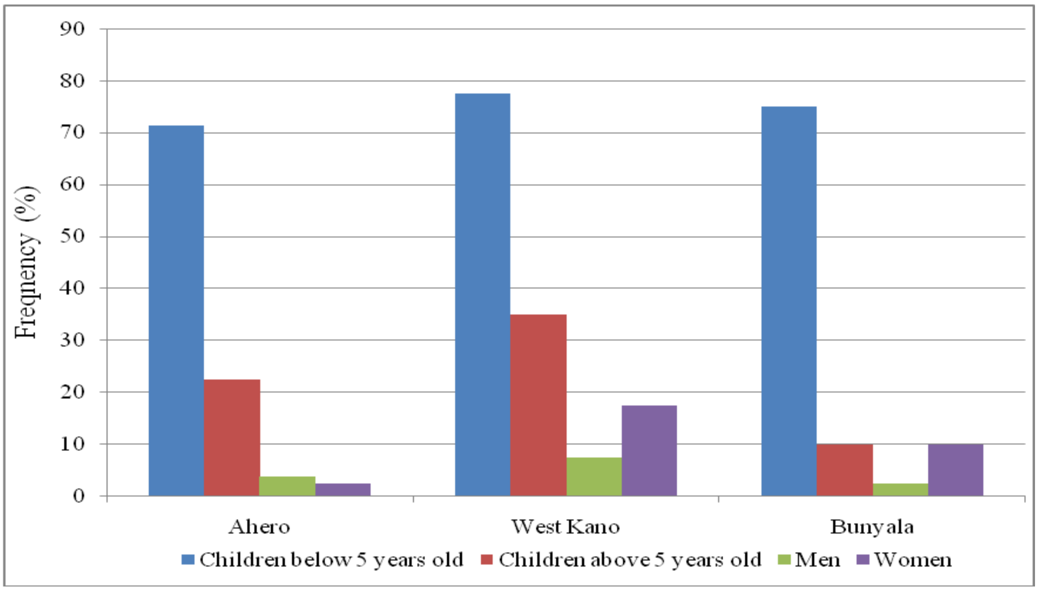
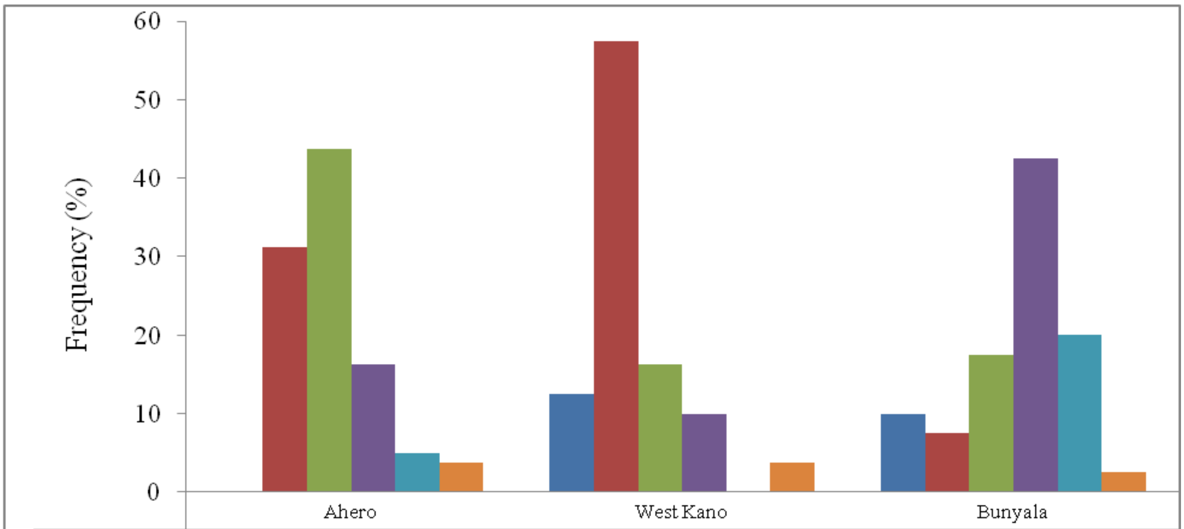


Figure 4: Vulnerability to waterborne diseases among household members

Across the gender of household members, a higher proportion of women than men in WKIS (17.5% versus 7.5%, respectively) and BIS (10% versus 2.5%, respectively) are more vulnerable to waterborne diseases. This is due to women's role on collecting domestic water, hence high chances for them to consume raw water at the point of collection.

Generally, the frequency with which a household member falls sick is shorter in AIS and WKIS compared to BIS. In AIS, 31.1% and 43.8% of the households surveyed reported that household members fall sick after every 3-4 months and 5-6 months, respectively. In WKIS, a high proportion of household respondents indicated that most household members succumb to waterborne related diseases every 3-4 months. The situation in BIS is slightly different with household members falling sick after 7-8 months. However, of critical concern is the 2.5% and 10% of household respondents in WKIS and BIS, respectively, who reported that a household member falls sick every 1-2 months. It is assumed the reasons for frequent illness is because of prevalence of waterborne vector causing diseases, such as mosquitoes, unhygienic means of handling water from source, storage and use. It should be noted that rice irrigation schemes are prone to flooding hence the high prevalence of diseases. BIS is least flooded with most respondents reporting the use of improved well for domestic water unlike AIS and WKIS who use pump boreholes (Figure 5).



	Ahero	West Kano	Bunyala
1 - 2 month	0	12.5	10.0
3 - 4 Months	31.3	57.5	7.5
5 - 6 Months	43.8	16.3	17.5
7 - 8 Months	16.3	10.0	42.5
9 - 10 Months	5.0	0.0	20.0
11 - 12 Months	3.8	3.8	2.5

Figure 5: Frequency of household members falling sick in the three Irrigation schemes

The high frequency of household members falling sick in AIS and WKIS presents negative implications on the time spent by women in caring for sick. The impact is reduced economic woman hours that could otherwise be invested in productive activities. In addition, a high frequency of sickness means that income generated from rice production and sale of domestic livestock is used frequently to pay hospital and medicine bills for the sick members, instead of re-investing in income generating activity. This increases the health costs of households (Table 6) and requires urgent technology to treat drinking water and improve household hygiene and sanitation in order to reduce the frequency of sickness and costs on healthcare.

Table 6: Average amount spent on treating waterborne diseases annually

Treatment expenditure (Ksh)	Distribution (%)		
	Ahero	West Kano	Bunyala
Less than 8,000	71.3	15.0	42.5
8,000 - 16,000	22.5	32.5	42.5
16,001 - 24,000	3.75	7.5	2.5
24,001 - 32,000	0	21.3	10.0
32,001 - 40,000		10.0	0
More than 40,000	2.5	13.8	2.5
Total	100	100	100

Expenditure on treatment of diseases varies among households in the three irrigation schemes. A higher proportion of households in AIS (93.8%) and BIS (85%) spend less than Ksh 16,000 to treat diseases. An estimated 21.3% and 10% of surveyed households in WKIS and BIS, respectively spend Ksh 24,000 - 32,000. More households however, in WKIS (23.8%) spend more than Ksh 32,000 on treatment of diseases compared to 2.5% each in AIS and BIS. These expenditure patterns are in concert with the prevalence levels and frequency of household members falling sick due to water borne diseases.

4.2 Water availability and use

Households in AIS and BIS have access to four sources of water for domestic use whereas all households surveyed in WKIS obtain the water used for domestic use from pump boreholes (Figure 6). About 55% and 53% of households interviewed in AIS and BIS, respectively, obtain their water from pump boreholes and lined (improved) wells. Plates 2 indicate four common sources of water in the three irrigation schemes.

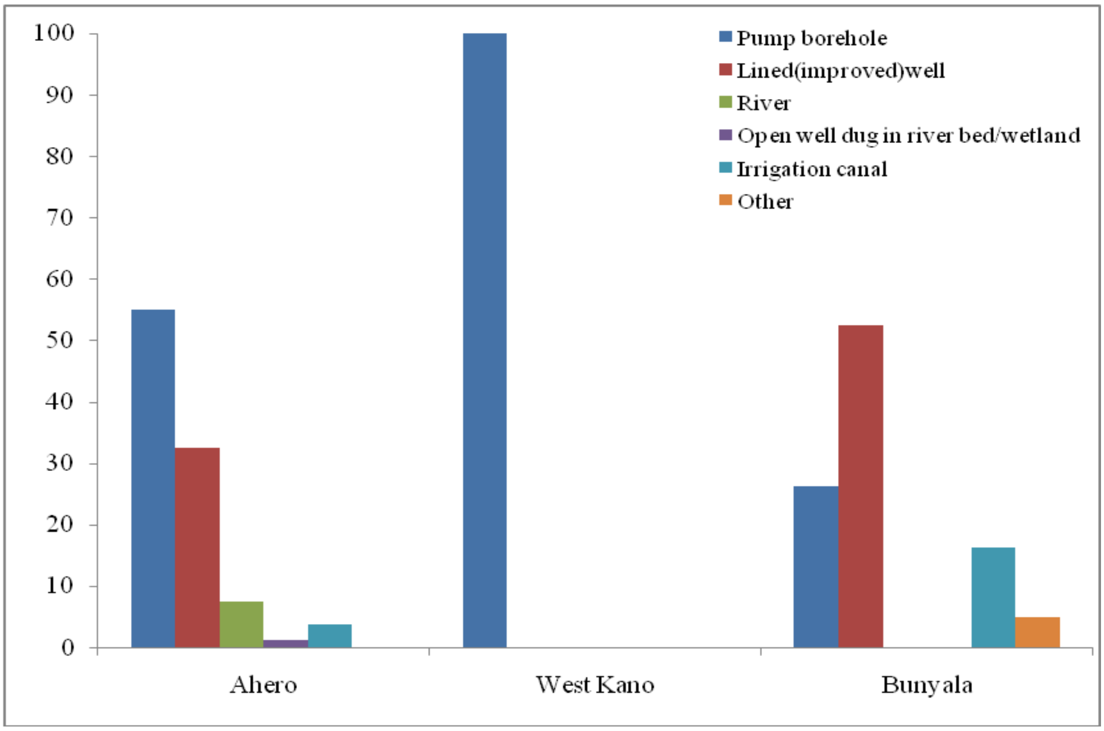


Figure 6: Sources of drinking water in the three irrigation schemes

a: protected hand pumped well

b: roof rainwater harvesting

c: irrigation canal

Plate 2: Various domestic water sources found in the study areas

Most of the households interviewed prefer the above water sources because they are in close proximity to their homes. Fifty one per cent (51.3%), 53.8% and 60% of households surveyed in AIS, WKIS and BIS, respectively prefer the water sources because time taken to reach them is less than 15 minutes. Between 22.5% (AIS) and 37.5% (BIS) spend 15-30 minutes to the water sources, while 18.8% and 23.8% of households in AIS and WKIS take more than 30 minutes to obtain water used for domestic purposes. However, in BIS, only 2.5% of households take more than 30 minutes to reach domestic water sources. Most of the respondents understand the importance of protecting water sources (Table 7). A high proportion of respondents 93.8% in AIS, 80% in WKIS and 92.5% in BIS stated that water sourced from protected sources compared to unprotected source is clean.

