

The Role of Gender in Adoption of Climate Smart Push-Pull Technology in Western Kenya

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ICIPE:

World-renowned entomologist, Thomas R. Odhiambo, founded the International Center for Insect Physiology and Ecology, more commonly known as *icipe*, in 1970. From its founding, *icipe* has set its mission to “alleviate poverty, ensure food security, and improve the overall health status of peoples of the tropics by developing and extending management tools and strategies for harmful and useful arthropods, while preserving the natural resource base through research and capacity building.”

The mission of *icipe* has led to the development of similar objectives specified to areas covering animal, plant, human, and environmental science. These objectives have included a goal of creating knowledge on improved arthropod management, building capacity regarding the involvement of youth and empowerment of women, and policy building with African institutions and government, to name a few.

To tackle such a spectrum, *icipe* has created a team incorporating the knowledge and skills of behavioral biologists, entomologists, biochemists, ecosystem ecologists, social scientists, and more, all collectively working to develop “environmentally safe integrated pest and vector management options.” These experts can be found at *icipe* headquarters in Nairobi and branching to field sites located in Mbita Point and Port Sudan.

Icipe has commanded the attention of entomologists worldwide as the positive and negative effects of insects continue to determine food security and health status around the majority of the tropics. Through collaboration with nearly 200 national systems, universities, and various research institutes spanning the globe, the knowledge pulled to the alleviation of poverty is vast beyond compare.

Over four decades of inquiry has led to multiple publications, various newsletters, and continued research on tropical insects including, but not limited to, stemborers, mosquito, Tsetse, the African Fruit Fly, Diamond back moths, and Thrips with the hope of improving the livelihood of African smallholder farmers and families.

THOMAS ODHIAMBO FIELD STATION:

The *icipe* Thomas Odhiambo Campus (IOTC) was established in 1977 on the shores of Lake Victoria within the township of Mbita Point. Stretching over 60 acres of land in far western Kenya, the IOTC is home to the majority of *icipe's* field research. A lush insect biodiversity has been prosperous in the area due to the humid, equatorial climate that is present; such conditions have made the IOTC a suitable and sought-after location for research on crop pests and vectors for multiple diseases.

The field station, which is equipped with an abundance of laboratories, offices, guest housing, a medical clinic, an elementary school, high security, and more, has drawn the attention of students worldwide as well as a variety of NGO's such as Nagasaki University, Care Kenya, International Medical Corps, etc. Each year, PhD scholars, Masters students, visiting scientists, and interns travel to the IOTC to work with one of the six resident scientists on projects dealing with dissemination of push-pull technology, Malaria, Tsetse, and other topics falling under the umbrella of habitat management and entomology research.

CLIMATE SMART PUSH-PULL TECHNOLOGY:

It was the year 1997 when Dr. Zeyaur Khan developed an instrumental agricultural technology that would change the lives of millions of Africans throughout the countries of Kenya, Uganda, and Tanzania. Conventional Push-Pull technology (PPT), as it came to be known, was a transformative technique of intercropping and border cropping that was introduced to farmers in 1998.

As stemborer insects and parasitic weeds in the genus *Striga* depleted harvests, PPT allowed for once vulnerable staple crops, to find defense. Conceptually the new practice was quite simple. By intercropping desmodium (a 'push' plant) with cereals, and bordering the crops with Napier grass or Brachiaria grass (a 'pull' plant) stemborers were directed away from the main staple crop and pulled toward the superiorly attractive border crops. Aside from the 'pushing' role of stemborer done by the desmodium, this intercrop suppressed the *Striga* weed by stimulating germination, then preventing root growth. Unable to attach and acquire nutrients from the roots of the staple crops, the *Striga* quickly died.

The desmodium also reaps other benefits including "fixing atmospheric nitrogen, adding organic matter to soil, and conserving soil moisture," all of which enhance the overall health and fertility of the soil.

Push-Pull technology's effectiveness can be clearly drawn from the improved livelihood of the nearly 90,000 adopters to date. Due to this new agricultural advancement, around 80% of Sub-Saharan Africa has seen an increase in yield, soil fertility, and fodder availability. Realistic, simple, and inexpensive, PPT was perfectly suited for the environment in which adoption was taking place.

As environmental and climate patterns began to change, the effectiveness of PPT began to decline in the face of sporadic, light rains and incessant dry spells. The complimenting fodder crops could no longer withstand the harsh conditions that accompanied these unfavorable variations. Further research led to the introduction of a new solution: Climate-Smart Push-Pull Technology (ADOPT). Developed in 2011, and introduced to smallholder farmers in 2012, Climate-Smart PPT substituted the previous fodder crops with drought tolerant species: Greenleaf desmodium (*Desmodium Intortum*) and Brachiaria grass (*Brachiaria cy mulato II*). Providing a defense against the unprecedented climactic changes, Climate-Smart PPT has gone further to address issues of gender equality and laborious farming requirements. Dissemination continues to grow in popularity as African farmers observe its multitude of benefits. Known as "the novel farming system for ending hunger and poverty in Sub-Saharan Africa," Conventional Push-Pull, and it's succeeding technology, continue to achieve this mission almost two decades later.

Role of Gender in Adoption of Climate Smart Push-Pull Technology in Western Kenya

ABSTRACT:

Push-Pull Technology (PPT) was a novel breakthrough in agricultural methodology that provided a strong defense against malnutrition and hunger issues, which saturated the area. Providing a higher yield, defense against Stem-borer insects, and resistance to Striga weed, PPT seemed to erase the multitude of problems, which were the burden of so many African farmers. As climate changed, rains grew brief and sporadic, and temperatures rose to scorching levels, crops were unable, even with such advancements, to withstand these new circumstances. These alterations in weather patterns created a pressing demand for new technology. Drought resistant plant varieties were necessary in order to insure a plentiful harvest, withstand the unnatural rains, and again, fight against invasive weeds and insects, which depleted harvests. After much research and testing, Climate-Smart PPT (ADOPT) was introduced with the goal to fight against these issues and create a labor saving, gender friendly replacement to its preexisting technology.

