Drought Tolerant Maize for Africa (DTMA) Project

Country Report – Household Survey

Characterization of Maize Producing Households in Manyoni and Chamwino Districts in Tanzania

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CIMMYT
International Maize and Wheat Improvement Center

The International Maize and Wheat Improvement Center, known by its Spanish acronym, CIMMYT® (www.cimmyt.org), is an international, not-for-profit research and training organization. With partners in over 100 countries, the center works to sustainably increase the productivity of maize and wheat systems to ensure global food security and reduce poverty. The center's outputs and services include improved maize and wheat varieties and cropping systems, the conservation of maize and wheat genetic resources, and capacity building. CIMMYT belongs to and is funded by the Consultative Group on International Agricultural Research (CGIAR) (www.cgiar.org) and also receives support from national governments, foundations, development banks, and other public and private agencies. CIMMYT is particularly grateful for the generous, unrestricted funding that has kept the center strong and effective over many years.

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Acronyms

DFID :	Department for International Development (United Kingdom)
DTMA:	Drought Tolerant Maize for Africa
Hh :	Household
MEU :	Man-Equivalent Units
MT :	Metric ton
NGOs :	Non-Governmental Organizations
OPV :	Open Pollinated Varieties
PCA :	Principal Components Analysis
SSA :	Sub-Saharan Africa
Masl :	Meters above seal level
PCA :	Principal Component Analysis
NGOs :	Non-Governmental Organizations

Foreword and acknowledgement

Maize is Africa's most important cereal crop. It is particularly vital for more than 300 million people in sub-Saharan Africa (SSA) whose livelihoods are threatened by recurrent droughts responsible for crop failures. Considering the devastating impact of droughts on food security and economic development in SSA, effective solutions are of uttermost importance, especially as the situation is set to worsen as climate change progresses.

The Drought Tolerant Maize for Africa (DTMA) initiative aims to address this challenge. It joins the efforts of people, organizations and projects supporting the development and dissemination of drought tolerant maize in 13 countries in SSA. The initiative is supported by the Bill & Melinda Gates Foundation and Howard G. Buffett Foundation. For further information about the initiative, visit the project website (http://dtma.cimmyt.org).

Developing, distributing and cultivating drought tolerant maize varieties is a highly relevant intervention in SSA to reduce vulnerability, food insecurity and the damage to local markets caused by food aid. However, for this to succeed, it needs to be embedded in the local reality. For this purpose, each of the participating countries was supported to conduct a community assessment and a household survey in the target areas. This report presents the findings of the household survey, which serve as a baseline and characterizes the maize producing households in Chamwino and Manyoni Districts of Tanzania.

This country study received financial support from the DTMA project. During the course of the study, the authors benefitted from constructive contributions from Wilfred Mwangi, Roberto la Rovere, Girma Tesfahun Kassie and Olaf Erenstein, among others; and editing by Wandera Ojanji. The authors are responsible for any remaining errors and inferences.

1 Introduction

Smallholder farmers with up to 10 hectares of farm land per household, account for about 85% of the maize produced in Tanzania. Their farming system is however characterized by low use of improved technologies (fertilizers, seeds and crop husbandry practices), resulting in the observed low yields and slow growth in productivity (URT, 2006). Medium-scale commercial farms (10-100 ha) account for 10% of maize production in Tanzania with large-scale commercial farms (>100 ha) accounting for the remaining 5%.

Tanzania's maize production is affected by low and erratic rainfall. Between 1961-65 and 1985-95, the national maize production was estimated to have grown annually by 4.6%, of which 2.4% could be attributed to area growth and 2.2% to yield growth (Katinila *et al.,* 1998). In the period of 1984/1985 through 1996/1997 maize production increased annually by 4.2% and by 5.1% from 1996/1997 through 2004/2005 (URT, 2006). Despite the growth in maize production, average yields are less than 1.5 t/ha and show a regional diversity, tending to be higher in high-potential areas such as in the southern highlands.