Table 7: Advantages of households obtaining water from protected sources

Advantages of protected water source	Distribution (%)		
	Ahero	West Kano	Bunyala
No advantage	1.3	7.5	2.5
Water is clean	93.8	80.0	92.5
Less likely to get sick/better health	61.3	32.5	25.0
Close to house	7.5	6.3	5.0
Other	0	0	2.5

The main reasons for preference of the water source mostly used by households include closeness to the water source, availability of clean water from the source among other reasons (Table 8). The women and girls are the main people (85% in AIS, 60% in WKIS and 77% in BIS) in a household who fetch domestic water (Table 8).

Table 8: Reasons for the preferred source of water in the three irrigation schemes

	Frequency (%)		
Reasons for preferred water source	Ahero	West Kano	Bunyala
Water is closest	38.8	41.25	42.5
Water is clean	28.8	37.5	12.5
No queuing	1.3	5.0	0
Source closest and clean water	17.5	7.5	30.0
Clean water and reliable source	3.8	1.25	0
Closest source and no queuing	7.5	2.5	
Closest, clean and reliable	1.3	1.25	
Closest, clean, reliable and regular	1.3	3.75	15.0
Who fetches water			
Woman alone	49.0	25.0	35.0
Boy alone	4.0	3.0	2.5
Man alone	1.0	3.0	2.5
Woman and girl	46.0	35.0	42.5
Woman, girl and boy		22.0	2.5
Woman and Boy	0	11.0	10.0
Woman and man		1.0	5.0
Total	100	100	100

Most households in AIS (62.5%) and WKIS (75%) chlorinate the water used for drinking. In BIS, respondents interviewed reported that they do not apply any form of treatment to the water used for drinking. This can be explained by the fact that many household fetch domestic water from community boreholes that are regularly chlorinated. Only 5% of households surveyed in BIS boil the water used for drinking compared to 33.8% in AIS and 18.8% in WKIS. A small number 17.5% and 21.3% of households in AIS and WKIS filter the water with a cloth before drinking (Table 9).

Over 92% of the households surveyed in all the irrigation schemes store the water collected for drinking in containers with a lid. Less than 8% of households in WKIS use containers without a lid and 5% in BIS do not use any container. The clay pot is the most commonly used type of container to store drinking water by most households surveyed in AIS (83.8%) and WKIS (72.5%). Only 50% of households interviewed in BIS use clay pots for storing drinking water, while a significant proportion of 40% use plastic jerry cans. The clay pot is believed to keep water cool and enjoyable to drink. Overall, most households (over 90%) were positive on the need to treat drinking water before use (Table 9).

Table 9: Household drinking water management strategies

Water management strategies	Distribution (%)		
	Ahero	West Kano	Bunyala
Action taken on collected water used for drinking			
Nothing	18.8	15.0	50.0
Boil	33.8	18.8	5.0
Filter with a cloth	17.5	21.3	0
Filter with sand/ceramic filter	0	5.0	
Chlorinate	62.5	75.0	10.0
Others	11.3	3.8	35.0
Nature of water storage container			
Container with no lid	3.8	7.5	0
Container covered with a lid	96.2	92.5	95.0
No container	0	0	5.0
Type of container			
Clay pot	83.8	72.5	50.0
Plastic jerry can	5.0	7.5	40.0
Others	11.2	20.0	10.0
Need for treating water			
No	1.3	3.8	10.0
Yes	98.8	96.2	90.0

4.3 Availability and use of latrines

Most households surveyed have family latrines (Table 10). Majority of households (between 77% - 88%) have pit latrines, however, not all family members use them. The respondents in AIS (56.2%), BIS (77.5%) and 81% in WKIS make use of latrines whereas 22.5%, 15% and 2.5% respectively reported the contrary. The reasons for not allowing all family members to use the latrines range from difficulties due to age (very young or very old); preference for open defecation; productive activities that compel some members to work out in the field and the need to avoid bad smell. The implications arising from open defection include; contamination of surface and sub-surface water and contamination of uncooked food (vegetables and tubers).

Table 10: Availability and use of latrines by households

Availability of pit latrine	Distribution (%)		
	Ahero	West Kano	Bunyala
Presence of family Latrine			
No	20.0	8.8	22.5
Yes	80.0	88.8	77.5
No response	0	2.4	0
Whether used by all family members			
No	22.5	2.5	15.0
Yes	56.3	81.3	77.5
No response	21.2	16.2	7.5
Reasons for not using latrines			
Age	15.0	1.3	5.0
Don't like latrines/prefer bush	1.3	2.5	2.5
Work out in the field/away from latrines most of the day	1.3	3.8	0
Dirty/Smell bad	0	0	2.5
Others	0	0	7.5

When questions were asked on disposal of child faeces below five years, between 58% - 74% of the respondents surveyed disposed in latrines (Figure 7). Few respondents dispose the wastes in fixed places. However, 10% of households in BIS do not have a fixed place for disposal of the child faeces.

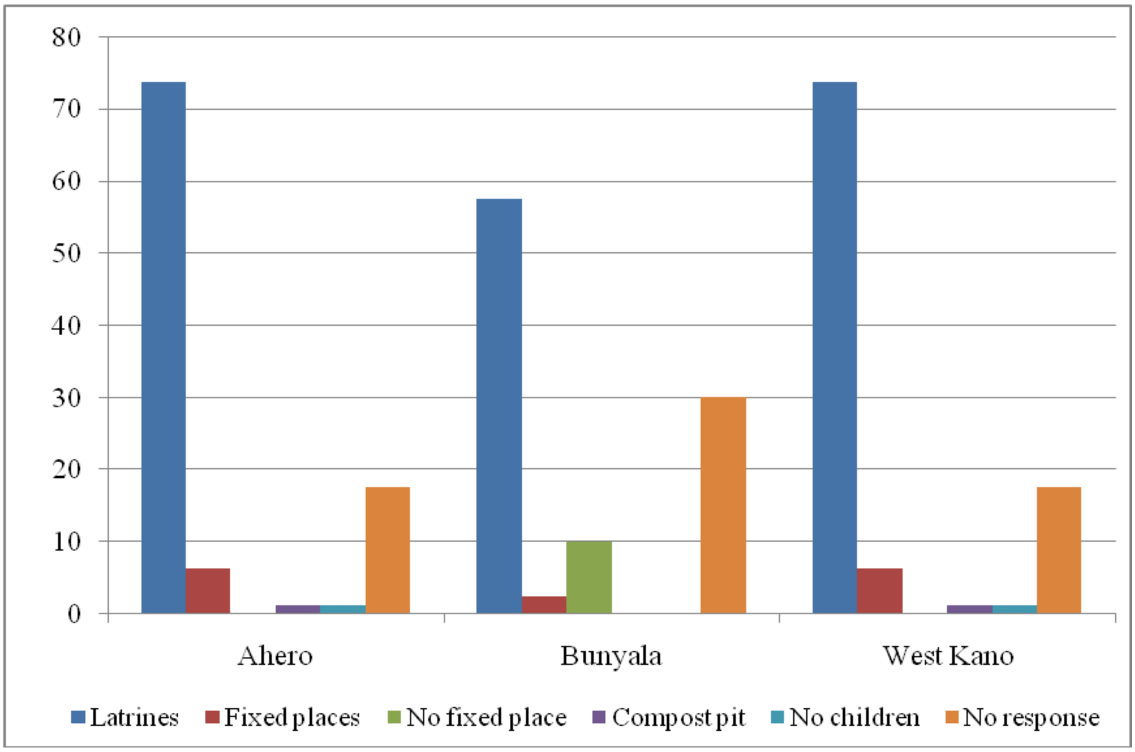


Figure 7: Disposal of the faeces from children under five years of age

Sharing of latrines with non-family members is a common practice among households in all the irrigation schemes surveyed. As shown in Table 11, between 67% - 88% of the households reported that the family toilets have collapsed at some point. Since most household members do not use latrines, the alternative sites used by most households are the bushes or fields and neighbours latrines. The reasons why households do not have latrines include frequent collapse of latrines within the neighborhood and lack of people to dig the latrines. Digging latrines during rainy season is a challenge, thus most households would wait until the dry season to dig their latrines. Even though most of the households were observed to have a latrine within their compound, the physical characteristics as observed are summarized in Table 12.

The need for family latrines among households is highest in WKIS (71.4%) as indicated in Table 13. This is because 88.8% of the households surveyed reported that their family latrines collapsed at some point and that 66.7% of the households use neighbor's latrines. The benefits that most respondents gave were that latrines close to the home are convenient and exude less smell than open defecation. In addition, family latrines provide privacy, reduces the population of flies and the risk of contacting diseases (Table 13).

Table 11: Characteristics of family latrines

	Distribution (%)		
	Ahero	West Kano	Bunyala
Is latrine used by non-family members?			
No	37.5	37.5	30.0
Yes	37.5	48.8	42.5
Has the latrine ever collapsed?			
No	6.2	11.2	5.0
Yes	67.5	88.8	85.0
Alternative sites/places to defecate			
Bush/field	52.4	11.1	38.5
Neighbor's latrine	47.6	66.7	53.8
Others	0	22.2	7.7
Reason for not having latrine			
No one to dig latrine	0	0	14.3
Just arrived/ waiting for next season		40.0	0
Other latrines collapsed recently	94.7	40.0	42.9
Others	5.3	20.0	42.9

Table 12: Observed latrine characteristics in the three irrigation schemes

	Distribution (%)					
Observation	Ahero		West Kano		Bunyala	
	No	Yes	No	Yes	No	Yes
Is there a cement slab?	57.5	5.0	65	23.8	75.0	25.0
Is the slab or floor in good condition?	50.0	12.5	57.5	31.2	76.7	23.3
Is there debris on the floor or slab?	35.0	27.5	38.8	50.0	53.3	35.0
Is there urine or water on the floor or slab?	35.0	27.5	45	43.8	30.0	70.0
Are there feaces on the floor or slab?	52.5	10.0	80	8.8	67.5	7.5
Is there a lid for the hole?	60.0	2.5	81.2	7.5	75.0	25.0
Is the lid on the hole?	62.5	37.5	88.8	5.0	75.0	25.0
Is the pit full or almost full?	46.2	16.2	40	48.8	63.3	36.7
Are the walls or roof strong?	43.8	18.8	63.8	25	83.3	16.7
Can you be seen while you are in the latrine?	31.2	31.2	58.8	30.0	83.3	16.7
Is hand washing station within 5 m from the latrine?	56.2	6.2	86.2	2.5	75.0	25.0
Is there a soak-away for urine and water?	57.5	5.0	88.8	0	75.0	25.0
Is latrine located at least 30 m from a water point?	32.5	30.0	80	8.8	75.0	25.0

Table 13: Need for and benefits of having a family latrine

	Distribution (%)		
	Ahero	West Kano	Bunyala
Need of a family latrine?			
No	47.1	28.6	55.6
Yes	52.9	71.4	44.4
Benefits of having latrine			
No benefits	0	0	1.25
Close to home/convenient	48.8	40	1.25
Less smell	2.5	27.5	40.0
Privacy	55.0	70.0	40.0
Fewer flies	0	18.75	47.5
Less chance of getting disease	10.0	82.5	22.5
Others	1.3	1.25	7.5

4.4 Hand washing

Whereas most respondents in the three irrigation schemes know the importance of washing hands (Table 14), there are variations in understanding the reasons for doing so. Washing hands before eating scored 93% - 100%. In AIS (91%) and BIS (97%), the need to keep hands clean scored higher than in WKIS (73%). In AIS 96% respondents reported they wash hands to reduce chances of contracting diseases and enhance a better health.

