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THE INFLUENCE OF GENDER SPECIFIC DECISIONS ON HOUSEHOLD TECHNOLOGY CHOICE WITHIN THE FARMING HOUSEHOLDS IN CENTRAL UGANDA

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ABSTRACT

How households make decisions, who influences decision making and how members bargain over resources and opportunities greatly affects the livelihood and wellbeing of members within a given household. This study sought to understand gender specific decisions and their influence on household technology choice, packaging and adoption of agricultural technologies. Growing Bananas with Trees and Livestock (GBTL) technology system was implemented by National Agricultural Research Organisation and Bioversity International in three districts of Central Uganda: Kiboga, Nakaseke and Ssembabule. Using Principal Component Analysis (PCA) and Cluster Analysis (CA), typologies were created in which two distinct clusters of farming households were revealed. Using a bargaining model of technology adoption, three types of households were identified; male and female only, female only and male only headed households. For technology uptake, either a single component, two components or all components of a technology was adopted. Results indicated that Household size, age, land owned, labour and gender composition of the household positively influenced the adoption of the technology. Farm households were able to take up and adopt components of the technology that were equivalent to the available household resources. Technology choice and adoption was influenced by available land, labor and household objectives (food, income and nutrition security). Households' ability to avert the loss of production and/or assets was very varied and depended on household size. For non-business home expenses, decisions followed a gendered perspective where households with both male and female, had more participants involved in household decision making, households make decision jointly when it comes to purchases and sales. Banana plantations establishment and management was for the spouse. Livestock production was initiated and managed by the household heads. Individual decisions were influenced by age of the household head, livestock owner. Joint household's decision making was significant on purchases, sales of inputs and outputs, land ownership, and were influenced by household size and farm size. This study brings out important policy implications that in order to ensure widespread adoption of improved technologies, there should be equitable access to complementary inputs, especially land and labour for females. And technology packaging should take into consideration the gender specific decisions for sustainable agricultural development.

Key words: Decision making, Technology choice, adoption, Coffee banana farming system, Gender

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INTRODUCTION

Households are comprised of individuals who do not share the same goals, they pool resources and share them for a common good. Decision-making is mediated by power and reflects gendered social norms about what people can do and the claims they can make on resources helps in understanding household dynamics. How households make decisions, who influences decision making and how members bargain over resources and opportunities greatly affects the livelihood and wellbeing of members within a given household [1].

Agricultural production and productivity can be increased through adoption and diffusion of modern agricultural technologies as one of the key pathways for agricultural transformation and economic growth in developing countries. While several African countries including Uganda, have substantial resources devoted to agricultural technology development, aggregate technology choice and adoption remains low [2]. Several factors influence technology adoption in Africa including credit constraints, transaction costs and other market imperfections and lead to reduced rates of technology adoption.

Agricultural Technology Adoption

There are many theories that have been used in research about technology adoption, for instance, the technology acceptance model (TAM), theory of planned behaviour (TPB), unified theory of acceptance and use of technology (UTAUT) and the framework [3]. There are statistical approaches used in investigating the use of new agricultural technology, some adoption studies employ bivariate analysis at household level, measuring adoption at a point in time, whereas some diffusion studies model the cumulative adoption rate at the aggregate level. Ruttan and Thirtle [4] discussed the dichotomy between diffusion as a process and adoption due to individual heterogeneity as an artificial one, in that the diffusion curve is simply the aggregate of the individual adoption decisions.

There are a number of theoretical models explaining the time to adoption, based on learning, information acquisition, prior beliefs of the profitability of the innovation, these provide the basis for empirical work. Much of the empirical work which has been undertaken has focused on the economic potential and risk associated with alternative technologies, the characteristics of the farmer (representing human capital assets), and farm assets (which link to factor costs, capital costs and risk aversion). However, other factors are potentially relevant, particularly in the context of a study of sustainable agricultural technologies.

Motives for economic behaviour are not only for profit maximization, complex, and benefit third party, but may be political, religious, for personal consumption and ownership. Studies have provided evidence that attitudes are indeed important in

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the choice of agricultural practices, with regard to conservation/sustainable technology [5]. Lampkin and Padel [6] reviewed the evidence on the motivations of organic farmers and identified the most common factors among organic producers as concerns about their family's health, husbandry (such as soil degradation and animal welfare), lifestyle choice (ideological, philosophical, religious) and financial considerations.