Thus, the role of gender in the adoption of Climate-Smart Push-Pull technology in Western Kenya became the topic of study. With the belief, and hope, that the adoption of Climate-Smart PPT provided both a drought tolerant substitute to the original PPT as well as a gender friendly and labor saving agricultural procedure, my work began.

The significance of such a study lies in the reality of African household dynamics. If household socioeconomic characteristics, gender roles, and degree of access and control are changing, then Climate-Smart PPT has been effective in providing not only a drought tolerant technology but an abundance of new opportunities especially for women to gain more control, access, education, and nutrition. It is nothing short of fact that women in Kenya are the force of labor in nearly all household and farm activities. Finding relief from their heavy burden is far from simple when both cultural and education-based obstacles stand in their way. By choosing this hypothesis we were able to not only assess the agricultural benefits of this new technology but also the positive repercussions that follow.

INTRODUCTION:

Martin Luther King Jr. once said, "The ultimate measure of a man is not where he stands in moments of comfort and convenience, but where he stands at times of challenge and controversy.

Africa, unfortunately, has been in a state of challenge and controversy for some time. Devastated by failed harvests, unending dry spells, life-threatening diseases, and more, those who call Africa home have been given no choice but to fight through trial after trial. Yet, through the devastation, Africa has remained strong in character and hope, constantly searching for a way out of poverty. For many who have adopted Climate Smart Push-Pull, the search for a life without such destitution has come to an end. Thanks to the genius of Professor Dr. Zeyaur Khan and contributing Push-Pull scientists, African farmers have finally found the transformative technology to propel them from a life of challenge and controversy to one of comfort and convenience

OBJECTIVES:

The overall objective of this study was to investigate the role of Gender in Adoption of Climate Smart Push-Pull Technology in Western Kenya. Specific objectives were:

1. To describe the household's socioeconomic characteristics in order to gain a full understanding of the push-pull farming families
2. To profile gender role and participation in field labor on Climate-Smart push-pull technology farms
3. To evaluate the degree of access and control of agricultural resources and benefits by either gender
4. To establish benefits derived from the overall adoption of Climate-Smart Push-Pull Technology

METHODOLOGY:

A detailed, yet brief questionnaire was designed - and tested prior to official conduction - which aimed to describe household socioeconomic characteristics, asses gender participation in PPT field labor, evaluate the degree of access and control of agricultural resources, and to establish the benefits derived from adoption of Climate-Smart PPT.

A total of 61 farmers were randomly selected in the districts of Bondo and Siaya. Farmers were chosen only if both the father and mother were still living and together. The exclusion of widows and female-headed household was to ensure a true evaluation of labor and control with a male presence. Interviewees were divided further by gender in order to expose the true evaluation of participation as seen from the perspective of the varying sexes. A total of 31 female farmers and 30 male farmers were administered the official questionnaire.

Each farmer was allotted approximately 30 minutes for his or her interview session. All interviews were conducted either in the homestead or in varying public settings (i.e. elementary school, marketplace, etc.) For further triangulation of questionnaire responses, two Focus Group Discussions (FGD) were conducted including a total of 30 farmers. Broken into districts of Bondo and Siaya, the group's contained and equal number of male and female respondents in order to reach a common answer from the amalgamation of varying responses.

The 61 questionnaires in full were entered into a statistical analysis program - Statistical Package for Social Sciences (SPSS). Following coding and entry, answers were deciphered to excavate the percentage of work, control, and benefiteres as they stood between the two genders.

RESULTS:

SOCIOECONOMIC RESULTS:

Interviewed farmers-51% female and 49% male- averaged an age of 47 years with a mean of 18 years of farming experience for males and 19 years for females. Male farmers remained superior in land ownership as reflected by respondents. Such superiority was also reflected in the male respondents' average acreage under cereal production where men possessed a mean of 3.3 acres over the females 2.3 acres.

Average education was heavy in the level of primary-15 (50%) for males and 20 (64.5%) for females- while men possessed twice as many of the college student rankings in comparison to women (4 males to 2 females). The lowest tier of education (the absence of education) fortunately only represented 1% of the total 61 interviewees. Collectively, the average household size was 7 persons.

TABLE 1: Breakdown of Socioeconomic Results

Variable		N	Mean (S.E)
Age of farmer (in years)		61	47.05(1.366)
Gender	% Male	30	49.1%
	% Female	31	51.6%
Household size		61	7.33(0.319)
Farming experience (in years)	Male	30	18.33(2.33)
	Female	31	19.16(1.93)
Farm size/Land Owned (in acres)	Male	30	3.31(0.32)
	Female	31	2.3(0.24)
Size Under Cereal Production (in acres)	Male	30	1.97(0.2)
	Female	31	1.47(0.16)
Education			
Gender	Level of Education	N	Percentage
Male	None	0 (0.0%)	
	Primary	15 (50%)	
	Secondary	11 (36.7%)	
	College	4 (13.3%)	
Female	None	1 (3.2%)	
	Primary	20 (64.5%)	
	Secondary	8 (25.8%)	
	College	2 (6.5%)	

FIELD LABOR RESULTS

Participation in field activities revealed a strong female presence with the exception of land preparation, purchase of inputs, cattle feeding, and milking. The data expressed a relatively equal participation amongst boy and girl children as well as a moderate presence of hired help on farm activities. Sporadically amongst interviewees, group participation was present in farm labor.