Table 14: Hand washing habits among respondents

	Distribution (%)		
	Ahero	West Kano	Bunyala
When hands are washed			
Before eating	97.5	93.8	100
Before preparing food	60.0	37.5	52.5
Before feeding a child	48.6	10.0	10.0
After using the latrine	86.3	76.3	70.0
Others	1.25	42.5	75.0
Importance of hand washing			
Make hands clean	91.3	73.8	97.5
Lessen the chance of disease/better health	67.5	96.3	92.5
Makes hands look good	20	1.3	0
Others	0	1.3	0

The proportion of respondents who wash hands after visiting the latrines is 70% for BIS and 86.3% in AIS and 76% in WKIS. The results show a high number of respondents (30%) do not wash hands after visiting the latrines, hence the prevalence of hygiene related diseases in the study sites. About 48% of respondents in AIS wash their hands before feeding children, while only 10% of respondents in WKIS and BIS wash hands before feeding children.

This habit is a key predisposing factor that explains the higher proportion of households in WKIS who reported higher cases of disease prevalence among children aged below 5 years of age (77.5%) and children above 5 years of age (35%), compared to AIS. It is important to note that washing hands in most cases is done with water only and in few occasions, soap is used. The project intends to change the respondents' attitude towards not just washing with water, but wash with water and soap. It is also important to wash hands with clean water to reduce chances of food contamination.

4.5 Food hygiene

Table 15 shows the responses on food hygiene; where over 97% of the households interviewed keep leftover food in a covered container. Regarding knowledge of how to keep leftover food safe for eating, over 91% of the household reported pre-heating the food, while some keep it covered in order to prevent flies from contaminating it. The main reasons why households cover food that has not been eaten is because they want to keep off flies, avoid risks of diseases related to food contamination and generally to keep food clean and hygienic. Most households (97.5% in AIS, 93.8% in WKIS and 92.5% in BIS) also wash fruits and vegetables before eating or cooking. Some respondents (43.8% in AIS, 33.8% in WKIS and 32.5% in BIS) peel the raw fruits before eating while a small percentage rub the fruit with cloth before eating.

Table 15: Handling of leftover and raw foods

	Distribution (%)		
	Ahero	West Kano	Bunyala
Where leftover food stored			
Never have leftover food	1.25	0	0
Covered container	97.5	97.5	97.5
Open container	2.5	2.5	2.5
In the house	11.25	38.8	0
Give it to animals	0	15.0	2.5
Others	1.25	15.0	0
Knowledge on how to keep leftover food safe for eating			
Keep it covered	20.0	12.5	0
Reheat it	93.75	91.3	100
Re-cook	13.75	3.8	2.5
Keep it away from flies	0	25.0	0
Others		3.8	
Reason for covering food when not being eaten			
Keep flies off	51.3	68.8	95.0
Prevent diseases	46.3	38.8	80.0
Keep food clean	50.0	48.8	7.5
Others	5.0	28.8	20.0
Handling of raw fruits and vegetables before eating			
Nothing	0	2.5	7.5
Wash them	97.5	93.8	92.5
Rub them	1.3	2.5	0.0
Peel them	43.8	33.8	32.5
Others	3.8	32.5	0

4.6 Solid waste disposal

Most households dispose most of their rubbish by burning, although the proportions vary across the three irrigation schemes; AIS 81%, WKIS 70% and BIS 55% (Table 16). This may seem an effective means to manage solid waste. Others dispose solid waste by composting; throwing in dug pits or piling it in heaps. Throwing rubbish outside the homestead, piling in heaps or throwing in the bushes creates favourable conditions that attract rodents and flies that can easily contaminate food and cause water source pollution. The respondents should be made aware of some environmentally friendly means of disposing solid waste such as reduce, reuse, recover and recycle. This will be integrated in the farmer schools that will be conducted by the research team.

Table 16: Solid waste disposal sites

Places for rubbish disposal	Distribution (%)		
	Ahero	West Kano	Bunyala
Outside the homestead	5.0	7.5	17.5
In a pit	30.0	37.5	50.0
In a pile	11.3	2.5	5.0
Make compost	12.5	27.5	10.0
Burn it	81.3	70.0	55.0
In the bush	0	3.8	7.5

4.7 Diarrhoea disease

The respondents were asked questions related to diarrhoea because it is related to the sanitary conditions in a household. More than 70% respondents had no experience in the three irrigation scheme sites. Less than 30% of the respondents had encountered incidences of diarrhoea in the past week prior to the interview (Table 17). About 21.3%, 38.8% and 5.0% of the respondents in AIS and WKIS respectively, reported that children under 5 years of age are affected by diarrhoea cases.

Table 17: Diarrhoeal cases in the past one week, by age and number

	Distribution (%)		
Diarrhoea cases in the past week	Ahero	West Kano	Bunyala
Yes	23.8	27.5	17.5
No	76.2	72.5	82.5
Age of those affected by diarrhea			
Less than 6 months	15.0	20.0	0
Between 6 months and 5 years	6.3	18.8	5
More than 5 years	3.8	3.8	15
No response	75.0	57.5	80

Table 18 shows the respondents feedback when asked how they manage diarrhea. Households surveyed in AIS (42.3%) administer a solution of sugar and salt to treat cases of diarrhea while 30.8% in AIS, 37% in WKIS and 12% in BIS gave more liquids. Thirty seven per cent of respondents in BIS treat diarrhea with ORS (oral rehydration solutions). In situations where family members experience three or more watery stools in a day, 95% in BIS, 53% in AIS and 42% in WKIS seek medical assistance from health centre or clinic.

Table 18: Initial (household) and remedial (medical) treatment of diarrhoea cases

	Distribution (%)		
Normal treatment of diarrhoea cases	Ahero	West Kano	Bunyala
More liquid	30.8	37.8	12.5
Sugar-salt solution	42.3	18.9	12.5
ORS packet	19.2	10.8	37.5
Medicine from health clinic/centre	7.7	27.0	12.5
Others	-	-	25.0
Remedial measure for 3 or more watery stools in a day			
More liquid		11.3	
Sugar-salt solution	17.5	56.3	62.5
Thin porridge/cereal based ORS	5.0	5.0	5.0
ORS packet	20.0	10.0	12.5
Medicine from health centre/clinic	53.8	42.5	95.0
Traditional medicine	5.0	8.8	5.0
Other	-	7.5	7.5

This implies the respondents are aware of the seriousness of diarrhea to children and other members of the family. Distance from health centres may cause delay in seeking medical assistance hence the use of remedial approaches. Households that use traditional medicine are very few. This can be explained by lack of knowledge or the practice among these communities. With regard to whom the respondents consult in case of a diarrhea case, 95% in

BIS and 66% in AIS consult a health clinic staff; 73% in WKIS and 50% in AIS consult a village health worker (Table 19).

Table 19: Persons consulted in the households for advice treatment

	Distribution (%)		
	Ahero	West Kano	Bunyala
No one	1.3	7.5	-
Village health worker	50.0	73.8	5.0
Health clinic staff	66.3	18.8	95.0
Pharmacist	12.5	0.0	67.5
Family member	11.3	0.0	35.0
Friend	5.0	1.3	5.0
Traditional practitioner	1.3	0.0	2.5
Others	-	-	22.5

4.8 Observation of general compound tidiness

During the baseline survey, observations were made on the general level of tidiness within the compounds of the selected households. The observed findings are summarized in Table 20. These results indicate that over 87% of respondents live in mud floored houses; over 63% have mud walls and over 62% have roofs made of iron sheets. This implies the respondents hardly use income from growing rice to improve their housing situation.

Table 20: Response on compound observation in the three irrigation schemes

	Distribution (%)					
	Ahero		West Kano		Bunyala	
Observation	No	Yes	No	Yes	No	Yes
Rubbish laying about	47.5	52.5	37.5	62.5	15.0	85.0
Animal/human faeces laying about	57.5	42.5	57.5	42.5	35.0	65.0
Un-penned animals	63.8	36.2	51.2	48.8	27.5	72.5
Floor made of mud	11.2	88.8	11.2	88.8	12.5	87.5
Floor made of Brick/cement blocks	71.2	8.8	30.0	70.0	92.5	7.5
Walls made of mud	17.5	63.8	33.3	66.7	20.0	80.0
Bricks/cement block walls	92.5	7.5	91.2	8.8	92.5	7.5
Wall made of iron sheets	88.8	11.2	92.5	7.5	97.5	2.5
Walls made of timber	98.8	1.2	97.5	2.5	100	-
Straw/rids/Grass thatched roofs	100	-	95.0	5.0	60.0	40.0
Tin/iron sheets roof	6.2	93.8	15.0	85.0	37.5	62.5
Asbestos/tiles roof	100	-	100	-	100	-
Roofs made of plastic foils	100		100		100	
Is roof rain water harvesting done?	60	40	86.2	13.8	95.0	5.0
Whether there is a dish rack	67.5	32.5	87.5	12.5	100	-

CHAPTER 5: RICE PRODUCTION

5.1 Land ownership and use characteristics

Table 21 shows that most farmers in AIS (95%) and WKIS (86.2%) grow rice on less than seven acres of land, most of which is allocated by NIB. In BIS 50% of the respondents cultivated three to five acres of land allocated by the NIB, and less than 8% rent land for rice production. About 8% and 11.9% of farmers in BIS and AIS, respectively, rent less than three acres of land for rice growing. In WKIS, 16.3% of the respondents rent up to seven acres of land for rice cultivation. Most households surveyed in AIS (95%) and WKIS (86.2%) cultivate less than 5 acres of land allocated by NIB. In BIS 50% of the households surveyed grow rice on less than five acres of land allocated by NIB. A higher proportion of farmers in WKIS (16.3%) rent land under rice production, compared to AIS (11.2%) and BIS (7.5%).