However, care is required when interpreting results on attitudes and motivation because without relying on recall results, it is difficult to discern whether attitudes expressed at the time of results collection were held at the time of adoption (and so may have been a significant factor in the choice of technology) or whether they have evolved over time (and so are irrelevant to the adoption decision). The differences in attitudes or beliefs of many farmers involved in 'alternative' farming systems such as organic farming is likely to be related to the farmer and farm characteristics noted above as featuring in much empirical work. Although there have been variations in the precise findings regarding these differences in demographic profile [7], implying that farmers, (i) were motivated significantly by non-economic factors in converting to organic production, and (ii) had different characteristics in terms of demographics, economic situation and attitudes. Information is also viewed as a critical factor in the adoption process, particularly in terms of awareness and evaluation of alternative technologies. Low-input systems have been described as 'information intensive' and the availability of information is particularly important for a 'knowledge-based' innovation such as organic farming [8].

Decision-making and farmer perceptions

A broad category of outcome measures is related to processes, rather than final outcomes and include who makes key decisions within the household, individuals' perceptions about gender roles and social norms. The question of who makes the decisions within the household is occasionally used as an outcome variable because it captures the aspect of women's bargaining power. It is assumed that women who have more bargaining power are more involved in decision making. For example, Allendorf [9] used a measure of women's empowerment, proxied by questions on who makes the decision on health care and household expenditures. Connelly *et al.* [10] used questions about who usually makes decisions in the family about events such as children's education, family planning, large purchases, investments, and the women's own migration.

It is challenging to make sure that the decision-making questions capture the key issues that of interest. It may be the case that women make the decisions, but within the constraints provided by husbands. For example, women without their own income may be given a budget for food and household expenses. They control how to spend it but are responsible for using it to provide meals. Thus, the

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cultural context is important to consider, and caution should be used when interpreting these results across countries. This study builds on the previous studies that have classified coffee-banana farms in Uganda by incorporating social, economic and livestock variables to understand gender specific decisions and their influence on household technology choice and adoption in central Uganda.

MATERIALS AND METHODS

Study area

This study was conducted in three districts of central Uganda namely, Kiboga, Ssembabule and Nakaseke. The common feature among the three districts is that they are naturally divided into two geographical areas that respectively support pastoral and crop farming and located in what is known as the Masaka-Mbarara cattle corridor. The farm sizes in these areas have declined, the area under annual cropping has increased, grazing lands have been converted to agriculture and production has become increasingly market oriented. Soil fertility, particularly for poor-resource households, has been declining due to more continuous cropping, smaller farms and off-farm crop sales resulting in nutrient mining.

Sampling

Participants in the study were from sites where the Growing of Bananas, Trees and Livestock Technology (GBTL) was implemented. A total of 247 respondents were interviewed across the three sites. Typically, in banana-growing regions, some households have a few goats which are tethered each day by roadsides or fallowed fields. The GBTL technology aims to increase on-farm manure production for bananas with a technology within reach of more resource-poor farm households. Goats are zero-grazed in a raised floor shelter facilitating manure collection, shrub legumes planted on field borders or contours are plucked every day. Farm households learn both to calculate total fodder intake based on goat size and performance to balance the protein-rich legumes with energy foods like banana skins, sweet potato vines and other pruned vegetation. Resources for technology implementation and expansion, including seed, building materials for the raised floor structure, fodder and crop by-products are widely available within the rural community.

The interviews were conducted using a pre-tested and semi-structured questionnaire among primary and secondary beneficiaries. Over the project life, primary farm households in the villages tested the technology and secondary beneficiaries learned about the technology from primary households. Data were collected by trained research assistants. The respondents had benefited directly or indirectly from project inputs such as fodder shrub planting material, goats and kids

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produced from the goats given as well as training sessions for two years to fine-tune and adapt technologies by household.

Primary data were collected on variables such as labour, land, education, household composition, livestock, crop resources, tree resources, access to information, access to extension services, education level of the spouses and absolute income. Data collected were entered in Statistical Package for the Social Sciences (SPSS), after which analysis was done using R to generate clusters and statistical analysis done in Stata.