The largest variation between father and mother participation can be seen in planting, weeding, and marketing. Women took on, in total, an average of 85% of the labor for planting while the men represented only 55% of the force. For general weeding and the uprooting of Striga, women represented 90% of the labor to men's 62% and 90% to men's 60%. Marketing revealed extremely stark differences as women marketed 39% of cereals to men's 13%, 60% of fodder to men's 21% contribution, and 42% of milk to men's 18% marketing participation.

TABLE 2: Breakdown of Field Labor

Daily Farm Activities	Category of Participants in Field Activities					
	Father	Mother	Boy	Girl	Hired	Group
Land Preparation	74%	71%	23%	23%	32%	2%
Layout of PPT	60%	72%	8%	6%	8%	23%
Purchase of Inputs	63%	55%	0%	0%	1%	1%
Planting	55%	85%	8%	6%	21%	11%
General Weeding	62%	90%	9%	6%	21%	11%
Striga Uprooting	60%	90%	9%	8%	21%	6%
Manure Application	65%	82%	11%	9%	8%	8%
Harvesting of Cereals	65%	82%	18%	13%	14%	6%
Harvesting of Desmodium for fodder/sale	67%	70%	13%	8%	13%	3%
Harvesting of Brachiaria (Mulato) for fodder/sale	67%	65%	9%	4%	11%	3%
Marketing of Farm Produce						
A. Cereals	13%	39%	0%	0%	0%	0%
B. Fodder	21%	60%	0%	0%	0%	0%
C. Milk	18%	42%	0%	0%	0%	0%
Cattle Feeding						
A. Open Grazing	34%	8%	4%	0%	9%	0%
B. Paddock Feeding (Cut and Carry)	60%	42%	6%	0%	4%	0%
C. Stall Feeding (Cut and Carry)	62%	41%	6%	0%	4%	0%
Milking	59%	27%	9%	3%	6%	0%

**The table represents multiple responses. N=61.

CONSUMPTION OF MILK IN HOUSEHOLD

Consumption of milk in the household produced relatively uniform results. A majority of respondents expressed a preference towards children; this preference resulted in a 43% consumer rate of boys and girls from male respondents. Female respondent answers reflected a more selective and gender-biased outcome with boy children consuming 21% of milk and girl children falling short at 20%.

A large imbalance was observed in entire family consumption with male respondents reporting collective consumption 24.6% of the time while female respondents communicate this distribution 4.9% of the

TABLE 3: Consumption of Milk in the Household

Gender	Person Consuming Milk In Household				
	Father	Mother	Boy	Girl	Entire Family
Male (Respondent)	26%	25%	43%	43%	25%
Female (Respondent)	7%	12%	21%	20%	5%

MEANS OF HEARING ABOUT ADOPT

To grasp a general feel for the dissemination process farmers were asked how they *first* heard of ADOPT. 49.2% responded saying they first heard from early adopters, following was farmer groups with 16.4%. 14.8% said farmer groups were where they first heard of ADOPT and extension officers followed at 13.1%. NGO's occupied 4.9% followed by farmer teachers at 1.6%

TABLE 4: Means of Hearing About ADOPT

Means of Hearing	Frequency	Percent
Early Adopters	30	49.2
Extension Officers	8	13.1
NGO	3	4.9
Field Days	9	14.8
Farmer Teacher	1	1.6
Farmer Group	10	16.4
Total	61	100

DECISION ON MILK SALE

Decision on the sale of milk in the household nearly expressed a state of gender equality. Eight of the respondents from those who sold milk expressed full control by the father, a fraction of 13%. Six respondents placed the mother as the deciding figure on sale of milk representing 10% of whole. A joint decision making approach claimed the majority of respondents with 18 respondents aligning in this category, a total of 30%. Those remaining did not produce enough milk for sale or did not possess any form of milk in the household.

TABLE 5: Decision on Milk Sale

Deciding Figure	Frequency	Percent
Father	8	13.1
Mother	6	9.8
Jointly	18	29.5
N/A	29	47.5
Total	61	100

DECISION ON FODDER

When asked on the deciding figure for fodder sales, results aligned exactly with those of milk sale. Again, the father was given 13.1% of the deciding power while the mother remained with slightly less control at 9.8%. Trumping both was the joint decision making power at 29.5%, representing 18 respondents.

TABLE 6: Decision on Fodder Sale

Deciding Figure	Frequency	Percent
Father	8	13.1
Mother	6	9.8
Jointly	18	29.5
N/A	29	47.5
Total	61	100

DECISION ON CEREAL

The deciding figure on sale of cereals expressed a state of gender equality. Individually, both the mother and father were said to hold 12% of the decision making power. Sixteen respondents voiced a joint decision making process for the sale of cereal, this portion representing 26.2% of the total. Those respondents who did not sell cereals produced on their farm occupied the remaining 50.8%.

TABLE 7: Decision on Cereal Sale

Deciding Figure	Frequency	Percent
Father	7	12
Mother	7	12
Jointly	16	26
Do Not Sell Cereals	31	50
Total	61	100

CONTROL OVER INCOME FROM SALE OF FARM PRODUCE

CONTROL OVER INCOME FROM SALE OF MILK

From the 32 total respondents who were capable of selling milk from their farm production, 7 respondents put the power in the father representing 11.5% of the total. Women were given 13.1% of the control. The 8 respondents who claimed the women to have more control expressed the female figure possessing a greater knowledge of the adequate amount of milk needed to keep the children properly nourished. By giving her control over the income she was then able to purchase food sources that were lacking in the home. Joint control represented 27.9% of the total with 17 respondents sharing that the opinion of both the father and the mother were greatly taken into consideration before using the income acquired.