Table 21: Land use characteristics and rice production

	Land Area (Acres)	Irrigated land allocated by NIB	Irrigated land rented	Total area under rice farming	Area under rice production last season
			Frequency (%)		
Ahero	None	0	88.8	5.0	7.5
	0.1 - 2.9	33.8	11.2	36.2	38.8
	3 - 4.9	61.2	0	50.0	47.5
	5 - 6.9	3.8	0	7.5	5.0
	7 – 10	1.2	0	1.3	1.2
West Kano	None	0	83.8	0	0
	0.1 - 2.9	46.2	10.0	45.0	48.8
	3 - 4.9	40.0	3.8	45.0	45.0
	5 - 6.9	13.8	2.5	7.5	3.8
	7 – 10	0	0	2.5	2.4
Bunyala	None	50.0	92.5	0	0
	0.1 - 2.9	0	7.5	47.5	50.0
	3 - 4.9	50.0	0	50.0	47.5
	5 - 6.9	0	0	2.5	2.5

Table 22 shows approximately half of the respondents in the three irrigation schemes have practiced farming for about 20-40 years, with one third cultivating rice for 30-40 years. About 60% of the farmers in AIS have participated in 1-2 meetings or demonstrations on rice production in the previous year compared to 27.5% in WKIS and 25% in BIS. This means that the level of awareness of new knowledge on rice production is likely to be higher among farmers in AIS than in the other two irrigation schemes. These results imply farmers may be using old techniques in growing rice, thus there is need to create awareness for them to use current and most productive farming technology. This project will aim at demonstrating to farmers how they can improve their rice production per unit area using water and other inputs efficiently; hence improve their income and livelihoods.

Table 22: Experience and participation in meetings or demonstrations on rice production

	Frequency (%)		
Number of years in rice farming	Ahero	West Kano	Bunyala
1-10	25.0	18.8	25.0
11-20	10.0	25.0	17.5
21-30	23.8	23.7	17.5
31-40	26.2	20.0	25.0
41-50	7.5	7.5	10.0
Above 50	7.5	5.0	5.0
Number of meetings participated			
None	28.8	52.5	35.0
1	37.5	10.0	7.5
2	22.5	17.5	17.5
3	7.5	17.5	17.5
4	3.7	2.5	17.5
>4	0	0	5.0

5.2 Land tenure in the irrigation schemes

In the three irrigation schemes, 86.2%, 77.5% and 92.5% of the respondents in AIS, WKIS and BIS, respectively, own the land under rice production. Less than 4% of respondents in all the irrigation schemes rent the land cultivated, while about 1% in WKIS lease the land used to grow rice. Production costs vary across the three irrigation scheme. The total proportion of farmers who rent land for rice production is; 3.8%, 12.5% and 2.5% in AIS, WKIS, and BIS, respectively; and spend Kshs 10,000 to Kshs 15,000 annually. About 8.8% and 2.5% of the respondents in AIS and WKIS, respectively, spend Kshs 15,001 to Kshs 20,000 annually, whereas only 2.5% of farmers in BIS spend over Kshs 25,000 annually to rent land for rice production (Table 23).

Table 23: Land tenure and rice production characteristics per annum

	Distribution (%)		
	Ahero	West Kano	Bunyala
Ownership			
Owned	86.2	77.5	92.5
Rented	2.5	3.8	2.5
Leased	0	1.2	0
Owned and Rented	11.3	17.5	5.0
Rental cost per year (Ksh/acre)			
10000 – 15000	3.8	12.5	2.5
15001 – 20000	8.8	2.5	0
25000 – 30000	0	0	2.5
Irrigation water fee (Ksh/acre)			
2000 – 2500	0	0	0
2501 – 3000	0	2.5	0
3001 – 3500	100	15.0	100
3501 – 4000	0	82.5	0

Similarly, the cost of irrigation water fee for all rice production in AIS and BIS ranges between Kshs 3,001-3,500 per acre of land cultivated. The paid water fee to NIB mainly covers the operation and maintenance costs of the irrigation infrastructure. In WKIS, majority of farmers (82.5%) spent about Kshs 3501- 4000; 15% spent Kshs 3001- 3500; and 2.4% of farmers spend less than Kshs 3,000 on irrigation water fee. The higher water fee cost in WKIS compared to both AIS and BIS is because there is double pumping at the inlet from Lake Victoria and outlet as drainage to the wetland in WKIS.

Table 24 shows the age at which rice seedlings are transplanted and the seedling density per spot. In the three irrigation schemes, most farmers (92.5%, 65% and 97.5%) in AIS, WKIS and BIS, respectively transplant seedlings from the nursery at 21-23 days old. Only in WKIS did we identify farmers (15%) who transplant at 18-20 days old. Between 2.5% (BIS) and 6.25% (AIS and WKIS) of the respondents transplant seedlings from the nursery at 24-26 days. A small proportion of farmers in WKIS (8.8%) transplant seedlings after 27-30 days and about 5% transplant seedlings when they are more than 30 days old.

On number of seedlings per hill (density), majority of respondents 80% in BIS indicated three; while 77% in AIS and 47% in WKIS indicated two. Fifteen per cent in AIS indicated three and twenty per cent in BIS indicated two. There is a great variation in WKIS whereby 11% show one; 10% show 1-2; 18% show 2-3 and 11% show 3. These results show disparities in the number of seedling transplanted at each spot in the field, thus there is need to educate farmers on the optimum density per spot to enhance productivity.

Table 24: Age of seedling during transplanting and seedling density

	Distribution (%)		
	Ahero	West Kano	Bunyala
Age of seedling (days)			
18 – 20	0	15.0	0
21 – 23	92.5	65.0	97.5
24 – 26	6.25	6.2	2.5
27 – 30	1.25	8.8	0
More than 30 days	0	5.0	0
Number of seedlings per hill			
1	1.3	11.2	0
1 – 2	1.3	10.0	0
2	77.5	47.5	20.0
2 – 3	5.0	18.8	0
3	15.0	11.2	80.0
4	0	1.2	0

5.3 Cost of rice production and preferred variety

In AIS, 56.3% of farmers prefer IR2793-80-1 as compared to 50% of farmers in BIS (Table 25). In WKIS, 58.8% of the farmers interviewed rank Basmati 370 variety highly (58.8%). In the absence of the IR2793-80-1 rice variety, farmers in AIS would cultivate Basmati 317; whereas farmers in WKIS and BIS would replace their highly ranked varieties with IR2793-80-1 and BW 196, respectively. In terms of overall preference of rice variety; 81.3% in AIS and 87.5% in BIS prefer IR2793-80-1 rice variety, while 42.5% in WKIS prefer Basmati 370 varieties. The reasons for preference of respective varieties are due to long periods of cultivation and lack of awareness on new improved rice varieties. When farmers were asked where they purchased the rice seed, most of them indicated that they purchased most of the rice seeds cultivated from NIB. The results show a positive relationship between the farmers' preferred variety and the proportions purchased.

Table 25: Respondents' preferred rice variety

		Distribution (%)					
	Rice variety	Rank 1	Rank 2	Rank 3	Purchased	Own	Preferred
Ahero	IR2793-80-1	56.3	35.0	6.3	55.0	1.3	81.3
	Basmati 370	40.0	38.8	15.0	35.0	3.8	16.3
	ITA 310	2.5	22.5	21.3	2.5	2.5	1.3
West Kano	IR2793-80-1	21.2	35.0	18.8	62.5	1.3	35.0
	Basmati 370	58.8	26.2	15.0	27.5	5.0	42.5
	ITA 310	20.0	31.2	26.2	2.5	1.3	20.0
Bunyala	IR2793-80-1	50.0	47.5	10.0	87.5	1.3	87.5
	Basmati 370	22.5	27.5	10.0	5.0	2.5	12.5
	ITA 310	0	5.0	22.5	1.3	1.3	0
	BW 196	27.5	20.0	7.5	0.0	1.3	0

The cost of producing rice in the three irrigation schemes involve field operations and activities like; preparing the nursery bed, land preparation, transplanting seedlings, applying top dressing fertilizers on established rice crop, spraying, irrigating, weeding, cutting, heaping, staking or drying rice (7.2%), threshing, packaging and transportation. Most households surveyed use both hired and family labour (Table 26). Plates 3 shows some of the activities conducted during the growing season.

(a): land levelling

(b): sowed nursery

(c): transplanting

(d): fertiliser inNIB inputs store


(e): hand weeding


(f): irrigation event


(g): bird scaring


(h): cutting mature rice crop


(i): threshing


(j): a busy harvesting day


(k): sun drying rice


(l): transport of dried rice to stores

Plate 3: Various activities during the rice growing season in the irrigation schemes

In AIS, most households surveyed prefer hired labour over family labour, except in nursery preparation. Transport costs are higher than all other rice production activities particularly in AIS and BIS. In WKIS, more households surveyed hire labour in transplanting seedlings (15.1%), threshing (8.0%), heaping, staking or drying (7.2%) rice and land preparation (5.7%). In BIS, most households spend more on transplanting seedlings (7.2%) and land preparation (6.6%). The unit costs for the other activities in the three rice irrigation schemes are summarized in Table 26.

Table 26: Labour costs per acre of irrigated rice paddy

	Distribution (%)								
	Hired labour					Family labour			
	Number		Unit cost	Gender		Number		Gender	
Activity	People	Days	(Ksh)	Male	Female	People	Days	Male	Female
Ahero									
Nursery Bed	1.0	1.0	132.8	0.2	0.5	3.0	2.7	1.3	1.6
Land preparation	3.4	2.2	189.4	1.0	2.4	2.1	2.8	1.0	1.2
Transplanting	6.7	1.5	124.8	3.8	3.6	2.1	0.9	1.1	1.1
Top dressing fertilizers	0.7	0.4	203.3	0.5	0.1	0.9	0.8	0.8	0.2
Spraying	1.1	1.9	228.4	0.8	0.2	0.5	3.5	0.5	0.1
Irrigating	0.9	49.3	173.6	0.5	0.6	0.6	1.0	0.5	0.1
Weeding	5.1	2.4	168.6	1.1	3.3	2.2	1.9	1.1	1.1
Cutting	5.9	1.0	146.6	3.0	1.7	0.7	0.3	0.5	0.2
Heaping/Staking/drying	8.7	1.0	200.0	0.5	7.4	0.9	0.3	0.4	0.5
Threshing	8.7	1.0	201.3	0.4	7.8	0.8	0.3	0.4	0.5
Transport cost	-	-	1,045.0	-	-	-	-	-	-
West Kano									
Nursery Bed	2.9	3.4	279.0	2.3	0.4	1.7	3.4	0.7	0.9
Land preparation	5.7	5.6	304.9	3.1	2.4	1.8	5.5	0.7	1.1
Transplanting	15.1	1.1	183.2	4.8	7.8	1.4	1.3	0.5	0.9
Top dressing fertilizers	1.1	1.0	222.1	1.0	0.0	0.7	0.6	0.4	0.3
Spraying	1.2	1.3	340.4	1.1	0.0	0.7	0.5	0.4	0.3
Irrigating	1.2	3.9	320.5	0.9	0.2	1.0	1.0	0.7	0.4
Weeding	4.4	2.8	432.8	0.5	3.4	1.2	2.8	0.4	1.0
Cutting	4.4	1.0	336.7	4.3	0.1	0.8	0.5	0.4	0.3
Heaping/Staking/drying	7.2	1.0	161.2	0.9	6.1	1.4	0.9	0.4	1.0
Threshing	8.0	1.0	152.8	0.9	6.3	1.4	1.0	0.4	1.0
Transport cost	2.3	1.0	105.6	2.3	0.0	1.6	1.0	0.8	0.8
Bunyala									
Nursery Bed	1.5	2.2	196.0	0.4	1.1	1.5	2.9	0.8	0.7
Land preparation	6.6	6.0	225.0	5.1	1.1	3.4	0.5	0.5	7.2
Transplanting	7.2	3.6	3.6	237.5	0.2	1.2	2.6	0.5	0.7
Top dressing fertilizers	0.7	1.3	177.1	0.7	0.2	0.4	0.7	0.2	0.1
Spraying	1.0	1.9	203.8	1.0	0.0	0.0	-	-	-
Irrigating	1.0	8.5	20.0	0.9	0.0	0.8	-	0.5	0.3
Weeding	4.2	6.0	173.1	0.1	4.0	1.1	3.7	0.5	0.6
Cutting	4.1	3.2	267.1	3.9	0.0	0.0	-	-	-
Heaping/drying/threshing	7.1	3.4	172.0	0.0	7.1	0.9	2.7	0.1	0.8
Transport cost	2.6	1.2	286.6	-	-	-	-	2.6	0.1
Others	1.9	2.8	-	1.9	0.0	0.6	1.6	0.6	-