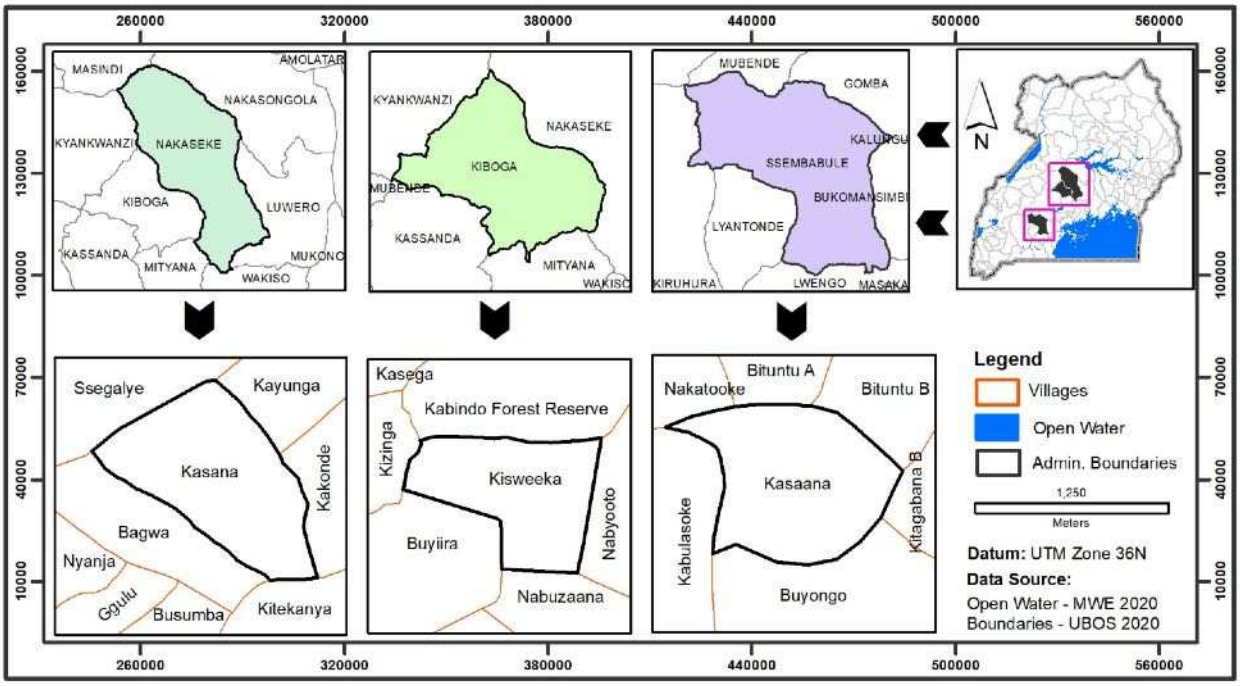

Figure 1: Map showing the study area (Kiboga, Nakaseke and Sembabule)

The role of husbands and wives in farm technology choice

Except for the rare couple that shares common preferences and equal access to resources and information, the distribution of decision-making authority between spouses can be expected to affect the allocation of household resources. Scholars seeking to understand these intra-household dynamics have generated a rich literature on the broader measures, determinants, and household consequences of spousal bargaining power and decision-making [11]. These household dynamics are important for resource allocation in many contexts, and certainly in low resource, high risk, and relatively isolated environments with strong gender norms, such as arise in many rural parts of the developing world.

From the 1980s, the concept of Gender and women position in the household has moved from purely education and socio-economic levels to explicitly including access to control over production resources and empowerment which is to have

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the rights, capacity and assets to be able to make choices. Intra-household bargaining power is a form of empowerment, where decision-making authority is used as an indicator [12] and intra-household bargaining and decision-making processes [11]. In households where the spouse holds decision-making authority, this may be influenced by women being highly educated. In households where the women are active in the labour market, the spouse has a higher self-perception of decision-making authority. However this authority may not be matched with the husband's perception on the contrary. In the urban settings market access increases women's household authority in decision making [13].

INTRA-HOUSEHOLD BARGAINING AND DECISION-MAKING AUTHORITY

Until the 1960's, the individual and the households were considered synonymous. With the advent of the "new home economics," unitary household models were developed to look at labour allocation, fertility and marriage [14]. Individuals are recognized in these models but are assumed to maximize a single household utility function. During the 1980's household bargaining models in which individuals had separate utility functions were developed. Bargaining models have been applied to examine demand, marriage, fertility, divorce and labour supply [15]. Of particular interest are applications in the developing countries where the role of women in agriculture is widely recognized. Most development objectives focus on the well-being of individuals. Policies are targeted to increase the percentage of individuals who avoid poverty, who can read, who are free from hunger and illness, or who can find gainful employment. Individual welfare, however, is based in large part on a complex set of interactions among family members. Until recently, most policy analyses implicitly viewed the household as having only one set of preferences. This assumption has been a powerful tool for understanding household behaviour, such as the distribution of tasks and goods. But a growing body of evidence suggests that this view is an experience that comes at considerable and possibly avoidable cost.

The relationship between intra-household decision-making authority, resource allocations, and positive outcomes for women and children has been observed in many different cultural and economic contexts. In India, for example, increased women's authority relative to their husbands' is associated with increased use of modern contraception and to declines in infant and child mortality. Similar reproductive, maternal, neo-natal, and child health outcomes have been observed in Latin America, Africa (Egypt, Mali) and in Southeast Asia [16]. Increasing women's bargaining power is associated with increased expenditure, shares on key household goods such as health and education leading to improved child outcomes for example in Iran [17].