Maize is one of the key staple food crops and a major cereal consumed in Tanzania. It is estimated that the annual per capita consumption of maize in Tanzania is 112.5 kg and national maize consumption is estimated to be three million tons per year. Maize is grown in all 21 regions of Tanzania. The crop is annually grown on an average of two million hectares or covering about 45% of the cultivated area in Tanzania. Although maize productivity is more favourable in high rainfall areas in Tanzania – such as southern highlands, the Lake Victoria zone, and the northern zone - maize is also produced in the central zone of Tanzania, a zone that suffers significantly from drought. For instance, Singida and Dodoma are central regions of Tanzania with a relatively dry climate but with still substantial maize areas. Maize production in the central zone is also hampered by poor seed supply systems and internal road networks. Maize yields in Singida and Dodoma average only 0.4 tons per ha which is far below the national average yield of just over 1 ton per ha.

Despite maize production from the central zone being relatively limited, the region's farm households can provide surpluses during years with enough rains (Mdadila 1995). Drought tolerant maize varieties have therefore the potential to improve productivity in these drought prone zones, thereby increasing food security and poverty alleviation.

The main goal of this study is to characterize maize production, consumption and marketing systems at the household level and to analyze determinants and impacts of past adoption of improved maize varieties and the potential adoption of drought tolerant maize in selected locations. Specific objectives are to:

- Identify farm level constraints hindering access to and uptake of technology.
- Identify farmers' perceptions of and preferences for maize variety attributes in relation to drought (e.g., yield increments; food security; reduction in hunger months and cash income).
- Characterize maize production practices, farmer access to farm inputs, produce markets, extension, credit, NGOs services and gender mainstreaming.
- Characterize household livelihood strategies, their perception of risks and threats, and coping strategies.

2 Materials and Method

2.1 Sampling and data collection

The study focuses on the drought prone maize producing areas of central Tanzania. Chamwino and Manyoni districts were purposely selected from Dodoma and Singida regions respectively to achieve a twofold sample criteria: a location where significant maize is produced; and secondly, where drought stress is also significant and there are opportunities for drought maize tolerant varieties to increase overall returns on investment to both farmers and seed producers.

At the district level, three villages characterised by drought stress and maize production potential were purposively selected from each of the two districts with the help of extension staff. From each village, approximately 25 farmers were randomly sampled from the register of households, to make a total sample of 151 households for the whole study. To increase data validity and reliability, farmers were interviewed by researchers, trained enumerators and experienced extension officers using a structured questionnaire.

2.2 Agro-climatic characterizations of survey locations

Chamwino is one of the six districts in Dodoma region that is geographically located in central Tanzania. It has a surface area of 776,472 ha with a population of 257,340 people in 2008. Chamwino is a low-rainfall district, like others in the region, and receives an average of 400 mm to 650 mm per annum. Temperature ranges between 18^0C to 31^0C. The district's administrative capital Dodoma is located at 6.183^0S latitude and 35.746^0E longitude. The altitude of sampled households in the district averages 995 meters above sea level (masl), ranging from 899 to 1150 masl.

Manyoni is one of the three districts in Singida region in central Tanzania. It covers a total land area of 2,862,000 and had a population of 205,423 people according to the 2002 National Population Census. The district administrative capital Manyoni is located at 5.747^0S latitude and 34.835^0E longitude. The altitude of the sampled households in the district averages 1139 masl (ranging from 824 to 1347 masl). According to the district's public records, rainfall ranges from 480 mm to 750 mm. The highest rainfall level in the past 20 years was during the El-Nino rains in 1997/8 when rainfall reached 1336.5 mm and the lowest was 327.5 mm, in 1999/2000.

2.3 Data analysis

Descriptive statistics were employed to characterise the socioeconomic and biophysical features of the households. Principal component analysis and logistic regression analysis were used to generate the wealth index and to determine the factors that influence adoption decision of improved maize varieties respectively.

2.3.1 Principal component analysis

Principal component analysis (PCA) was used to generate the wealth indices for each household based on fixed asset and livestock endowments. This asset based method was employed following the rich literature base that highlights the difficulty and irregularities of wealth indicators developed based on reported income and expenditure data. According to Montgomery et al (2000), the collection of accurate income data is quite demanding as it requires extensive resources for household surveys, in some cases, an indicator of income is difficult to use. For example, income information does not capture the fact that people may have income in kind, such as crops which are traded (Cortinovis et al, 1993). Therefore, asset based indicators have become quite common in characterising welfare states of people (Filmer and Prichett, 2001; McKenzie, 2003).