Table 27 shows the source and cost of inputs whereby, 80% of the farmers in all the three irrigation schemes purchase fertilizer for both planting and top dressing, except in WKIS where only 7% of the respondents use fertilizer to plant rice. The quantity of fertilizer used varies in the three irrigation schemes as shown in Table 27. In AIS, farmers use almost an equal proportion of fertilizer for planting and top dressing at a cost of Kshs 1680-1710.

In WKIS, farmers use more fertilizer for planting (60.7 kg) than topdressing (47.9 kg) at between Ksh 2135 and Ksh 4670, respectively. This can be explained by the variety grown (Basmati 370). Only 2% of the respondents in AIS and WKIS use farm manure. As the crop matures, farmers in all the three irrigation schemes purchase sisal twine and chemicals at approximately Kshs 1105 in WKIS; compared to Kshs 480 in BIS and Kshs 102 in AIS. This can be explained by the fact that dealers sell chemicals directly to farmers in WKIS whereas farmers purchase chemicals through NIB in both AIS and BIS.

Table 27: Source and cost of inputs for rice cultivation per acre

	Input use		Source	Quantity/units	Unit cost	Total cost (Ksh/acre)
	Yes	No				
Ahero						
Seeds	80	0	Purchased	27 Kg	72.7	1755.6
Fertilizers (planting)	80	0		49.4 Kg	34.2	1710.6
Fertilizers (topdressing)	80	0		48.8 Kg	33.4	1676.5
Farm manure	2	78	Self	-	-	-
Stakes	80	0		5 Pieces	87.5	460
Sisal twine	80	0	Purchased	4.4 Pieces	45.5	114
Others (chemicals)	13	67		2.8 Kg	35.9	102.3
West Kano						
Seeds	80	0	Purchased	25.8 Kg	93.6	2382.5
Fertilizers (planting)	7	73		60.7 Kg	1535.7	2135.7
Fertilizers (topdressing)	80	0		47.9 Kg	1543.9	4666.2
Farm manure	2	78	Self	-	-	--
Stakes	6	74		338.7 Pieces	18.3	1800
Sisal twine	3	77	Purchased	3.6 Pieces	88.6	242.9
Others (chemicals)	17	67		125.2 g/Litre	6.6	1104.4
Bunyala						
Seeds	40	0	Self	25 Kg	90.7	2266.3
Fertilizers(planting)	40	0	Purchased	2 Kg	1750	3500
Fertilizers(topdressing)	40	0		47.9 Kg	1543.9	4666.2
Stakes	3	37	Self	338.7 Pieces	18.3	1800
Sisal twine	3	37	Purchased	3.6 Pieces	88.6	242.9
Others (chemicals)	40	0		400 g/Litres	1.2	480

On the interval of weeding the rice crop, over 70% of households in the three irrigation schemes indicate at least twice, though the proportions increase from AIS (70%); WKIS (86%) and BIS (95%), the results are shown in Table 28. A significant proportion of farmers in AIS (26.2%) weed the rice three times during the crop cycle. About 35% of the households in AIS weed rice crop after 30 days while another 30% in the same irrigation scheme weed after 20-24 days. In WKIS and BIS, 53.2% and 55.0%, respectively weed their rice crop after 10-14 days. A significant section of the households surveyed in BIS (32.5%) weed after 20-24 days, while in WKIS, only 11% of the households weed after the same period, with an increasing proportion (13.4% and 15.8%) weeding after 25-29 days and 30 days, respectively. Enquiries made on methods of weeding revealed that, over 80% use manual hand pulling while the remaining 16% use herbicides in WKIS. The significant difference can be attributed to scarcity of labour.

Table 28: Frequency, interval and method of weeding rice crop

	Distribution (%)		
Activities	Ahero	West Kano	Bunyala
Number of weeding			
1	2.5	11.2	2.5
2	70.0	86.2	95.0
3	26.2	2.6	0
4	1.3	0	2.5
Weeding interval (Days)			
1-4	0	0	0
5-9		3.8	5.0
10-14	13.8	53.2	55.0
15-19	0	2.5	2.5
20-24	30.0	11.0	32.5
25-29	21.2	13.4	0
30	35.0	15.8	5.0
Methods of weed control			
Mechanical	2.5	1.2	0
Manual hand pulling	96.2	82.5	100.0
Hand Hoe		0	
Herbicides	0	16.3	0
Others		0	

Figure 8 shows the sources of irrigation water identified by the respondents. Ninety nine per cent (99%) in BIS and AIS draw the water for irrigation from the NIB canal/river whereas in WKIS (95%) use water from Lake Victoria. A paltry 1.2% and 5% of respondents in AIS and WKIS, respectively use water from wells.

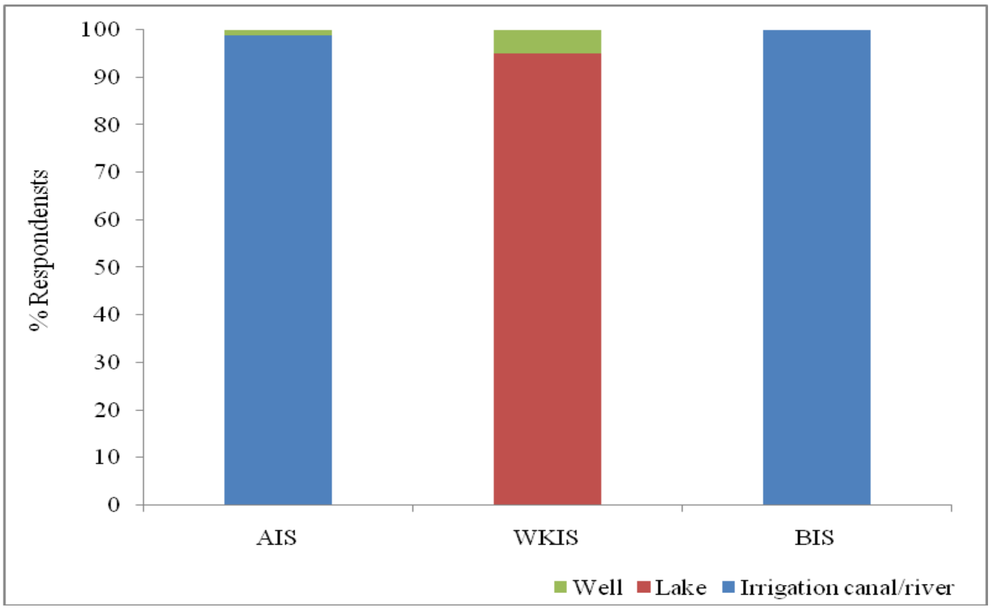


Figure 8: Source of irrigation water for rice cultivation

Farmers in the three irrigation schemes attain varied rice yield levels. However, a higher percentage of farmers in WKIS (78.6%) and BIS (72.5%) realize yields not exceeding 3,500 kg, compared to 51.2% of farmers in AIS who harvest the same quantity of rice. In a similar trend, respondents in the irrigation schemes indicate that they sell varying proportions of their harvest to generate income to meet household needs. More farmers in WKIS (82.6%) and BIS (77.5%) sell at least 3,500 kg of rice harvested. In AIS, however, 51.6% of the respondents sell a similar quantity of the rice harvested (Table 29).

Table 29: Rice production and utilization

Quantity (Kg)	Distribution (%)					
	Total harvested			Total sold		
	Ahero	West Kano	Bunyala	Ahero	West Kano	Bunyala
1 – 1500	16.2	26.2	20.0	18.8	42.5	22.5
1501 – 2500	16.2	36.2	22.5	15.0	27.6	20.0
2501 – 3500	18.8	16.2	30	17.8	12.5	35
3501 – 4500	7.5	11.5	17.5	8.8	6.2	12.5
4501 – 5500	10.0	1.2	2.5	9.0	2.5	10.0
5501 – 6500	8.8	2.5	7.5	12.4	3.8	-
6501 – 7500	7.5	2.5	-	10	1.2	-
7501 – 8500	6.2	1.2	-	1.2	-	-
8501 – 9500	3.8	-	-	2.5	-	-
9501 – 10500	2.5	-	-	2.2	1.2	-
Over 10500	2.5	2.5	-	2.3	2.5	-

Comparatively, a higher proportion of farmers in AIS (22.5%) harvest over 6,500 kg of rice, while only 2.5% of the respondents realize more than 10,500 kg of rice annually. In tandem with their production, 18.2% of the farmers in AIS sell more than 6,500 kg of their total harvest, with only 4.9% of farmers in WKIS selling the same quantity. In BIS, however, production levels are comparatively low with no farmers realizing more than 6,500kg of rice. This may be due to irrigation water scarcity, poor drainage and high incidence of pests and diseases experienced at BIS as indicated in Table 31.

Over 90% of respondents in all the three irrigation schemes surveyed retain up to 500 kg of the rice produced for domestic use (Table 30). This implies that most of the rice produced by farmers in the three irrigation schemes is for sale; with a paltry amount of rice produced for domestic consumption. The results show that rice is not a basic food for most of the respondents, thus rice is sold to purchase staple food. The price of one kilogram of rice offered to farmers in the three irrigations schemes varies as follows; AIS (60%) and WKIS (65%) sell their rice for between Kshs 37- 44 per Kg. In BIS 40% of the farmers interviewed sell the rice produce for Kshs 29-36 while 52.5% sell rice for Kshs 37-44 per Kg. It is only in AIS and WKIS that a small proportions of farmers sell their rice for Kshs 45-52 per kg (20% and 18.8%, respectively) and Ksh 53-60 per Kg (3.8% in both schemes).

These results imply that farmers receive very low prices for their produce which in turn has negative impacts on their annual income and livelihoods. The variations in production levels in the three irrigation schemes and the selling prices of rice produced have implications on the returns on investment for farmers and household incomes.