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Given such evidence of the potential benefits of greater women's intra household power, a growing body of empirical work in development economics has sought to identify predictors of women's bargaining power in the household. Historically, the simplest models of household decision- making that we relied upon were a unitary household model. Such models effectively assumed that household members pooled resources (household income and/or that husband and wife preferences were treated as homogeneous (or, alternatively, that only the husband's preferences were relevant determinants of household resource allocations). However available studies suggest that husbands' and wives' relative intra-household decision-making authority is highly relevant to resource allocation, implying that most households do not fully pool income and in many cases spousal preferences are not homogeneous [18].

Theoretical insights offered by various co-operative and non-co-operative bargaining models offer alternative characterizations of intra-household decision making processes that may better reflect actual patterns of decision making than a unitary household model. Co-operative models indicate that household bargaining outcomes are negotiated directly between spouses and that outcomes rely on each spouse's relative ability to claim power and to threaten defection from a less than desired negotiation outcome by invoking an outside option, such as the threat of spousal sanctions through divorce or non-cooperation within marriage [19]. Non cooperative models assume independent actions on the part of both spouses leading to a self-enforcing Nash equilibrium, which may or may not be Pareto efficient. The key difference in cooperative and non-cooperative models is the stability of the bargaining outcome. Cooperative models are presumed stable in the absence of any changes to the spouses' relative bargaining power, while non cooperative equilibria may shift as new information about the spouse's position and strength becomes available. Results consistent with non-cooperative bargaining models have now been observed across a range of developing country contexts, emphasizing the potential for shifts in women's decision-making authority leading to shifts in welfare, other outcomes for women and entire households [20].

Research has focused on finding valid measures of decision-making authority in addition to measuring outcomes of women's bargaining power [21]. Most models consider women's property, financial assets, and engagement in the labor market to be key determinants of women's authority over household decisions. Other factors such as age, education, and social and political assets, spousal communication, trust and spousal contributions to the household, and institutionally determined gender norms and ideology have also been examined. Some of these factors are predicted to affect the bargaining process while others may affect relative power via provisioning women with outside (exit). Recently, household

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composition for example presence of children has also been hypothesized to shape women's decision-making roles and arguably also their exit options [22].

Though we have learned a great deal from this literature, asset-based models of intra-household decision making leave open several unanswered questions, often driven by data constraints. First, studies are usually limited to a single or few household decisions. But real-life households engage in countless decisions, and simple asset based models of spousal negotiating power cannot explain situations where the allocation of decision making authority within a single household varies depending upon what decision is at stake. For example, the presence of a spouse's parents in a household may strengthen wives' bargaining power in the Philippines, but the effects are different for daily household decisions versus core household financial decisions. Such findings suggest that previous studies predicting spousal decision making authority across a single decision may have missed meaningful variation in spousal authority across different decisions [19].

Most studies on intra household decision making looked at only one spouse's report of relative power. Ignoring the disagreement that husbands or wives may encounter with the other spouse's assessment of household decision making power. This lack of information on gender specific decisions on household technology choice may be an especially serious weakness of past studies since household outcomes ultimately depend on the behavior of two (or more) individuals who may agree or disagree on any specific course of action. Disagreement over decision making power may particularly affect women, and if the preponderance of survey respondents are male heads of households, then gaps in our understanding of women's true power may be particularly acute. Husbands have reported that decision making within the household is shared, but when spouses are asked if this is true, the wives have strongly disagreed [19]. Understanding gaps in women perceived versus actual decision making authority may help explain some adoption paradoxes in programs targeting women. For example, Miller and Mubarak [23] in their study, discovered that women who bear disproportionate cooking costs have stronger preferences for healthier stoves but lack the authority to make purchases. If women are not empowered to make independent choices about household resource use, then it may not be possible to exploit gender differences in preferences in order to promote technology adoption [19].

The available evidence suggests that discrepancies between husband and wife reports of household matters may be large for example husbands and wives differ widely in assessments of the woman's level of mobility, her access to economic resources, and her decision-making power [19]. Ghuman *et al.* [24] analyzed similar survey data from India, Pakistan, Thailand, the Philippines, and Malaysia and concluded that men and women not only differ in their assessments of

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women's decision making authority, but in some cases even have different understandings of the questions, differentiating between "having final say" and "having input" in very different ways. Bradshaw [25] found out that men and women in Nicaragua differ significantly in their estimates of women's household labor contributions, particularly in rural areas where men dramatically under-value women's income generating activities relative to women's own self reports.