PCA is a statistical procedure used to reduce dimensions of a data set in terms of aggregating variables through orthogonal linear combinations of the variables. Mathematically, from an initial set of n correlated variables, PCA creates orthogonal components, where each component is a linear weighted combination of the initial variables. For n assets and livestock, for instance,

$$PC_1 = a_{11}X_1 + a_{12}X_2 + \ldots + a_{1n}X_n$$
$$\vdots$$
$$PC_m = a_{m1}X_1 + a_{m2}X_2 + \ldots + a_{mn}X_n \qquad (1\&2)$$

where a_{mn} represents the weight for the m^{th} principal component and the n^{th} variable.

The weights for each principal component are given by the eigenvectors of the covariance matrix as we used the original data. The correlation matrix could be used if the data were standardized. Using the scores generated by the first principal component and the mean and standard deviation of the original data set, the wealth indices were computed using the formula:

$$W_j = \sum_{i}^{n} [\gamma_i * (x_{ij} - \bar{x}_i) / \delta_i] \qquad (3)$$

where, ***Wj*** is the wealth index for each household; γ_i represents the weights (scores) assigned to the n assets and livestock on the first principal component; x_{ij} is the original observation of asset i in household j, $\bar{x}_i$ is the mean holding of asset i in the sample, of each of the *n* variables; and δ_i the standard deviation of holding of each of the assets in the sample.

The wealth indices were used to categorize the households into three wealth classes. Wealth class one has the poor households and their indices ranged from the negative minimum to the mean of the negative indices, and the rich wealth class included households with indices that are above the average of the positive wealth indices. Those households with indices between the mean values of the negative and positive wealth indices were classified as middle income.

2.3.2 Logistic regression

The data analysis also included logistic regression to determine the factors that influence adoption decision of improved maize varieties. The logit model is based on the plausible assumption that each decision maker selects adoption or non-adoption decision only if it maximizes its perceived utility. Utility is, however, latent and only the decision variable (adopting or not adopting) is observed. The decision of the respondent "y" takes on one of two values, 0 (not-adopting) or 1 (adopting). The probability that the respondent decides to adopt improved maize varieties can be formulated as

$$\Pr ob(Y_i = 1) = F(X_i\beta) \qquad (4)$$

where X_i is a vector of explanatory variables and β is a conformable vector of coefficients to be estimated. By choosing F to be a logistic distribution, the probability can be estimated using the logit formulation as

$$\Pr ob(Y_i = 1) = \Lambda(X_i\beta) = \frac{\exp(X_i\beta)}{1+\exp(X_i\beta)} \qquad (5)$$

An easier way of interpreting the estimated coefficients is considering the partial derivatives of the probability that Y_i equals one with respect to a continuous variable or with respect to a change from the reference level to another of a discrete variable (X_k). The partial derivatives give the marginal effects and are formulated as

$$\frac{\partial E(Y_i = 1)}{\partial X_k} = \frac{\exp(X_i \beta)}{(1+\exp(X_i \beta))^2} . \beta_k \tag{6}$$

The estimation of the logit model is done with the maximum likelihood (ML) approach. The general log likelihood function is specified as

$$\log \boldsymbol{L}(\boldsymbol{\beta}) = \sum_{i=1}^{N} \boldsymbol{Y_i} \log \boldsymbol{F}(\boldsymbol{X_i'\beta}) + \sum_{i=1}^{N} (1-\boldsymbol{Y_i}) \log(1-\boldsymbol{F}(\boldsymbol{X_i'\beta})) \tag{7}$$

The first order condition of the ML function is generated by differentiating the above equation with respect to β, which gives;

$$\frac{\partial \log \boldsymbol{L}(\boldsymbol{\beta})}{\partial \boldsymbol{\beta}} = \sum_{i=1}^{N} \left[\frac{\boldsymbol{Y_i} - \boldsymbol{F}(\boldsymbol{X_i'\beta})}{\boldsymbol{F}(\boldsymbol{X_i'\beta})(1-\boldsymbol{F}(\boldsymbol{X_i'\beta}))} \boldsymbol{f}(\boldsymbol{X_i'\beta}) \right] \boldsymbol{X_i} = 0 \tag{8}$$