TABLE 8: Control of Income from the Sale of Milk

Controlling Figure	Frequency	Percent
Father	7	11.5
Mother	8	13.1
Jointly	17	27.9
Do Not Sell Milk	29	47.5
Total	61	100

CONTROL OVER INCOME FROM FODDER

When the 61 respondents were posed the question regarding control over income from fodder, a fairly centralized response was given. The control was nearly evenly divided between the four subcategories of father, mother, jointly, or non-sellers. The father possessed control over the income in 21.3% of the households or 13 of the total 61. The mother was shown to have control in 12 out of the 61 households or a total of 19.7%. A joint control was shown in 19 homes (31.3%) and 27.9% of homes did not sell the fodder produced from the plots.

TABLE 9: Control of Income from the Sale of Fodder

Controlling Figure	Frequency	Percent
Father	13	21.3
Mother	12	19.7
Jointly	19	31.1
Do Not Sell Fodder	17	27.9
Total	61	100

CONTROL OVER INCOME FROM CEREALS

Farmer responses to control over income from cereals displayed the father with 11.5% or 7 of the 61 total. Women were shown to have more control (13.1%). 24.6% of the data was occupied by a state of joint control over the income; this represented 15 of the 61 respondents. The remainder (50.8%) did not sell the cereals produced on the far.

TABLE 10: Control of Income from the Sale of Cereals

Controlling Figure	Frequency	Percent
Father	7	11.5
Mother	8	13.1
Jointly	15	24.6
Do Not Sell Cereals	31	50.8
Total	61	100

Person Benefitting from Sale of Milk:

In order to properly evaluate how the benefits of the Climate-Smart Push-Pull Plots affected the family, the question was posed to farmers regarding who benefits from the sale of the various farm produce. Milk, fodder, and cereals were evaluated. A relatively uniform response was observed as many respondents reported the entire family benefitting from the sales due to an overall increase in livelihood. Statistically, the father was said to have 27.9% of the benefits, the mother and children following with a percentage of 26.2%. Female respondents showed the mother benefitting most dramatically with a percentage of 24.6%, followed by children and the father with a percentage of 21.3%.

TABLE 11: Person Benefitting from the Sale of Milk

Gender	Person Benefitting from the Sale of Milk			
	Father	Mother	Boy	Girl
Male (Respondent)	27.90%	26.20%	26.20%	26.20%
Female (Respondent)	21.30%	24.60%	21.30%	21.30%

Person Benefitting from Sale of Fodder:

Male respondents, when ranking the benefiter from the sale of fodder, had the mother falling short of the father with 26.2% to the male's 27.9%. Following, only 24.6% of respondents expressed the boy and girl children to benefit from the sale. Female respondents communicated a uniform percentage for the father and children (39.3%). Mothers were said to benefit 44.3% of the time by the female interviewees.

TABLE 12: Person Benefitting from the Sale of Fodder

Gender	Person Benefitting From the Sale of Fodder			
	Father	Mother	Boy	Girl
Male (Respondent)	27.90%	26.20%	24.60%	24.60%
Female (Respondent)	39.30%	44.30%	39.30%	39.30%

Person Benefitting from Sale of Cereals:

A similar response was shown from the sale of cereals. Male respondents placed 23% of the benefits in the father's hands, 21.3% were assigned to the mother and 19.7% were said to represent the benefits received by both boys and girls. Female respondents showed the father to benefit 21.3% of the time, falling short the mothers 26.2%. Both boys and girls were said to share in the benefits 23% of the time, as communicated by the female respondents.

TABLE 13: Person Benefitting from the Sale of Cereals

Gender	Person Benefitting From the Sale of Cereals			
	Father	Mother	Boy	Girl
Male (Respondent)	23.00%	21.30%	19.70%	19.70%
Female (Respondent)	21.30%	26.20%	23.00%	23.00%

Decision on Land Use:

Land use and seed variety are undoubtedly vital parts of farm success. Traditionally the deciding figure of such choices lay solely in the hands of men to align with cultural norms. When the question was presented to the farmers, similar results were found. The father held control 36.1% of the time or 22 out of the 61 respondents. The mother only possessed control in 5 out of the 61 cases, a slim margin of 8.2%. Such imbalances were redeemed in the high percentage of joint decision-making, which represented 55.7% of respondent.

TABLE 14: Decision on Land Use

Decision Maker	Frequency	Percent
Father	22	36.1
Mother	5	8.2
Jointly	34	55.7
Total	61	100

Decision on Seed Variety:

The decision regarding seed variety showed similar results with the father solely deciding 32.8% of the time. The mother was seen to be the sole decision maker 11.5% of the time, as frequently as 7 in a total sum of 61. Joint decision-making was as frequent as 34 times out of the 61, occupying 55.7% of the total.

TABLE 15: Decision on Seed Variety

Decision Maker	Frequency	Percent
Father	20	32.8
Mother	7	11.5

Jointly	34	55.7
Total	61	100

NUTRITION STATUS AFTER ADOPT

Farmers were asked how they would compare the nutrition status of the family after adopting Climate-Smart PPT. With the goal of alleviating poverty, this question enabled a direct link to such evaluation. Improvement nearly swept the entirety of responses, seeing as 60 out of 61 farmers demanded a clear improvement. This response was 98.4% of the total. The single respondent who did not observe an improvement in nutrition status lacked a source of milk and had only recently adopting Climate-Smart PPT. This respondent accounted for 1.6% of the whole.

TABLE 16: Nutrition Status of Household after ADOPT

Response	Frequency	Percent
Yes (Improved)	60	98.4
No (Did Not Improve)	1	1.6
Total	61	100

Use of Income (School Fees):

Due to a previously perceived gender bias in Kenyan society, it was necessary to evaluate how Climate-Smart Push-Pull has affected the education opportunities of both boy and girl children. Female respondents communicated an absence of bias regarding who receives funding when income is available. Male respondents showed a slight preference, expressing boy children to receive the funds 37.7% of the time to girl children's 34.4%. The remaining percentages were occupied by varying other household needs such as using the income to buy inputs, build shelter, establish business, purchase clothing, utensils, etc.