Intra household discord, or husband-wife discrepancies in self-reported authority over household decisions, has two potential implications. First, from a household resource perspective, discordant couples may suffer from inefficiencies in individual and household resource use if both spouses assume, they have decision making power and preferences differ, efforts could be either duplicative (both spouses do the same work) or decision related activities may be neglected (if each spouse perceives the other as responsible). Second, the presence of intra household discord may have important policy implications; namely, for a given decision, if husbands and wives both claim power, or both defer power, the results of interviewing one or the other spouse about household decision making processes (important, among other things, for targeting development interventions) may lead to erroneous conclusions. If the biases present in the results of surveys that only interview one spouse are random, little is to be gained from worrying about discord. If the biases are not random, then it helps concentrating efforts on learning how to better target efforts on gender specific decisions and their influence on household technology choice.

A Conventional Technology Adoption Model

The general economic framework of the single decision maker adoption model is built on the work of Domencich and McFadden [26] for random utility formulation. The ith individual is assumed to maximize the expected utility of the present value of the profit of the jth technology, where profit, π, is defined as

$$\pi_j = P_y' f(X, T_j, \mu) - P_x' X \qquad (3.1)$$

With P_y and P_x being vectors of output and input prices; X, a vector of inputs that depends upon the jth technology, T, chosen; and $f()$ the production function, which is dependent upon the inputs chosen, the technology and the given attributes, μ, of the farm and its operator. Solution of the profit maximizing problem yields an indirect profit function $\mu_j(p_y, p_x, \mu)$. Assuming ε is an unobserved component of the profit function, the profit of the jth technology for the decision maker is denoted by $\pi_{ij} = \pi_i(P_{yi}, P_{xi}, \mu_i) + \varepsilon_{ij}$ (3.2)

The ith individual chooses the jth technology when expected utility of the present value of profit of the jth technology exceeds that of alternative technologies $k =$

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$1, \ldots, m-1$. Thus, the probability of the ith individual adopting the jth technology, $P_{ij,}$ can be expressed as follows:

$$P\_ij = P[E(\pi\_ij) \geq E\ \llbracket(\pi\rrbracket\ \_ij); k = 1,2, \ldots, m] = \{\varepsilon\_ik - \varepsilon\_ij \leq E\{\pi\_j\ (P\_yi, P\_xi, \mu\_i)\ ] - E\{\pi\_k\ (P\_yi, P\_xi, \mu\_i)\ ] \quad (3.3)$$

Where P is the probability, and E is the discounted expected utility operator, if the ε_{ij} are independently and identically distributed with a Weibull density function, then McFadden [27] has shown that one can express the probability that the ith individual will choose the jth technology with a standard logit model:

$$P_{ij} = \frac{\exp\pi_j(P_{yi}, P_{xi}, \mu_i)}{\sum_{k=1}^{m} \exp\pi_k(P_{yi}, P_{xi}, \mu_i)} \quad (3.4)$$

A bargaining model of technology adoption

In a bargaining framework, the household is still regarded as the unit of production. However, it is not assumed that individuals are in total agreement about resource or time allocation. Individuals in a household allocate resources within their control to maximize their own utility. Households can be modeled as a non-cooperative or cooperative game. As a non-cooperative game, individuals are unable to make binding contracts because they are not enforceable [28]. They choose their strategies independently though not necessarily simultaneously. A strategy that maximizes one person's payoff given the strategy of the other is called best reply strategy. An equilibrium point is defined when a mutual best reply strategy is reached though solutions may not be unique, and may be dynamic, the Cournot-Nash equilibrium, a static non cooperative game with a unique solution, is most frequently used to model household decisions. For simplicity, these models assume non cooperative behavior otherwise.

Failing a judgment of Solomon in which the couples are permitted to divide their farm operations into two independent enterprises, technology choice among two people requires cooperation, as only a single technology choice is generally impossible. Representing technology choice as a cooperative game implies that the couple communicates an essential condition to make binding contracts. Cooperative games are Pareto optimal and provide an internal distribution which depends on the bargaining power of the family members [29]. The outcome of the conflict is the point which is an element of the payoff space or feasible set. It is assumed that there is at least one feasible payoff vector that can be reached through cooperative behavior that is a better outcome for each player than disagreement, since the player who would lose more in a disagreement can be used as a threat to bargain with. This threat point or fallback position is often defined as the options outside the game for example separation or divorce [30].