Where f is equal to F', denoting the density function. For the logistic function the above equation is simplified as;

$$\frac{\partial \log \boldsymbol{L}(\boldsymbol{\beta})}{\partial \boldsymbol{\beta}} = \sum_{i=1}^{N} \left[\boldsymbol{Y_i} - \frac{\exp(\boldsymbol{X_i'\beta})}{1+\exp(\boldsymbol{X_i'\beta})} \right] \boldsymbol{X_i} = 0 \tag{9}$$

The solution for this equation is the maximum likelihood estimator $\hat{\boldsymbol{\beta}}$. This estimator can be used to estimate the probability that Y_i= 1 for a given X_i as;

$$\hat{\boldsymbol{P}}_i = \frac{\exp(\boldsymbol{X_i'\hat{\beta}})}{1+\exp(\boldsymbol{X_i'\hat{\beta}})} \tag{10}$$

3 Household Characteristics

3.1 Categorizing household access to capital assets

Farmers own various assets that help them sustain their day to day livelihoods. These include human, natural, physical, financial and social capital (Table 1). Human capital considers contribution to households' labour force needed for performing various farm operations. Other assets that facilitate livelihood strategies include livestock (cows, bulls, sheep, pigs) and physical assets. Social capital like membership in some organizations can also be important for enabling access to other resources to improve livelihoods.

Table 1. Categorization of capital assets covered in survey instrument.

Capital Category	Capital Asset
Natural Capital	1. Total farm size 2. Cultivated farm size 3. Total tropical livestock unit
Physical Capital	4. Own motor vehicle 5. Own bicycle 6. Own ox-plough 7. Own scotch-cart 8. Own wheelbarrow 9. Own Television 10. Own Radio 11. Own Water tank 12. Own Mobile phone
Human Capital	13. Household labour capacity
Social Capital	14. Membership to an association
Financial Capital	15. Benefit from aid projects 16. Access to credit

Figure 1 shows the distribution of households according to wealth index generated by the PCA or reported household assets. About half the households were classified as in the middle class category (46%) whereas 40% were relatively well endowed and 13% poorly endowed (Table 2). The findings indicated further that Manda, Manchari, Msemembo and Chikuyu villages were poorly endowed while the other two (i.e. Sanjaranda and Itiso) villages were well endowed.

Table 2. Distribution of households by wealth categories.

Wealth Index class	Frequency	Percent
Poor class	20	13.2
Middle class	70	46.4
Rich class	61	40.4
Total	151	100.0