Table 30: Quantity of rice retained for domestic use and rice selling price

	Distribution (%)		
	Ahero	West Kano	Bunyala
Quantity of rice (kg)			
None	1.2	1.2	5.0
1-500	93.8	91.3	90
501-600	0	0	2.5
601-700	2.5	2.5	0
701-800	0	0	2.5
901-1000	2.5	2.5	0
More than 1000	0	2.5	
Price (Ksh/kg)			
21-28	3.7	1.2	7.5
29-36	12.5	11.2	40.0
37-44	60.0	65.0	52.5
45-52	20.0	18.8	0
53-60	3.8	3.8	

The respondents were asked to identify problems they encountered in rice production and to rank them in order of importance. The results shown in Table 31 indicate the following: in AIS diseases and pests, high cost of fertilizers, access to loans and credit as well as low prices of rice produced are the most critical problems facing farmers. In WKIS, diseases and pests, inadequate irrigation water and low prices of rice produced are the most critical problems whereas in BIS, disease and pest infestation, high cost of fertilizers, inadequate irrigation water, low prices for rice produced and poor drainage are ranked in order of importance. On overall pest and disease control; high costs of fertilizers and irregular water supply are the major problem facing rice farmers.

These results imply farmers are faced with common rice production problems that should be addressed by stakeholders in order to reduce costs of production, improve prices of produce and provide incentives for farmers to produce rice as both as a cash crop and food crop.

Table 31: Problems encountered in rice production

	Distribution (%)		
Problems	Ahero	West Kano	Bunyala
1. Access to loan	53.8	13.8	7.5
2. Diseases/pest	81.3	92.5	95.0
3. High cost of fertilizers	72.5	11.3	92.5
4. Inadequate grain storage facility	3.8	3.8	37.5
5. Inadequate irrigation water supply	21.3	53.8	85.0
6. Lack of quality seeds	20.0	23.8	5.0
7. Low rice prices	45.0	35.0	75.0
8. Poor drainage	0	8.8	55
9. Others	37.5	70.0	85.0

In order to improve rice production and enhance efficient water use in the three irrigation schemes, respondents identified the following incentives as shown on Table 32.

Table 32: Incentives for enhancing irrigation water use efficiency in rice production

<table>
<tr><th colspan="2" rowspan="2">Action and incentives</th><th colspan="4">Distribution (%)</th></tr>
<tr><th>Rank 1</th><th>Rank 2</th><th>Rank 3</th><th>Rank 4</th></tr>
<tr><td rowspan="9">Ahero</td><td>Water scheduling equipment</td><td>27.5</td><td>7.5</td><td>7.5</td><td>13.8</td></tr>
<tr><td>Efficient irrigation equipment</td><td>0</td><td>8.8</td><td>0</td><td>3.8</td></tr>
<tr><td>Training</td><td>7.5</td><td>20.0</td><td>2.5</td><td>32.8</td></tr>
<tr><td>Information on new crops</td><td>0</td><td>0</td><td>27.5</td><td>2.5</td></tr>
<tr><td>Information on new markets</td><td>15.0</td><td>30.0</td><td>0</td><td>7.5</td></tr>
<tr><td>Water pricing</td><td>22.5</td><td>26.2</td><td>28.8</td><td>10.0</td></tr>
<tr><td>Compliance with regulations</td><td rowspan="2">0</td><td rowspan="2">0</td><td>2.5</td><td>12.2</td></tr>
<tr><td>Water meters</td><td rowspan="2">0</td><td>15.0</td></tr>
<tr><td>Others</td><td>27.5</td><td>7.5</td><td>2.5</td></tr>
<tr><td rowspan="9">West Kano</td><td>Water Scheduling equipment</td><td>7.5</td><td>13.8</td><td>5.0</td><td>10.0</td></tr>
<tr><td>Efficient irrigation equipment</td><td>43.8</td><td>5.0</td><td>16.2</td><td>20.0</td></tr>
<tr><td>Training</td><td>11.2</td><td>42.2</td><td>23.8</td><td>16.2</td></tr>
<tr><td>Information on new crops</td><td>8.8</td><td>15.0</td><td>20.0</td><td>12.5</td></tr>
<tr><td>Information on new markets</td><td>3.8</td><td>8.8</td><td>10.0</td><td>12.5</td></tr>
<tr><td>Water pricing</td><td>3.8</td><td>5.0</td><td>10.0</td><td>13.8</td></tr>
<tr><td>Compliance with regulations</td><td rowspan="2">0</td><td>3.8</td><td>12.5</td><td>6.2</td></tr>
<tr><td>Water meters</td><td>6.2</td><td>0</td><td>6.2</td></tr>
<tr><td>Others</td><td>5.0</td><td>1.2</td><td>2.5</td><td>0</td></tr>
<tr><td rowspan="9">Bunyala</td><td>Water Scheduling equipment</td><td>2.5</td><td>2.5</td><td>15.0</td><td>20.0</td></tr>
<tr><td>Efficient irrigation equipment</td><td>7.5</td><td>52.5</td><td>25.0</td><td>7.5</td></tr>
<tr><td>Training</td><td>72.5</td><td>27.5</td><td>0</td><td>0</td></tr>
<tr><td>Information on new crops</td><td rowspan="5">0</td><td>5.0</td><td>12.5</td><td>7.5</td></tr>
<tr><td>Information on new markets</td><td>0</td><td>2.5</td><td>22.5</td></tr>
<tr><td>Water pricing</td><td>2.5</td><td>10.0</td><td>17.5</td></tr>
<tr><td>Compliance with regulations</td><td>2.5</td><td>27.5</td><td>20.0</td></tr>
<tr><td>Water meters</td><td>0</td><td>2.5</td><td>5.0</td></tr>
<tr><td>Others</td><td>17.5</td><td>7.5</td><td>5.0</td><td>0</td></tr>
</table>

Households in AIS prefer the installation of water scheduling equipment (27.5%), water pricing (22.5%) and information on new markets (15.0%). In WKIS, farmers rank efficient irrigation equipment (43.8%) as the most important intervention, followed by training (11.2%). Training of farmers is a key intervention proposed by farmers in BIS (72.5%). Installation of an efficient irrigation equipment ranks second (52.5%) and compliance with regulations was ranked third.

It is important to note that rice farmers in the three irrigation schemes, have identified the problems they face and suggested some solutions which this project will integrate in the farmer's field schools that will be conducted from time to time. A foreseeable challenge is change of attitude from the norm of rice growing using continuous flooding to the new SRI technology for rice farmers. Data that will be obtained from model sample farms will assist to have farmers adopt the new technology which will increase rice yield per acre and per unit water to enhance household income and improve livelihoods thus reducing poverty.

CHAPTER 6: CONCLUSION AND RECOMMENDATIONS

6.1 Conclusion

The results from the baseline study reveal that, awareness on water safety and sanitation is high. It is evident that the main sources of water are pump boreholes and lined (improved) wells. The major challenge in the use of these sources is the seasonal flooding episodes experienced in the region that subject it to pollution since the flood water mixes with wastes from shallow pit latrines and open defecation. This exposes the inhabitants of the main western Kenya irrigation schemes to high prevalence of water borne diseases such as diarrhea, typhoid and dysentery.

The flat topography of the study area coupled with the black cotton soil type (vertisols); make the area vulnerable to contamination of drinking water due to flooding. The survey established that the area is unlikely to have clean drinking water unless point of use (POU) drinking water treatment technologies and other interventions are exploited.

The western Kenya schemes (AIS, WKIS and BIS) are pump-fed; this has a negative impact to the farmer since it elevates the production costs as the farmer meets the pumping cost of irrigation water. There is need to explore gravity water sources to cut down on the production cost and improve on the farmer's income. This could be facilitated through the construction of dams upstream and gravity intake works and conveyance to offer continuous water supply to the schemes.

The findings from the survey indicate that the inhabitants of western Kenya rice schemes have limited sources of livelihoods and most rely on rice farming. However, most of them attain low yield levels which do not help in improving their living standards in terms of housing, education facilities, health facilities and infrastructure in general. Those in the rice producing zone need to be encouraged to practice commercial rice farming. This can be achieved by accessing credit facilities, availing loaning facilities (soft loans) and initiating community based organizations to increase their bargaining power with financial institutions.

Many sectors in Kenya have benefited from the cooperative movement-a factor that seems not to have infiltrated into the rice farming sector. Rice farmers need encouragement to form cooperative societies that will enable them access credit facilities at low interest rates as compared to the banking sector. Such societies are better placed in accessing inputs and produce markets that offer competitive prices due to their strong bargaining power.

The survey found that the low rice productivity can partly be attributed to application of inadequate rates of inorganic fertilisers and non-use of organic manures apart from infestation of pests and diseases. It is apparent that seedlings are transplanted late by majority of growers, when tillering has already occurred. Sustainable intensive rice production in the irrigation schemes require judicious selection of high yielding varieties, adopting integrated nutrient management through use of both inorganic and organic fertilisers and efficient use of available irrigation water.

However, emerging technologies in rice farming practices are still poorly disseminated to farmers since most of them stall at experimental level. For example the system of rice intensification (SRI) that involves intermittent wetting and drying of paddies as well as specific soil and agronomic management practices - an alternative system that can be considered to increase crop water productivity is still not well perceived by farmers due to lack of information. If appropriately applied SRI could help cut down on rice production costs by reducing wastage of water. The national irrigation board needs to empower farmers by disseminating new technology through farmers' field schools and continuous demonstration.

6.2 Recommendations

Rice productivity

1. Since rice growers within the west Kenya irrigation schemes are organised along water supply canals in blocks; farmers' field schools (FFS) can be initiated within one or a combination of such units. It is possible to adopt SRI based on irrigation blocks after each FFS has successfully completed cropping season-long training. Growers can synchronise field operations and activities such as land preparation, nursery preparation, transplanting, choice of variety, fertiliser application, weed management, irrigation water scheduling and control, up to harvesting. The FFS can be integrated in the administration of cooperative/group credit and loan systems to facilitate acquisition of inputs and produce marketing. FFS can also enhance adoption of safe drinking water filtration kits by households.
2. The findings from this study reveal that rice farming is the main source of income for the inhabitants of the rice growing schemes. It is therefore important to enhance techniques that will greatly improve rice crop production at affordable costs. It is also necessary to consider the introduction of different crops that could benefit from the already established irrigation system in order to reduce risks related to over reliance on a single cropping system that could be vulnerable to pest infestation.

Drinking water

1. The coverage of point of use (POU) drinking water treatment devices are close to zero in the study area therefore introduction of the devices to communities should include the formation and training of self help groups to ensure that there are community members involved in constructing and promoting the devices at the household level in the community.
2. Reliance upon a Multiple Barrier Approach (MBA) represents the best way to achieve a healthy water supply. Therefore in areas where there are insufficiently protected water sources (or in the event of switching to a lower quality water source), MBA as an integral part of POU treatment of drinking water should be taught.
3. Additionally, promotion of regular cleaning and use of safe water storage containers with a lid to minimize opportunities of recontamination of treated drinking water should be part of a water hygiene program.