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Two fall back positions are defined below. The first involves selling the farm and splitting the proceeds. Define the selling price as V, and the proportion received by the female as γ, exogenously determined. Then the fall back earnings of the wife are $\pi_f = P_f W_f + \gamma V$ and those of the husband are $\pi_m = P_m W_m + (1-\gamma)V$. Defining the indirect expected Utility of profit by ϕ, the fallback position of each spouse can be defined as $\phi(P_{i,} V, \gamma)$, where $I = m, f$.

Alternatively, one spouse would keep the farm, transferring some proportion of the profits to the other. For the sake of argument, assume that the husband keeps the farm and the wife receives a transfer related to the earnings of the farm, M. thus the fall back earnings of the wife are $\pi_f = P_f W_f + \gamma M(.)$. The fallback position of the husband is the solution to

$$\begin{aligned} &\max E(\pi_m) = E[P_m W_m + (1-\gamma) M_j(X, T_{j,} F_m)] \\ &s.t\, M_j = P_y' f_j(X, T_{j,} F_{m;} \mu) - P_x' X \\ &\Omega_{mj} = W_m + F_{m.} \end{aligned} \tag{3.5}$$

The solution of the fallback position of the husband can be defined as $\phi_m(P_{y,} P_{x,} \mu, P_{m,} \gamma)$, and that of the wife as $\phi_f(P_{y,} P_{x,} \mu, P_{f,} F_{m,} \gamma)$ .The Nash Bargaining model is characterized by the solution to

$$\begin{aligned} &\max N \{E^f[\pi_j(T_{j,} X, F_m F_f W_m W_f)] - \phi_f(.)\} \\ &\{E^f[\pi_j(T_{j,} X, F_m F_f W_m W_f)] - \phi_f(.)\} \\ &s.t\, \pi_j = P_y' f_j(X, T_{j,} F_{m;} F_{j;} \mu) - P_x' X - B + P_m' W_m + P_f' W_f \\ &\Omega_{mj} = W_m + F_{m.} \\ &\Omega_{fj} = W_f + F_{f.} \end{aligned} \tag{3.6}$$

The individual profit function for the case in which the farm is sold is $\pi_j(P_{y,} P_{x,} \mu, P_{f,} P_{m,} B, V, \gamma)$ and for the case in which some portions of the earnings are transferred is $\pi_j(P_{y,} P_{x,} \mu, P_{f,} P_{m,} B, \gamma)$. The comparative statistics are obviously different in the two cases. As an alternative formulation, Kooreman *et al.* [31] developed a cooperative bargaining model for labour supply with exogenous bargaining power. Their model can be adapted to the technology adoption decision. The cooperative solution lies on the contract curve defined by $\max(1-\delta)E^m(\pi_j) + \delta E^f(\pi_j)$ subject to the constraints in equation (5) where δ is an exogenous bargaining weight. Thus, the probability of the ith farm adopting the jth technology is:

$$\begin{aligned} P_{ij} &= (1-\delta) P[E^m(\pi_j) > E^m(\pi_k)] + \delta P[E^f(\pi_j) > E^f(\pi_k) \\ &= \frac{\exp \pi_j(P_{yi}, P_{xi}, \mu_i, P_{fi,} P_{mi,} B_i, \delta_i)}{\sum_{k=1}^{m} \exp \pi_k(P_{yi}, P_{xi}, \mu_i, P_{fi,} P_{mi,} B_i \delta_i)} \end{aligned} \tag{3.7}$$

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If $\gamma = \delta$, that is, if the proportion of income transferred equals the bargaining weight, this yields the same reduced form specification for technology choice as model (3.5) in which the fallback position involves transfer of a portion of farm income.

RESULTS AND DISCUSSION

Technologies adopted

This study aimed at understanding gender specific decisions and their influence on household technology choice, which in return influenced packaging of agricultural technologies and their adoption. This was achieved through an agricultural intensification technology on growing banana with trees and livestock (GBTL) project which was implemented in the Districts of Nakaseke, Kiboga and Sembabule, central Uganda. Results indicate that 168 households were both male and female headed, 44 were female headed and 35 were male headed. The farming households were able to take up either a single component, two technology or all the components of the technology.

Loevinsohn *et al.* [32] look at adoption as the integration of a new technology into existing practice and is usually proceeded by a period of 'trying' and some degree of adaptation. Tambo *et al.* [33] analysed the differential impacts of conservation agriculture technology options on household income in sub-Saharan Africa. In order to realise the full benefits of conservation Agriculture (CA), farmers were encouraged to adopt the complete package of minimum soil disturbance, residue retention and crop rotation. However, implementation of the full package was found challenging in resource-poor and smallholder environments, hence, partial adoption was very common [34]. Thus, farmers may adopt a single practice or a combination of two practices or the full package. This implies that the part of the technology chosen may be attributed to available land, labor and household objectives including food security.