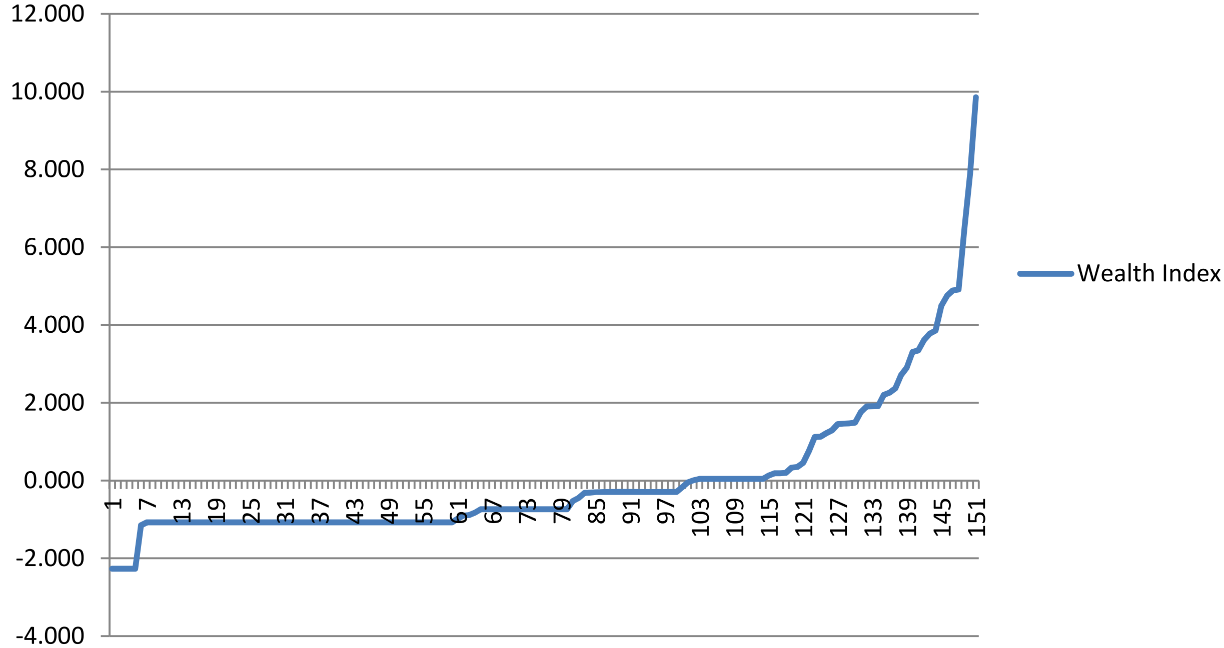

Figure 1: Distribution of households according to wealth index

3.2 Human capital

The household size ranged from 1 to 14 persons with a mean of 5.1 persons per household and about equally split between males and females. Children dominate in number with a mean of 3.1 per household; which implies that there were more dependants than those who contribute to household labour force. The age of the members ranged from 1 to 100 years with a mean 21.6 years. The households had on average 1.3 illiterate persons.

Human capital includes household labour availability (i.e. number of household members available at home for different activities). Household members spent most of the year at home contributing an average of 3.6 months of farm work per year. Household labour availability was calculated in terms of man equivalent units (MEU). The MEU considers both the age of household members and their contribution to household labour force. Different age groups were assigned indices between zero and one and then these indices were multiplied by the number of months available for farm work to get man months per year for each household member.[1] The labour availability averaged 10.9 months of MEU per year – about equally split between male and female members.

3.3 Natural capital

Land is an important natural capital with an average farm size of 4.3 ha in the study area, being somewhat larger in Chamwino. Both men and women have the right to acquire and own land. Land is typically owned – with only a few instances reporting renting of land in Chamwino.

[1] Man hour were calculated by assigning following weight for each age group: (0 thru 9=0) (10 thru 15=0.1) (16 thru 21=0.2) (22 thru 49=1) (50 thru 55=0.6) (56 thru 61=0.3) (62 thru 67=0.1) (68 thru Highest=0) then the weights are multiplied by the number of months available for farm work to get man months per year for each household member

3.4 Physical capital

The household dwelling is an indicator of household wealth. Most respondents were living in mud huts – including slightly over half that are thatched and a quarter that with galvanized iron sheet roofing (Table 3). The relative poverty of the surveyed households is also reflected in the limited assets reported. Bicycles were the most common types of asset owned by a 35% of respondents followed by radios (28%), with a few reporting mobile phones (6%), sewing machines (4%) and private water wells (2%). Few (3%) owned draught animals/ox ploughs. Those who owned draught animals argued that with ox plough it was possible to timely implement farming operations as well as expanding the cropping area.

Table 3. Type of dwelling used by surveyed households (n=151).

Type of dwelling	% of households
Mud hut with grass thatch roof	55.3
Mud hut with asbestos/iron roof	24.7
Block house with asbestos/iron roof	18
Brick house with thatch roof	2
Total	**100**

3.5 Financial capital

Financial resources are very important in supporting agricultural production. Capacity to purchase farm inputs like improved maize seeds, fertilizers, insecticides and implements depends highly on the financial position of the household. The survey indicated that 93.4% of the respondents had no access to credit thereby limiting potential agricultural investments particularly for low income farmers.

3.6 Social capital

Farmers reported receiving support from government and non government organizations, including those presented in Table 4.

Table 4.Main sources of institutional support to households.

Institution	Type of support provided
CARE Tanzania	Natural resources management
World Food Program	Food aid
Action aid	Support to orphans
World Vision	School support as well as agriculture
TACAIDS	HIV/AIDS control program
Village/Ward Executive Offices	Administration services and development stimulants

Extension services are important for the promotion of agricultural production in terms of technology dissemination (new varieties, input use, farm implements and technical knowhow). Respondent interactions with extension agents were reportedly limited, whereas few farmers reportedly acquired information from other sources including mass media.