TABLE 17: Use of Income on School Fees

Gender	Use of Income on School Fees	
	Boys	Girls
Male (Respondent)	37.70%	34.40%
Female (Respondent)	27.90%	27.90%

DISCUSSION:

A Need for Change

For generations, land has been passed down in African families from father to son. Despite the joint effort by family members on the farm, men traditionally hold control over land, resources, income, and decision-making power. Such circumstances continually limit the rights and resources of many smallholder women farmers. Such limitations, however, extend beyond the frame of farming.

A multitude of structural imbalances feed into this lack of inequality. Most present is the inequities with education. While there is a state of gender equality in primary education,

secondary and post-secondary are levels where gender balance is still prevalence (Girls'). Access to these opportunities is limited, and funds favor male education.

As times are changing so too is the need for the empowerment of women. Women are becoming the driving force behind a great deal of technological disseminations. As issues like HIV/AIDS continue to change household dynamics and alter the status of control, women are taking on an abundance of extra responsibilities often due to orphaned children being welcomed into the home. With these changes comes the emergence of an era in which women are seen as the primary provider in the home. Agricultural extension, health care, and a variety of other services have become yet another job of rural African women.

Fairly evident is the pressing need to empower women of Africa in order to find success, well-being, and food stability amongst the homesteads of rural, smallholder farmers. Such a need has led to a goal of gender equity in disseminations, control, and opportunity in order to ensure and build a foundation for a gender friendly front in Africa.

Labor and control relation

Push-Pull technology transformed the lives of farmers across Kenya and Sub-Saharan Africa. Credited for providing an adequate yield to nearly 90,000 farmers to date, its adopters are finding life outside of poverty. As climate change began to lessen the benefits of the original PPT, Climate-Smart PPT quickly provided an adjusted system able to withstand the sporadic rains and dry spells. Beyond its ability to withstand the unprecedented climate change, Climate-Smart PPT addressed issues of gender equality, access to agricultural resources, and control of both income and land. To understand and quantify the effectiveness of the technology, it was necessary to evaluate labor in comparison to control of income, access to resources, and role in decision-making. If one performs the labor but fails to have control over the results of the work (i.e. money from sale, improved nutrition, power to make decisions) the effectiveness is essentially nonexistent in relation to breaking down gender barriers. In a place where gender roles are deeply rooted in the cultural practices, which reign supreme to new ideals, breaking down this barrier is a daunting task.

Upon administration, farmers were asked to carefully evaluate who carries out the labor on the farm. By doing so, a clear division of work amongst family members was provided. Analysis showed a female dominated front in relation to nearly all areas of farm work. There was, however, a male presence in most activities. Children were seen sporadically along with hired labor and efforts from farming groups. Yet, despite contributions from other family members, it was certain that the mother was doing nearly everything.

While the mother was undoubtedly providing most of the labor, percentages reflected an emerging state of equality. Rather than devastatingly large disparities between male and female participation, the difference usually averaged around 15-25%. Nearly all farmers expressed a joint effort by the majority of the family in the various farm activities. While the figures do not express true equality, they do show an emergence of shared labor.

A majority of participants showed a joint decision making front within the household. An interesting point, brought up in the Bondo focus group discussion, provided a new perspective on control of milk sale. When asked who holds greater control over the quantity of milk being marketed, nearly all participants said the mother. While this answer was seen now and again

in interviews, to see a group of opinionated farmers agree on a female having nearly full control was a new viewpoint. When asked to elaborate, they explained that the mother has a greater knowledge of what is needed for proper nutrition in the household. To ask the father to decide this would be out of his understanding. In order to ensure a properly nourished family, the mother was to make the decision even if it included a choice to not sell. The sale of cereals included a similar system. Because the mother knew the amount of cereals the family would need, she shared a large portion of the decision making power. Fodder was usually left in the father's hands, as he dealt mainly with the livestock.

Control over income was the area where gender roles were most prevalent. While individual interviews showed a large majority to have 'joint control,' when the question was raised in the farmer group discussions, control was undoubtedly male dominated. Bondo even ranked control of fodder to be 85% to the father and 15% to the mother; milk was not much better with 80% to the father and 20% to the mother. Such percentages raise the question as to whether the household could find further improvement in nutrition and livelihood if the mother-who respondents claimed to possess greater knowledge on such topics-was given control.

The question of decision on land use showed, again, a large portion to be 'joint decision making.' To clarify the answers, this question was presented to the farmer groups. In Bondo, the father was given 90% of the deciding power to the mother's 10%. Siaya showed a slightly more equal state of control with the father receiving 60% control to the mothers 30%.

Such percentages bring up a curious case of labor verses control. While it appears that the mother is left doing all of the work with no reward, this is far from the case. Farmers in individual interviews were asked whether they have realized the labor saving benefits of ADOPT. Such benefits included reduced labor on preparation for the second season, reduced weeding and Striga hand pulling, and reduced time looking for fodder. Not a single farmer failed to notice these labor saving benefits. While control of income and decision making power may still remain in the father's hands, ADOPT has tremendously cut back on the amount of farm labor needed to run a successful production. This reduction has allowed women to gain ample amounts of time for various other activities including, but not limited to, attending farmer meetings, preparing adequate meals for the family, or even simply having time for the rest they so desperately need. Alleviating this labor is the first step to a gender friendly agricultural system. For young, married farmers, such a reduction could allot more time to receiving an adequate education, thus opening the door to hundreds of other opportunities that would increase livelihood.

Furthermore, the percentages of joint control are not to be overlooked. Seeing as such issues of income and power are culturally reserved for the male, to see a consideration for the opinion of mother's in farming households show immense progress in gender equality.