Hygiene

1. Many people reported washing their hands before eating. Relatively few, however, reported washing hands before preparing food and after using the latrine. Because this project is starting at very low coverage of point of use water treatment devices coverage, it offers an excellent opportunity to link hand washing with importance of availability and latrine use.

2. Proper rubbish disposal should be encouraged as part of the project hygiene education campaign. For example, avoiding burning as the main rubbish disposal method and encouraging composting for production of organic manure for use in the rice fields should be part of the education campaign.
3. Due to the failure to construct sustainable toilet facilities to curb pollution of water sources necessitated by unfavourable conditions such as the geology of the area (type of soil) and climate (frequent floods), a pilot scheme on the use of eco toilets could be explored to assess the possibility of introducing this method for human waste disposal.

General

1. If portable water and sanitation activities are executed in an area, they should be fully integrated so that the community understand the links between unprotected water sources, diarrheal disease (as well as other water-related diseases common in rice irrigation schemes such as bilharzias), latrine use in the interruption of faecal-route of disease transmission, and importance of hand-washing.
2. Health education should be conducted on all of the topics included in this survey, with particular emphasis on areas where knowledge was weak. In cases where misconceptions appeared to be fairly general across the population, they should be addressed through health education in the target communities.

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Annex 1: Baseline Rice Production, Water and Sanitation Survey Questionnaire

Baseline Rice Production, Water and Sanitation Survey
National Council for Science and Technology funded project Western Kenya Rice Irrigation Schemes: July 2011
Collaborating institutions: Chepkoile University College and National Irrigation Board

100 IDENTIFICATION

101 Date:__/__/2011 102 Name of respondent (*optional*): ____________
103 Tel No: _________________ 104 Irrigation Scheme: ____________________
105 Village: ___________________
106 Household GPS coordinates: *Lat: __⁰ __' __"* *Long: __⁰ __' __"* *Elevation: ______m*

200 RESPONDENT'S CHARACTERISTICS

201 Household head respondent's gender: 1. ☐ Female 2. ☐ Male 3. ☐ Both

202 Respondents level of education
1. ☐ None 2. ☐ Primary school 3. ☐ Secondary school
4. ☐ Technical/College 5. ☐ Tertiary/University 6. ☐ Adult literacy
7. ☐ Other (Specify)

203 Who in your family live and eat with you here?
1. ☐ Husband 2. ☐ Wife 3. ☐ Children (*No: __)*
4. ☐ Grand children (*No: ___)* 5. ☐ Others (*who*: ___, No:___)

204 How long have you lived in________________________ scheme?
1. ☐ Less than 6 months 2. ☐ 6 months to 1 year
3. ☐ 1-2 years 4. ☐ 3-5 years 5. ☐ Permanent resident

205 Do you plan to stay here for more than 1 year?
1. ☐ No 2. ☐ Yes 9. ☐ DK/NR

206 What is the major source of income to the household?
1. ☐ Fishing 2. ☐ Craftsman 3. ☐ Wage earning
4. ☐ Trading 5. ☐ Farming

207 What is the average household income per year?
1. ☐ Less than Kshs. 30,000 2. ☐ Between Kshs. 30,000-59,000
3. ☐ Between Kshs. 60,000-119,000 4. ☐ Equal or more than Kshs. 120,000

300 HEALTH ASPECTS

301 Which of the following illnesses do you consider as the greatest problem in your household? (*Multiple responses accepted*)
1. ☐ Malaria 2. ☐ Diarrhea 3. ☐ Dysentery 4. ☐ Typhoid
5. ☐ Others (*Specify* :____)

302 Who in your household suffers the most from these illnesses?
1. ☐ Children less than 5 years old 2. ☐ Children more than 5 years old
3. ☐ Men 4. ☐ Women
5. ☐ Others (*Specify* :____)

303 How often does some body in your household fall ill of any of the above illnesses?
____________________ (*indicate the frequency in the* ***number of months*** *in a year*)

304 On average, how much does this household spend on treatment from the above diseases yearly? Kshs: __________

400 WATER

401 From where did you get your drinking water today?
1. ☐ Pump borehole 2. ☐ Lined (*improved*) well 3. ☐ River
4. ☐ Open well dug in river bed/ wetland 5. ☐ Irrigation canal
6. ☐ Other (*specify*: ___________________) 9. ☐ DK/NR ***(GO TO 406)***

402 What are the advantages, if any, of getting drinking water from a protected well instead of unprotected well or river/wetland/irrigation canal? (*Multiple responses accepted*)
1. ☐ No advantages 2. ☐ Water is clear/clean
3. ☐ Less likely to get sick/better health 4. ☐ Do not need to treat
5. ☐ Closer to house 6. ☐ Other (*Specify*: _______________)

403 Which is the closest water point?
1. ☐ Pump borehole 2. ☐ Lined (improved) well 3. ☐ River
4. ☐ Open well dug in river bed/ wetland 5. ☐ Irrigation canal
6. ☐ Other (*Specify*: _________________)

404 How long does it take to walk to this source of water?
1. ☐ Less than 15 minutes 2. ☐ Between 15 and 30 minutes
3. ☐ More than 30 minutes

405 Why do you get water from there? (*Multiple responses accepted*)
1. ☐ Water source is closest 2. ☐ Water is clean
3. ☐ No waiting 4. ☐ Reliable/ usually water available
5. ☐ Regular source dry/not working 6. ☐ Other (*Specify*: ______________)

406 Who normally fetches water for this household? (*Multiple responses accepted*)
1. ☐ Woman 2. ☐ Girl 3. ☐ Boy 4. ☐ Man

407 Did you do anything to the drinking water you collected most recently? (*Multiple responses accepted*)
1. ☐ Nothing 2. ☐ Boil 3. ☐ Filter with a cloth
4. ☐ Filter with sand/ceramic filter 5. ☐ Chlorinate
6. ☐ Other (*Specify*: ____)

408 Could you please show me the container you use to store your drinking water?
(*Observe if the type of container is covered with a lid?)*
1. ☐ No 2. ☐ Yes 3. ☐ No container 4. ☐ Unwilling

409 What types of containers are used to store drinking water?
1. ☐ Pot 2. ☐ Jerricans 3. ☐ Reused (*chemical*) containers
4. ☐ Other: (specify: ____)

410 Do you have any need for treatment of your drinking water?
1. ☐ No 2. ☐ Yes

500 PIT LATRINES

501 Does your family currently have a latrine?
1. ☐ No (**GO TO 507**) 2. ☐ Yes 9. ☐ DK/NR **(GO TO 507)**

502 Does everyone in your family use the latrine?
1. ☐ No 2. ☐ Yes (**GO TO 505**) 9. ☐ DK/NR (**GO TO 505**)

503 If no, why doesn't everyone in your family use the latrine? (*Multiple responses accepted*)
1. ☐ Age (*Specify ages that do not use*________) 2. ☐ Don't like latrines/ prefer bush
3. ☐ Dirty/smells bad
4. ☐ Work out in the fields/away from latrines most of the day
5. ☐ Other (*Specify*________________________________)

504 Where do you dispose faeces of under 5 children?
1.☐ Latrine 2. ☐ Fixed places 3.☐ No fixed place
4.☐ Compost pit 5. ☐ No children

505 Are there others not from your family who use your latrine?
1. ☐ No 2. ☐ Yes 9. ☐ DK/NR

506 Since you have been here, has your latrine ever collapsed?
1. ☐ No 2. ☐ Yes 9. ☐ DK/NR (***GO TO 510***)

507 Given that your family does not currently have a latrine, where do family members usually go to defecate?
1. ☐ Bush/field 2. ☐ Neighbour's latrine
3. ☐ Public latrine: *Specify*: a. ☐ School b. ☐ Health centre c. ☐ Market
4. ☐ In the river bed 5. ☐ Other (*Specify*____________________)

508 Why don't you have a latrine? (*Multiple responses accepted*)
0. ☐ Do not want or need one 1. ☐ No tools/equipment
2. ☐ No one to dig it 3. ☐ Do not like smell
4. ☐ Just arrived/waiting for next season 5. ☐ Other latrine recently collapsed
7. ☐ Used to bush/ field 8. ☐ Other (*Specify*_________)

509 Would you like to have a family latrine? 1. ☐ No 2. ☐ Yes

510 What are the benefits, if any of having a latrine? (*Multiple responses accepted*)
0. ☐ No benefits 1. ☐ Close to home/convenient 2. ☐ Less smell
3. ☐ Privacy 4. ☐ Fewer flies
5. ☐ Less chance of getting disease/better health 6. ☐ Other (*Specify* ____________)

600 HAND-WASHING

601 When is it important to wash your hands? (*Multiple responses accepted*)
1. ☐ Before eating 2. ☐ Before preparing food
3. ☐ Before feeding a child 4. ☐ After using the latrine
5. ☐ Other (*Specify*___________________________________)

602 Why is it important to wash one's hands? (*Multiple responses accepted*)
1. ☐ To make them clean 2. ☐ To lessen the chance of disease/better health
3. ☐ To make them look good/smell good
4. ☐ Other (*Specify* ___________________________________)

700 FOOD HYGINE

701 Where do you store leftover food? (*Multiple responses accepted*)
0. ☐ Never have leftover food 1. ☐ Covered container 2. ☐ Open container
3. ☐ In the house 4. ☐ Give it to the animals
5. ☐ Other (*Specify* ___________________________________)

702 What should you do with leftover food to make it safe for eating? (*Multiple responses accepted*)
1. ☐ Keep it covered 2. ☐ Reheat it 3. Re-cook
4. ☐ Keep it away from flies 5. ☐ Other (*Specify*______________________)

703 Why should prepared food be covered when not being eaten? (*Multiple responses accepted*)
1. ☐ Keeps flies off 2. ☐ Prevents diseases 3. ☐ Keeps food clean
4. ☐ Other (*Specify* ___________________________________)

704 What do you do with raw fruits and vegetables before eating them? (*Multiple responses accepted*)
1. ☐ Nothing 2. ☐ Wash them 3. ☐ Rub them
4. ☐ Peel them 5. ☐ Other (*Specify*_________________________________)

800 RUBBISH

801 Where do you put your rubbish? (*Multiple responses accepted*)
1. ☐ Outside the homestead 2. ☐ In a pit 3. ☐ In the bush
4. ☐ In a pile 5. ☐ Make compost 6. ☐ In the field 7. ☐ In the river bed
8. ☐ Burn it 9. ☐ Others (*Specify*_________________________________)

802 Do you keep domestic animals?
1. ☐ No 2. ☐ Yes
a. ☐ Cows (*Number*:_______)
b. ☐ Goats (*Number*:_______)
c. ☐ Sheep (*Number* :_______)
d. ☐ Rabbits (*Number*:_______)
e. ☐ Chicken and ducks (*Number*:_______)
f. ☐ Other (*Specify* ________) (*Number*:___)