4 Household livelihood strategies

Households typically diversity the portfolio of livelihood options that sustain them, particularly in areas of marginal and high risk agricultural production. Farmers thus grow a variety of crops and undertake a variety of livestock activities in pursuit of various food and income goals. Farm activities are supplemented by non-farm employment and trading. Understanding this complexity is vital to development and deployment of technologies such as drought tolerant varieties aimed at improving the welfare of rural people. There are many dimensions to rural livelihoods which may involve provision of adequate food, income, shelter, transportation, water and sanitation, health care, recreation, maintenance of the productive capacity of the environment, and status in society.
The survey results indicate that crop and livestock production dominate livelihoods of the households in the two districts. Crop production was the most important activity, supplying food and income to the household. Some cattle, sheep, goats and chickens were kept but these were typically second in importance to crops. Some households also reported income from off-farm activities such as casual labor, crafts and petty trading. The main household expenditure items were food, education and health, with other expenditures including repairs, fuel wood, clothing, social contributions, gifts and remittances. A patriarchal system dominates in the study area and the household head thereby typically dominates decision making in terms of household activities, resource allocation and expenditures.

4.1 Crop production

Farmers in the study area use their land for crop production (including trees either planted or conserved natural forests) and grazing. Farmers were asked what determined their cultivated farm size – particularly what were the three most important factors they consider when allocating land to crops (Table 5). Food needs were the most widely reported as determining cultivated area (30%), followed by cash availability for inputs and hired labour, family labour availability and seed availability.

Table 5. Determinants of cultivated farm size.

Category	Responses (%)
Food needs	30
Cash availability to purchase other inputs	18
Expected family labor availability	17
Availability of seed	15
Cash availability to hire labor	14
Expected grain price after harvest	4
Current grain prices	2
Other	1
Total	**100**

Farmers were also asked about any changes in crop area over time. About half the respondents reported that their cultivated area remained unchanged, with 27.5% reporting an increase, while 20% had reduced their area (Table 6). Those with decreasing land had reasons of insufficient labour, drought, poor production technology – such as continuous use of hand hoes and planting of landraces. The prominent crops cultivated by the households are maize, sorghum, millet, groundnut, sesame and sunflower. Yields are relatively low – associated with pests and diseases and poor rain fall.

Table 6. Dynamics of cultivated farm size (% households).

Status	Manyoni	Chamwino	Overall
Same	39.7	86.2	52.9
Larger	32.9	13.8	27.5
Smaller	27.4	0.0	19.6

4.2 Livestock production

Livestock keeping was the second most important economic activity after crop production in the study area. Local chickens are the most prominent in terms of widespread ownership (54% households). About a fifth of the households reported owning cattle and a similar share reporting goats. Livestock tend to be indigenous breeds and were grazed on natural pastures. Livestock also are a household wealth indicator. Most commonly, livestock is owned by the household head, with joint or spouse ownership being less common. Those who owned cattle can sell animals to finance households' ventures and acquire inputs as well as surmount times of difficulties such as purchase of food during shortages. Livestock tend to be sold in periodic livestock markets organized in the wards. In both districts, chicken were the most marketed, followed by goats.

4.3 Threats and constraints affecting livelihood strategies

Most (61%) of the surveyed households reported being food insecure over the last five years. January was the worst month (Table 7), with food insecurity typically lasting 2-3 months (). The major reasons for such shortages were low maize yields realized due to the frequent droughts in the central regions of Tanzania. The main coping strategy for respondents (reported by 41%) was selling of assets during these periods to generate money to purchase food.

Table 7. Month when households were food insecure.

Months	No. of households	%
January	27	49.1
February	8	14.5
March	2	3.6
April	4	7.3
June	1	1.8
August	2	3.6
September	1	1.8
October	3	5.5
December	2	3.6
Total	55	100

Table 8. No. of months hhs were food insecure.

No. of months	No. of households	%
1	8	14.5
2	10	18.2
3	11	20
4	7	12.7
5	6	10.9
6	3	5.5
7	1	1.8
8	3	5.5
11	4	7.3
12	2	3.6
Total	55	100

Respondents were asked to mention the most important threats for livelihood strategies. The most common threats were drought, food insecurity and pest and diseases – all directly affecting crop production including maize. Floods were also reported especially in one of the three villages (Chikuyu) in Manyoni district which is a plain landform in the rift valley stretching downwards from Kenya through Tanzania to Malawi.

Farmers also reported on the most serious constraints for improving their livelihoods, including farm implements, limited capital, and illness. Farm implements affect the area cultivated as well as timing of farm operations. Limited capital constrains investment in agriculture whereas illness reduces the available family labor to engage in farming activities. Other constraints included low prices of farm produces, low production and markets.