Overall health and nutrition

Health and nutrition are basic human rights; yet, so many children and families have been denied such necessities. Food security has grown to be a concern of far too many farmers in Africa. To reach a state of adequate nutrition means so much more than simply shipping food to various parts of the world that fail to make ends meet. To truly offer nutrition means offering a means of self-sufficiency. ADOPT has done just that for all the farmers interviewed in

the districts of Bondo and Siaya. Only one farmer out of the 61 interviewed communicated that there was no increase in nutrition observed. The remainder of the farmers was eager to explain that the health status of their family has improved tremendously.

By finding an effective method of increasing yield, ADOPT provided an abundance of other positive repercussions. Such positive results have included an increase in income and a substantial reduction of labor on the farm. Both of these benefits have allowed families to receive proper nutrition even in times of unfavorable climactic conditions and much more.

The increase in income allowed for mothers to provide basic medications for their families or an opportunity to purchase various other food sources, which contained nutrients that the children were lacking. Many purchased milk if their livestock failed to produce enough, and reduced labor allowed for the children to also find more time for school work and rest. ADOPT has improved the overall health and nutritional status of practicing farmers as well as providing an opportunity to raise a healthy, successful family outside of poverty.

An inspiring success story was that of Rose Anguncha Bala of Siaya. A 52-year-old mother of 6, Rose adopted Climate Smart PPT in 2012 and instantly saw her life begin to change. With an increase in yield, a rewarding income from marketing, and healthy livestock from fodder availability, Rose was rewarded with a dairy cow from HEIPHER International. Her cow now produces around 16 liters daily, which almost quadruples the production of her native breed. Rose expressed extreme gratitude when revealing that her exact 2-acre plot went from producing 4kg of corn to 100kg after adopting. More remarkable, Rose has been able to fund a water hole on her homestead-which she paid 30,000 shillings to install. Her increase in livelihood has allowed her to take in two orphans whom she nourishes, cares for daily, and provides an education.

An Outlet for Education

During times of financial instability, families tend to show preference to funding the education of male children (Leonard). With such limitations working against girls, gaining secondary and post-secondary education has become a very real challenge. However, with improved income from the planting and marketing of ADOPT field produce; many families have lessened the likelihood of gender discrimination in the classroom. Beyond, if unable or unsuccessful in marketing, a majority of schools will accept maize or milk in exchange for school payments. In this way ADOPT has not only provided a way out of poverty, but the technology has offered an outlet to gaining a higher education for both sexes.

More than just an Agricultural Technology

The beauty of ADOPT lies far beyond the obvious agricultural success that it brings. What is so phenomenal is the sense of life-long learning that it promotes and provides for all adopting farmers, particularly women. It not only inspires women to work for food security, but also fosters a desire for knowledge.

The majority of extension work is carried out with a goal of providing a thorough understanding to adopting farmers along with a high level of peer education. With this goal in mind, dissemination leads to the empowerment of women fairly directly. Once women gain access to this knowledge through extension work, they provide a vital service to fellow farmers. For some farmers, their increase in knowledge has given

their husbands a greater respect for their wives and the work they do, often leading to a greater amount of control and decision-making power to be held by the women.

What's more is the psychological benefit it provides for adopting female farmers. By providing women with purpose- such as to spread the practice of Push-Pull farming- automatically instilled is a newfound morale and self-esteem. Females begin to recognize their worth to the homestead, village, community, and friends, which in turn creates a beautiful improvement in overall confidence.

This confidence encourages hard work, which has led to a great deal of exposure for a multitude of adopting female farmers. Several have found themselves in leadership positions within the community or farming group due to their abundance of knowledge and experience on creating a household that is food secure. It is effects like these that prove ADOPT's ability to promote a gender friendly livelihood amongst African farmers.

CONCLUSION:

The effects of Climate Smart Push-Pull technology can be quite easily observed through the improved livelihood of African smallholder farmers. From issues of low production to access to education, ADOPT has allowed practicing farmers to cover a large spectrum of pressing issues in everyday life.

Beyond the issues of Stemborer insects and invasive Striga weeds, ADOPT has aimed, and succeeded, at providing a gender friendly, and climate smart agricultural technology. Through unprecedented times of climactic changes, depleted harvests, and lack of resources, ADOPT has provided a solution to even the heaviest of problems.

While gender biased attitudes are inevitably still present, the improved income from surplus of farm produce has provided an opportunity to allow gender equity. In fact, even in households that do not sell, farm produce can and has been exchanged for school fees in order to allow both boy and girl children to attend school.

With 100% of respondents communicating a noticeable reduction of labor, ADOPT has provided relief from the heavy burden of African farmers. Beyond, this reduction has particularly provided women with a lighter burden and an increase in time for community and farming group activities. With the aim of targeting women in dissemination and encouraging a thorough understanding of farming practices, women are gaining a sense of self-purpose and respect from the community, their husbands, family, etc. This respect has gone further to allow a state of joint control and decision making on most homesteads.

Without reservation, this transformative technology is the answer to the most restrictive of problems in Sub-Saharan Africa; however, to continue to disseminate takes the work of the masses. It is not enough for 61 farmers to share in the benefits independently; it is instead necessary, and an issue of justice, to continue to spread this technology. Each family deserves adequate nutrition; each family deserves a state of gender equality; each family deserves a life outside of poverty, and for that very reason, each family deserves the chance to adopt Climate Smart Push-Pull Technology.

RECOMMENDATIONS:

In order to continue the alleviation of poverty amongst smallholder African farmers, it is more than necessary to continue dissemination through outlets including farmer groups, field days, extension workers, etc. As expressed by respondents, a possible continuation of dissemination could include providing seeds of desmodium in order to allow already adopting farmers to extend plots. Such extension would allow more success to the family, which, in turn, results into increased production with ultimate surplus for market sales.

It is also invaluable to continue the promotion of women's leadership amongst communities by fostering a sense of purpose through increased knowledge and practice of farming techniques such as push-pull. Only through such work can advancement towards a place of gender equality continue to be reached.