Among the respondents, 50% adopted only the banana and livestock component, 23.8% the whole package Banana, trees and Livestock (GBTL) and 26.19% only banana component. This may be attributed to households having freely growing trees (shrubs) and what was missing was quality bananas and livestock which are quite expensive. Households choice of bananas and livestock was influenced by the need for quality and improved seed. For the GBTL project high yielding banana varieties and fast-growing goats were introduced therefore the households only adopted part of the technology that was suitable for them. The package adopted addresed the food security component for the bananas and income security component for bananas and goats (Toggenburgs and Saneness breeds). The low adoption rates for the other packages is mainly attributed to the

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complementarity and men's involvement in activities within the households to support women through food, income and nutrition security. Amongst the households with males only, 49% adopted only the banana and livestock component, 31% the whole package (Banana, trees and Livestock- BTL) and 30% only banana component. Overall, 49.8% of the respondents adopted banana and livestock component, 20% banana livestock and trees and 26% adopted banana only. An agricultural technology component chosen and adopted is highly attributed to land, labor availability, and household objectives (food, income and nutrition security). Even so, previous studies have taken into consideration total farm size and not crop acreage on which the new technology is practiced [35]. Similarly, Ouma *et al.* [36] indicated that cost of hired labor was one of the factors constraining fertilizer and hybrid seed use and adoption in Embu county, Kenya. The larger the household size, the higher the probability of adopting a new technology. Selection of an agricultural technology that enhances sustainable production of food and fiber is a step in the right direction towards sustainable food security and economic development [32].

Results indicate that the sampled households were of three categories: those that were both male and female headed, male headed only and female headed households only (Table 2). The average household size was about five people per household except in male-only headed households where the average number was four. These results agree with Sauerborn *et al.* [37] who found that households' ability to avert the loss of production and/or assets was very varied and depended on household size, composition, assets type, duration of illness and on clustering of crises in rural households in Burkina Faso. Ghale *et al.* [38] concludes, that food security and the right to food impact women and men differently. For the spouse (female), mainly in the rural households their main objective is to attend to household food demands, achieving livelihood and food security.

Results indicate that the average age of household head was about 45 years although among households with male heads only, the male household heads were about 50 years old compared to female - headed at 44 years old. Female headed households were much younger but , implying that the majority of these households belonged to widows and single mothers. This implies that Age is associated with wealth hence higher empowerment [39]. The majority of the female households were widows having retained part of the household assets after the death of their spouses hence responsible for all household decision making without waiting for another person's consent.

Land ownership was found on average to be two hectares per household although female headed households had less access to land, and on average one hectare.

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Male and female headed households had more land, the possibility being that the household head acquired land from his parents. However, though the household has more land, decisions on access and land use may be greatly influenced by the household head. Razavi [40] in his study looks at liberalisation policies *vis-à-vis* land, land markets as a vehicle for women's inclusion, and employment generation as an effective strategy for both poverty eradication and gender equality. Results revealed that there were still troubling implications from a gender perspective in the current endorsement of 'customary' systems of land tenure and decentralisation of land management. About 70% of the overall sampled farmers reared goats. However, in the individual categories, the highest percentage of households rearing goats were only male headed households (77%) followed by male and female headed households (69%) and female headed households (66%). Household heads (men) interest is in livestock (rearing goats) for household income and status. This may be due to the fact that men are more involved in cash generating activities. This is mainly for taking care of all household cash need and when the livestock is sold this gives them an advantage through higher income [39]. In the promotion of the technologies, farmers were expected to grow fodder trees which were provided to the farmer experimentation group yet only 25 % of them were growing fodder for the goats. However, there were more male headed households (31%) growing fodder for the goats than the males and female headed households (Table 2). Naturally the male alone households are for widowers who are relatively old and less energetic. Hence fodder trees were being planted close to the homesteads for ease of access and being able to feed the goats.