5 Technology use in crop production

5.1 Maize input and seed use

More than half the farmers reported to have used some improved maize varieties over the last five years, the most common being Seedco, Cargil, Kilima, Ilonga, Staha, Pannar and otherwise unspecified 'hybrids'. When not using improved varities, farmers planted landraces although some of the varieties referred to as landraces may actually also have been improved varieties that have been released long ago or farmers may have forgotten their names or origin. Respondents often realize a yield increase when using the improved varieties as opposed to local varieties.

Farmers were also asked to mention some of the characteristics of the desired ideal maize variety. The most important attributes reported by a third of the respondents were early maturity and drought resistance, followed by yield potential and grain size. These findings indicate that early maturity and drought resistance are important characteristics for adopting improved maize varieties in central Tanzania where rainfall is a limiting factor. Information on improved seeds were obtained from the Ministry of Agriculture, other farmers, radio programs, local stockists, seed companies, NGOs and farmer groups/cooperatives. Some farmers said that they had never used improved varieties because of unavailability of improved seeds, lack of money to buy, lack of sufficient information on improved seeds and continual use of local maize varieties at no cost. Over half the farmers (57%) reported buying maize seed during the last season. Half of those who bought seed bought landrace averaging 20.8 kg per farmer. Seedco and Kilima were the next most popular seeds (Table 9). Farmers bought seed from fellow farmers, relatives, neighbors and traders (Table 10).

External input use other than seed is rare in the study area for maize. None of the respondents used chemical fertilizers or pesticides with most respondents complaining of high input prices. Farm yard manure was also not used with farmers citing its bulkiness and high quantities required per unit area as constraining factors.

Factors considered by respondents to select the maize varieties are presented in Table 11. The most important factors were high yield potential, drought resistance, disease resistance, early maturity and poundability.

Table 9. Seed quantity purchased in 2007/8 by variety by district (Kg).

Districts	Maize variety	Mean	N	Std. Dev.	Minimum	Maximum
Manyoni	Asilia (Landrace)	21.2	35	38.99	0	240
	Cargil	10.3	4	7.41	2	20
	Seedco	50.3	11	103.89	2	360
	Kilima	17.9	8	11.22	2	30
	Unclassified	12.2	6	6.46	4	20
	Total	24.3	64	52.04	0	360
Chamwino	Asilia (landrace)	19.5	13	21.01	2	80
	Seedco	15.2	5	13.97	6	40
	Kilima	16.0	5	5.48	10	20
	Ilonga	18.1	8	9.98	10	40
	Total	17.6	32	15.07	2	80
Total	Asilia (Landrace)	20.8	48	34.83	0	240
	Cargil	10.3	4	7.41	2	20
	Seedco	39.3	16	86.77	2	360
	Kilima	17.2	13	9.18	2	30
	Ilonga	18.1	8	9.98	10	40
	Unclassified	12.2	6	6.46	4	20
	Total	22.1	96	43.36	0	360

Table 10. Farmers' reported sources of seed purchase.

Maize variety	Fellow farmer	Neighbor	Do not know	Relative	Trader	Total
Asilia	4	1	44	0	0	49
Cargil	0	0	4	0	0	4
Seedco	2	0	15	1	0	18
Kilima	2	0	10	0	1	13
Ilonga	0	0	8	0	0	8
Staha	0	0	1	0	0	1
None	0	0	70	0	0	70
Total	8	1	152	1	1	163

Table 11. Factors considered for maize variety selection (% hh reporting).

Factors	First	Second	Third	Overall
High yield potential	45	10.1	22.1	77.2
Disease/pests resistance	9	32.6	7	48.6
Drought resistance	14	11.2	40.7	65.9
Resistance to storage pests		5.6		5.6
Maturity period	8	27	11.6	46.6
Number of cobs per plant	1	1.1		2.1
Good performance on poor soils			4.7	4.7
Cob size	1	6.7	9.3	17
Ease of poundability	17	1.1	1.2	19.3
Taste of meal	3	1.1	1.2	5.3
Cost of seed	2	1.1		3.1
Other		2.2	2.3	4.5
Total	100	100	100	100

5.2 Determinants of adoption of improved maize varieties

Maize varietal choice and decisions to adopt which variety to grow is influenced by a variety of factors, including information accessibility (important sources of information were agricultural extension staff, extension bulletins, news papers and radio), age, marital status of the household head, physical assets owned (wealth index), credit accessibility, decision making within the household and membership to an association. Table 12 lists some of the variables used here to analyze adoption decisions and their priory expectation.