900 DIARRHOEA

901 In the past week (7 days) has anyone in the household had diarrhoea? Diarrhoea means 3 or more water stools in one day. 1. ☐ No (**GO TO 904**) 2. ☐ Yes

902 State the age and number of those affected by diarrhoea in your household:
1. ☐ Less than 6 months old (*Record No.*:____________)
2. ☐ 6 months to 5 years of age (*Record No.*:____________)
3. ☐ More than 5 years of age (*Record No.*:____________)

903 What did you give him or her?
0. ☐ Nothing 1. ☐ More liquid 2. ☐ Sugar-salt solution
3. ☐ Thin porridge/cereal based ORS 4. ☐ ORS packet
5. ☐ Medicine from health clinic/centre 6. ☐ Traditional medicine
7. ☐ Other (*Specify*__________________________________)

904 If someone has 3 or more watery stools in a day, what should you give him or her? (*Multiple responses accepted*)
0. ☐ Nothing 1. ☐ More liquid 2. ☐ Sugar-salt solution
3. ☐ Thin porridge/cereal based ORS 4. ☐ ORS packet
5. ☐ Medicine from health clinic/centre (distance to health facility: ____Km)
6. ☐ Traditional medicine 7. ☐ Other (*Specify*___________________________)

905 Who do you consult for advice or treatment? (*Multiple responses accepted*)
0. ☐ No one 1. ☐ Village health worker 2. ☐ Health clinic staff
3. ☐ Pharmacist 4. ☐ Family 5. ☐ Friend
6. ☐ Traditional practitioner (*Specify whom* :_______________________)
7. ☐ Others (*Specify* ____)
9. ☐ DK/NR

1000 RICE PRODUCTION

1001 What is the location of your rice field in the scheme: Field No:___; Block:____

1002 Related to rice production, give the following land details:

		Acres	Ksh/acre
1.	Irrigated land allocated by National Irrigation Board		
2.	Irrigated land rented from others		
3.	Total area under rice farming (owned + rented) this season		
4.	Total land area under rice production last season/year		
5.	Is the land under rice production currently?		
	a). 0. ☐ Owned		
	b). 1. ☐ Rented		
6.	If the land is rented for rice production what is the rental cost per year		
7	Cost of irrigation water per acre in a growing season		

1003 What technique of sowing do you use? 1. ☐ Transplanting 2. ☐ Direct sowing

1004 At what age do you transplant the rice seedlings? (*Specify*: _____________days

1005 When transplanting, how many seedlings do you plant per hill? ___seedlings

1006 For each of the rice varieties that you grow provide the following information:

Rank	Name of Varieties (ranked)	Seed source	If purchased specify: Quantity (Kg)	Unit cost (Ksh/Kg)	Preferred variety (*Tick one only*)
	1	**2**	**3**	**4**	**5**
1.					
2.					
3.					
		1. Purchased (P) 2. Own (O)			

1007 For a **one acre** irrigated paddy field, how much labour (hired + family) do you use for the following farming activities related to rice production and how much do you pay them?

Activity	# of pple × # of dys *(Hired labour only)* *(Man days)*	Unit cost of hired labour *(Ksh / 1 man day)*	Gender of hired labour M	F	# of pple × # of dys *(Family labour only)* *(Man days)*	Gender of family labour M	F
	1	**2**	**3**	**4**	**5**	**6**	**7**
1 Nursery bed preparation							
2 Land preparation							
3 Transplanting							
4 Top dressing fertilizer							
5 Spraying							
6 Irrigating							
7 Weeding							
8 Cutting							
9 Heaping/Staking/Drying							
10 Threshing							
11 Transporting							
12Other(Guarding, bagging)							

1008 Do you use any of the following farm inputs with rice, and if so, what is their source and unit cost per acre?

Input	Yes	No	Source (Self/Purchased)	Quantity/acre used (units)	Unit cost (*units*)	Total cost /acre (Ksh)
	1	**2**	**3**	**4**	**5**	**6**
1 Seeds						
2 Fertilizers (*Planting*)						
3 Fertilizers (*Topdressing*)						
4 Farm Manure						
5 Compost						
6 Mulch						
7 Stakes						
8 Ties						
9 Other (specify)						

1009 What is the source of the irrigation water that you use for rice growing?

1. ☐ Borehole 2. ☐ Well 3. ☐ Lake 4. ☐ River/stream
5. ☐ Irrigation canal 6. ☐ Others (*Specify* :____________________________)

1010 What was the rice output for the last growing season?
1. Total harvested (_______Kg)
2. Total sold (_______Kg)
3. Total for Domestic use (_______Kg)
4. Rice price per unit sold (_______Ksh/Kg)

1011 What problems do you encounter in the rice production? (*Multiple responses accepted*)
1. ☐ Lack of quality seeds
2. ☐ High cost of fertilizers
3. ☐ Diseases/ pest
3. ☐ Inadequate irrigation water supply
4. ☐ Poor drainage
6. ☐ Inadequate grain storage facility
7. ☐ Access to loan
8. ☐ Low rice prices
9. ☐ Others (*Specify* :____________)
10. ☐ D/K or NR

1012 How many years have you been actively involved in farming? _____ (Yrs)

1013 How many years have you been growing rice? ________ (Yrs)

1014 In the past year, how many times did you participate in a meeting or demonstration on how to grow/manage rice? ____

1015. What actions and incentives would encourage farmers to use water more efficiently? *Rank top* ***four*** *most important*
0. ☐ Water scheduling equipment
1. ☐ Efficient irrigation equipment
2. ☐ Training
3. ☐ Information on new crops
4. ☐ Information on new markets
5. ☐ Water pricing
6. ☐ Encourage compliance with regulations
7. ☐ Water meters
8. ☐ Other:_________________

1016. What are the common rice pests and diseases encountered during the different crop stages, and what management measures do you take at the household level?

Crop Stage	Pests/disease	Control measures	No action taken
1.Emergency/Nursery			
2.Transplanting			
3.Tillering			
4.Heading			
5.Grain filling			
6.Maturity/Harvesting			

1017. How many times do you weed the rice from transplanting up to harvesting? _______

1018. What is the weeding interval (*in days*) after transplanting up to harvesting? ___days

1019. What is the method used in weed control?
1. ☐ Mechanical
2. ☐ Manual hand pulling
3. ☐ Hand hoe
4. ☐ Herbicides
5. ☐ Other methods (*Specify* :_________________)

1100 COMPOUND OBSERVATION

(LOOK AROUND THE COMPOUND. WHAT DO YOU SEE?)

	Observe	Response		Comments
1101	Rubbish laying about	0. ☐ No	1. ☐ Yes	
1102	Animal/human faeces laying about	0. ☐ No	1. ☐ Yes	
1103	Un-penned animals	0. ☐ No	1. ☐ Yes	

(LOOK AT THE **MAIN HOUSE** IN THE HOMESTEAD. WHAT DO YOU SEE?)

	Observe	Response		Comments
	Floor			
1104	Made of mud	0. ☐ No	1. ☐ Yes	
1105	Made of bricks/ cement blocks	0. ☐ No	1. ☐ Yes	
	Wall			
1107	Made of mud	0. ☐ No	1. ☐ Yes	
1108	Made of bricks/ cement blocks	0. ☐ No	1. ☐ Yes	
1109	Made of iron sheets	0. ☐ No	1. ☐ Yes	
1110	Made of timber	0. ☐ No	1. ☐ Yes	
	Roof			
1111	Straw/ rids/grass thatched	0. ☐ No	1. ☐ Yes	
1112	Tin/ iron sheet	0. ☐ No	1. ☐ Yes	
1113	Asbestos/ tiles	0. ☐ No	1. ☐ Yes	
1114	Plastic foil	0. ☐ No	1. ☐ Yes	
1115	Is rainwater harvested from roofs	0. ☐ No	1. ☐ Yes	
1116	Is there a dish rack?	0. ☐ No	1. ☐ Yes	

1200 LATRINE OBSERVATION

(*If the respondent has a private latrine, ask the following questions. If not, end the interview*.)

1201 May I please see your latrine?
0. ☐ No (*End the interview and thank the respondent*) 1. ☐ Yes

NB: The remainder of this questionnaire is observation only. Please fill in this section while inspecting the latrine.

1202 The latrine is located:
1. ☐ In the yard/near the house 2. ☐ In the neighbour's compound
3. ☐ Far from the house

1203	Is there a cement slab?	0 ☐ No	1 ☐ Yes
1204	Is the slab or floor in good repair?	0 ☐ No	1 ☐ Yes
1205	Is there debri on the floor or slab?	0 ☐ No	1 ☐ Yes
1206	Is there urine or water on the floor or slab?	0 ☐ No	1 ☐ Yes
1207	Are there faeces on the floor or slab?	0 ☐ No	1 ☐ Yes
1208	Is there a lid for the hole?	0 ☐ No	1 ☐ Yes
1209	Is the lid on the hole?	0 ☐ No	1 ☐ Yes
1210	Is the pit full or almost full?	0 ☐ No	1 ☐ Yes
1211	Are the walls and roof strong?	0 ☐ No	1 ☐ Yes
1212	Can you be seen while you are in the latrine?	0 ☐ No	1 ☐ Yes

1213 Are there flies in the latrine?

0. ☐ Yes   1. ☐ No

   a. ☐ A few
   b. ☐ Many

1214 Is there a water pot for hand-washing within 5 meters of the latrine?

0. ☐ No   1. ☐ Yes

1215 Is there a soak-away for urine and water?

0. ☐ No   1. ☐ Yes   3. ☐ N/A

1216 Is the latrine located at least 30 metres from a water point?

0. ☐ No   1. ☐ Yes

THIS CONCLUDES THE INTERVIEW. PLEASE THANK THE RESPONDENT FOR THEIR TIME AND COOPERATION.

Annex 2: Sample size

The actual households to be interview were sampled using systematic sampling based on the farmer registers available in the respective National Irrigation Board, Western Kenya Regional offices. The required sample sizes for each scheme are computed in the following table:

Ahero Irrigation Scheme					
Western Blocks			Eastern Blocks		
Block	Area (Acres)	Sample size	Block	Area (Acres)	Sample size
A	285.5	9	K	149.0	6
B	209.5	7	L	122.4	5
C	77.8	3	M	131.2	5
D	187.0	6	N	237.0	10
F	231.5	8	O	84.4	4
G	203.0	7	P	248.5	10
Total	***1194.1***	***40***		***973.9***	***40***
West Kano Irrigation Scheme					
Block 1			Block 2		
Block	Area (Acres)	Sample size	Block	Area (Acres)	Sample size
A	147.0	5	E	342.0	14
B	236.0	8	F	3000	12
C	370.0	12	G	96.0	4
D	327.0	10	H	245.0	10
J	163.0	5			
Total	***1243.0***	***40***		***983.0***	***40***
Bunyala Irrigation Scheme					
Section			Sample Size		
Main Scheme (managed by NIB)			20		
Out growers – Muluwa			20		
Total			***40***		
Total sample size for the survey			**200 Households**		