REFERENCES:

"Girls' Education and Gender Equality." *UNICEF*. 1 Jan. 2004. Web.

Leonard Munyao, Wambua. "Gender Issues Affecting the Girl Child in Kenya." *International Journal of Humanities and Social Science* 3.4 (2013). Print.

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PERSONAL EXPERIENCE:

“Take it to the farmer.”

Before any other, Norman Borlaug knew what the world needed to put an end to the malnutrition and poverty that had become so rampant. Until his last breath he fought for the rights of farmers, to aid them in this fight to feed our growing population amidst the struggles of unprecedented climate change and stark inequality. As Norman ended his time on the field, he passed his legacy on to us: the innovators, the believers, and the thinkers of today. He believed in us, the next generation, the youth, to finish this race that he so valiantly began. So here we are, running and searching unceasingly for a solution to our world’s hunger, always with Norman’s dream close to heart: “Take it to the farmer.”

Last June I was a very sheltered mid-west girl who had seen nothing of poverty, inequality, or suffering. Last June I was afraid of bugs (big and small), hated going to the basement alone (laugh all you want, yes I know I’m 19), and couldn’t imagine thinking about waking up to anything other than my mother’s voice. Last June, on a Friday in Iowa, I boarded a plane to spend two months in rural Kenya, alone. I now thank God that I did.

My goal was to arrive in Kenya an open book, I wanted to be marked and changed, molded and scarred by the beauty and turmoil that I would encounter while abroad. With this in mind I opened myself to every opportunity I encountered, leading me often to hours of conversation with the workers at *icipe* centered around the same question, “Tell me about your life,” and with each anecdote I fell more in love with the culture and wholesome nature that each man woman and child expressed to my naïve soul.

This love grew deeper as my work escalated. Morning came and I was routinely awakened by daily ferry rides across Lake Victoria as the sunrise poured crimson glows across the water. My Swahili lessons took place in the most exotic of classrooms as I attempted to pick up words and phrases throughout my interviews with humble farmers. I walked across the fields that provided their livelihoods, met the children who called Kenya home, and tasted the food that their soil grew. As the weeks passed the culture and life of this place began to seep within me, surging through my veins and opening my eyes to a new perspective, one of simplicity, hope, and humility.

The lifestyle was contagious to me; one where work followed passion and life exuded only joy. But the beauty to me was beyond the obvious and easily missed: it was the sincerity in their voices when I was stopped to ask how I was, it was the generosity of their hearts as they offered me tea and bread, and it was the pure beauty of their tethered hands and worn eyes that marked a life well lived, and a plot well tended.

Perhaps one of the most prominent pieces of my internship was the time I spent teaching math at the Mbita Point International School. Being as unequipped as I was to teach in a foreign country, the students met me with such respect and love that I was beyond overwhelmed. Daily I had to open the door to my classroom and quickly jump aside as the students eagerly sprinted to their seats. As I presented the class with questions each and every hand shot to the air begging for me to choose them. I had never in my life seen such a passion for knowledge as I did amongst that class. It was raw passion and inspiration, not a passive thought, but a constant pursuit. It was beautiful.

The memories continued as I pieced together my research and took on new experiences. I was able to spend time in town simply absorbing the daily life, having Matilda show me native dishes and fabrics along the way. I was even presented with the opportunity to interview Mama Sarah Obama, a push-pull farmer who lives in close proximity to where I was working. Spending the afternoon on her porch speaking of African life, equality of man, and the

beauty of community, I saw the true humanitarian nature of even the most successful of farmers.

Yet, as it all came to a close, I was struck by the reality that I could not stay here forever, and as painful as parting was, I left Kenya with two months of life-changing memories. I will forever be grateful for both the kindness and guidance of all those who I now have the honor of calling my friends. Touched as I was by both the poverty and turmoil of Africa, I left even more inspired by the strength and happiness that was so pervasive there. It is my sincerest hope to return to Kenya some day but I never could have imagined how hard it would be to say goodbye.

On my last night in Kenya I wrote in my journal the following words in reflection of those I had the blessing of meeting:

They believed in perspective, in tomorrow, and in themselves. They lived each moment because they knew the fragility of life. They understood the little things, they fought for the important things, and they dwelled not on the horrible things.

It is those words that I hold close to my heart as I continue on 8,000 miles from the people who touched my life so intimately. With a new perspective and a rejuvenated spirit I know truly believe that the pressing concerns of today are not to be tackled by a particular person but rather by all, working together, setting aside our differences, and believing each begging hand and crippled child can be fed, nourished, and released from the bonds of poverty and injustice. We all have a role to play and no time to waste. And with that reality I believe we all are carrying on the legacy of Dr. Norman Borlaug, the man who set us all on this crazy journey to feed our world.

Perhaps now, with confidence, we can say, *“Rest assured Dr. Borlaug, we are taking it to the farmer.”*



The role of gender in adoption of climate smart push-pull technology in Western Kenya

The specific objectives of the study: 1) to describe the households' socioeconomic characteristics 2) to assess the gender role and participation in smart PPT field labor (activity profile) 3) to evaluate the degree of access and control of PPT agricultural resources and smart PPT benefits by either gender 4) to establish benefits derived from adoption of climate smart PPT

SECTION A: Farmer Details

- Name of the Farmer: _____ Cell phone (if available) _____
 Village _____ County _____ Sub County (District) _____
 Gender of respondent: [] Male__ / [] Female__ Age: _____ (age should be of the actual PPT farmer)
 Who is the head of this household? _____
 Gender of household head [] Male [] Female
 Do you have any form of disability? [] Yes [] No
 If yes, does it hamper your ability to adopt the climate smart push-pull technology? [] Yes [] No
 Education: None____ Primary _____ Secondary _____ College _____
 Household size _____
 1) How many years have you been a farmer? _____
 2) What is the size of land you own? _____
 3) What size of land is under cereal production? _____
 4) When did you start planting Climate smart push-pull? _____
 5) Who made the major decision to adopt climate smart Push-pull?
 Father [] Mother [] Jointly []
 6) How did you first hear about ADOPT?
 1. Early Adopters 2. Extension Officers 3. NGO
 4. Field Days 5. Any other source (Specify)_____