Table 12: Variables used in analyzing the factors affecting adoption

Variable name	Measurement	Explanations	Priory expectations
Adoptdum	=1 if household scores at least 0.5 in planting improved varieties in the past 5 years (q48)	Dependent variable	
Wealthindex	Index generated using factor analyses based on asset ownership 1. Rich (1=yes, 0 No) 2. Poor (1=yes, o=No)	Wealthier household will most likely adopt improved varieties	+ve
Marstat	Marital status of the household head 1 =Married 0 = otherwise	Married house hold are more likely to adopt improved technology	+ve
Decmak	Decision making on farming activity 1=Household head 0=others members	House hold decision on adopting new technology is likely to be high	+ve
Agehhh	Age of the head of household (years)	Older farmers are less likely to try new technologies	-ve
Accredit	Access to credit 1=Yes 0=No	households accessing credit are more likely to adopt purchased inputs	+ve
Meassoc	Membership to an association 1=Yes 0=otherwise	Being member to an association increase the likelihood to adopt new technology	+ve
Credacc	Access to cash credit 1= lack of access to credit, 0=otherwise	Lack of access to input credit limits adoption	+ve

For the purpose of the present study, the dependent was whether the household has used an improved variety in the last season. The data were fitted to the Logit model since we have a binary choice variable (has adopted improved variety =1, 0 otherwise). Independent variables included represented farm, farmer, household, and institutional factors which are known to explain adoption of agricultural technologies such as improved seed. The STATA software was used in the analysis. The results are presented in Table 13. Out of the eight explanatory variables tested, four were significant. Marital status of the household head, decision making pattern in the household, and asset wealth status (both poor and rich dummies) have significant influence on the likelihood of adoption of improved maize varieties (Table 13).

Table 13. Determinants of adoption of improved maize variety.

Variables	Coef.	Odds-ratio	Std. Err.	z	P>z
Age of respondent	0.159	1.172	0.145	1.100	0.273
Age of respondent square	-0.002	0.998	0.002	-1.030	0.303
Marital status of hh head	-1.218	0.296	0.642	-1.900	0.058
Decision makers	-1.309	0.270	0.593	-2.210	0.027
Poor Class	-0.841	0.431	0.407	-2.060	0.039
Rich class	0.808	2.244	0.486	1.660	0.096
Membership to association	-0.977	0.376	0.726	-1.350	0.179
Access to credit	0.517	1.677	1.003	0.520	0.606
Constant	-0.062	0.940	3.642	-0.020	0.986

$P<0.05$, LR Ch^2 19.37, pseudo R^2 0.1431, log likelihood -58.0109

The estimated model was found to be significant ($p<0.05$) over the intercept only model. Married households were found to be less likely to adopt improved maize varieties. Getting married decreases the odds ratio (of adopting to non-adopting) by a factor of about 0.3. Moving from whole family based decision making to only household head decision making reduces nearly by a quarter (.27). When we compare the medium wealth class farmers with those in the poor class, being in the later group decreases the odds ratio (of adopting to non-adopting) by 0.431. Whereas, if a farming household moves from medium wealth class to rich wealth class, then its odds ratio of adopting improved maize varieties increases by a factor of 2.25. This is in line with the conventional wisdom that poor farmers tend to be more cautious in adopting new technologies as they are more risk averse whereas richer farmers can be more risk taking and invest in inputs.

6 Conclusion

Crop production and livelihood strategies are major challenges in the poor and drought-prone study areas of central Tanzania. Drought, food insecurity and pest and diseases were identified as the most serious threats to local livelihoods and have great impact on maize production. Drought tolerant maize thus seems to offer significant opportunities to improve livelihoods. Preferred attributes for maize varieties include yield, drought tolerance, and early maturity. Although maize is a major livelihood source, overall input use in maize production is low, due to limited purchasing power of the farmers. The decision to adopt improved maize seed is influenced positively by wealth status.

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