SECTION B: Objective 2: to assess the gender role and participation in smart PPT (activity profile)

7) Who carries the following activities? (tick as necessary)

Activities	Father	Mother	Boys	Girls	Hired
Land Preparation					
Layout of PPT plot					
Purchase of inputs					
Planting					
Weeding					
Striga Uprooting					
Manure application					
Harvesting of cereal					
Harvesting of Desmodium for					

fodder/sale					
Harvesting of Brachiaria Mulato for fodder/sale					
Marketing of farm produce					
a. Cereals	[]	[]	[]	[]	[]
b. Fodder	[]	[]	[]	[]	[]
c. Milk	[]	[]	[]	[]	[]
Cattles feeding					
a. Open grazing	[]	[]	[]	[]	[]
b. Paddock feeding (Cut-and-carry)	[]	[]	[]	[]	[]
c. Stall feeding (Cut-and-carry)	[]	[]	[]	[]	[]
Milking					

8) What is the state of your farm production after ADOPT?

Farm product	Improved	Reduced	No change
a. Milk			
b. Fodder			
c. Cereals			

9) Do you produce enough cereal and milk for household's consumption? [] Yes [] No

10) If yes, do you sell your surplus produce?

If yes, who benefits from the sale?

- a. Milk [] Yes [] No Father [] Mother [] Boy [] Girl []
- b. Cereals [] Yes [] No Father [] Mother [] Boy [] Girl []
- c. Fodder [] Yes [] No Father [] Mother [] Boy [] Girl []

11) Who consumes on the milk retained for household consumption?

Father [] Mother [] Boy [] Girl [] Jointly []

SECTION C: Objective 3: To evaluate the degree of access and control of PPT agricultural resources and smart PPT benefits by either gender

12) Who makes the major decision of when and how much milk to sale?

Father [] Mother [] Jointly []

13) If you sell milk, how much do you sell and retain for household consumption on a daily basis?

- a. Actual production in household _____
- b. Actual sale in liters _____
- c. Actual amount retained in liters _____

14) Who makes the major decision of when and how much farm produce to sell?

Farm product	Father	Mother
a. Milk		
b. Fodder –Mulato, desmodium and stovers		
c. Cereals		
d. Desmodium seeds		

15) Who has control over income from sale of your farm produce?

Farm product	Father	Mother
a. Milk		
b. Fodder –Mulato, desmodium and stovers		
c. Cereals		
d. Desmodium seeds		

16) Who makes the major decisions on land use?

Father Mother Jointly

17) Who makes the major decisions on seed variety used in production?

Father Mother Jointly

SECTION c: Objective 4: To establish benefits derived from adoption of climate smart PPT

18) What were the main reasons for adopting climate smart push-pull? (*Rank in order of importance*)

Striga infestation Stemborer infestation Poor soil fertility Low cereal production

Poor fodder production Drought/Low rainfall

19) Did you realize any of the following labor saving benefits after planting ADOPT?

a. Reduced number of weeding on ADOPT fields Yes No

b. Reduced striga hand pulling on ADOPT fields Yes No

c. Reduced time looking for fodder for your cattle Yes No

d. Reduced labor on land preparation from second season Yes No

e. Any other benefit (Specify): _____

20) Have you increased the number of your livestock because of fodder availability from ADOPT?

Yes ___ No ___

21) Do you think that your households' nutrition status has improved after ADOPT? Yes No

22) Do you think that your income has improved after ADOPT? Yes No

23) Generally, what is the income used for?

- a. Boys' school Fees []
- b. Girls' school Fees []
- c. Shelter/build house []
- d. Establish business []
- e. Buy inputs []
- f. Any other (specify) _____

24) How do you rate overall effectiveness of ADOPT in solving your farming constraints?

- a. Effective _____
- b. Not effective: _____

25) Do you have any other suggestions, comments or observations about climate smart ADOPT?

OFFICIAL FARMER GROUP QUESTIONNAIRE:

1) Who carries out the following activities?

Activities	Father	Mother	Boys	Girls	Hired
Land Preparation					
Layout of PPT plot					
Purchase of inputs					
Planting					
Weeding					
Striga Uprooting					
Manure application					
Harvesting of cereal					
Harvesting of Desmodium for fodder/sale					
Harvesting of Brachiaria Mulato for fodder/sale					
Marketing of farm produce					
d. Cereals	[]	[]	[]	[]	[]
e. Fodder	[]	[]	[]	[]	[]
f. Milk	[]	[]	[]	[]	[]
Cattles feeding					
d. Open grazing	[]	[]	[]	[]	[]
e. Paddock feeding (Cut-and-carry)	[]	[]	[]	[]	[]
f. Stall feeding (Cut-and-carry)	[]	[]	[]	[]	[]
Milking					

2) Who makes the major decision of when and how much farm produce to sell?

Farm product	Father	Mother
e. Milk		
f. Fodder –Mulato, desmodium and stovers		
g. Cereals		

h. Desmodium seeds		
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3) Who has control over income from sale of your farm produce?

Farm product	Father	Mother
e. Milk		
f. Fodder –Mulato, desmodium and stovers		
g. Cereals		
h. Desmodium seeds		

4) Who makes the major decisions on land use?

Father [] Mother [] Jointly []

5) What were the main reasons for adopting Climate Smart Push-Pull?

Striga Infestation []

Stemborer []

Poor Soil Fertility []

Low Cereal Production []

Poor Fodder Production []

Drought/Low Rainfall []