Results on decision making among households by technology adopted (Table 3), categorized household decision making within the household in three clusters: 1) male alone, 2) female alone and 3) both male and female. Technology adoption was categorized in three where households were only engaged in (Banana and Livestock), (BTL) and (Banana only). Results indicate that for Non-business home expenses the highest decisions for Banana and Livestock, Banana, Livestock and trees (BTL), and Banana only were made by households with both Male and Female at 43%, 37% and 48%, respectively. For Livestock sales and purchases the highest decisions for Banana and Livestock, Banana, Livestock and trees (BTL), and Banana only were made by households with female (46%) and by Male and female households at 38% and 48%, respectively. Female headed households had the highest proportion of Livestock sales and purchase decisions in banana and livestock technology implying that these households make decisions jointly when it comes to purchases and sales. Household decision making and technology choice was greatly influenced by gender in the banana and livestock technology. Households crop production decisions were influenced by both the household head and the spouse. The households with both male and female had

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the highest numbers of dependants, hence a high level of decision-making including crop sales. This may be attributed to the fact that men are normally involved in enterprises that generate cash giving them an advantage through higher income [39]. For Crop production, the highest decisions for Banana and Livestock, Banana, Livestock and trees (BTL), and Banana only were made by households with males and females at 43%, 49% and 52%, respectively. This concurs with Meijer *et al.* [41] who found that in Malawi, decisions about crops to grow, inputs to use and rearing livestock, were commonly made jointly by a husband and wife. For crop produce sales, the highest decisions for Banana and Livestock, Banana, Livestock, and trees (BTL) and Banana only were made by households that had both male and female at 48%, 41% and 51%, respectively.

Results on level of joint decision making among households (Figure 1) indicate that 64% of the household's decisions were made jointly (for example the household head and spouse) compared to only 36% non-joint decisions. The highest proportion of joint decision making was with Banana only technology, followed by Banana and livestock and lastly with BTL with 66%, 64% and 60%, respectively. On average for all the technology of the GBTL technology, 46% of the decisions were jointly made and only 36% had no influence on the household head or spouse. Osanya *et al.* [42] in Kenya found that husbands made most decisions concerning agriculture, while wives mainly decided on daily household expenditure. The highest percentage of joint decision making was with Banana only component, followed by Banana and Livestock. Households tend to have objectives beginning with food security, followed by income and finally nutrition. These decisions tend to be influenced by land availability and labour. For insistence, Thangata *et al.* [43], found that improved fallows were highly adopted in households with sufficient land and labor in Malawi.

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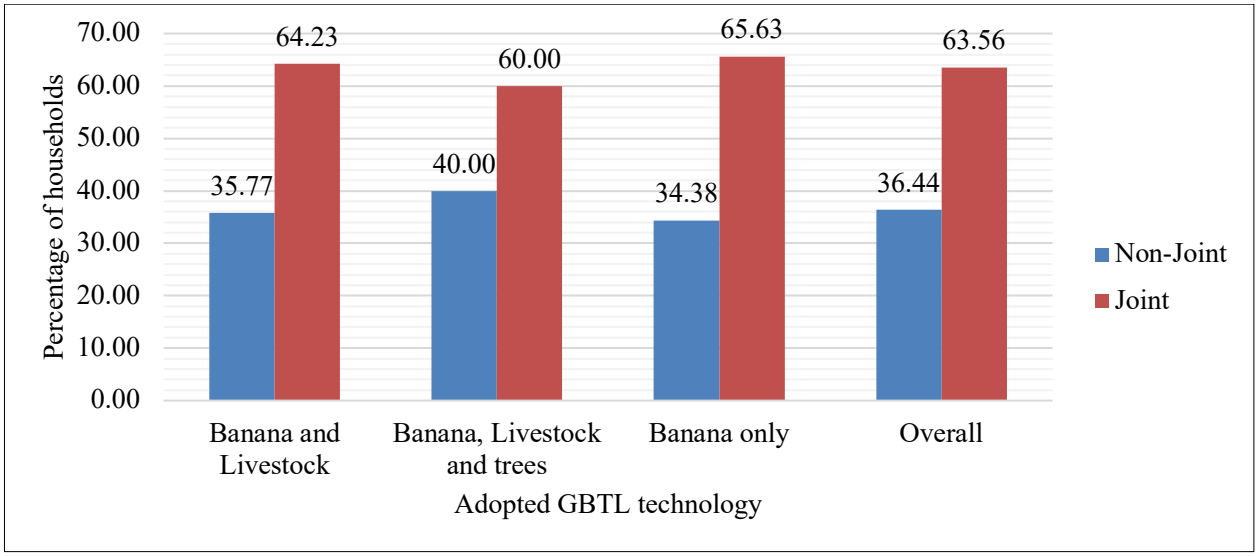

Figure1: Level of decision making among households in Naseke, Kiboga and Sembabule Districts, Central Uganda

Source: Household survey data: Kiboga, Nakaseke and Sembabule

Results on model of technology adoption (Table 4) indicates that in a combined model for technology adoption, land ownership was highly significant as a base outcome. This indicates that for banana and livestock component to be adopted land availability is very critical. For banana component only, household size was significant and critical implying that labor availability was an influencing factor in decisions regarding establishment and management of the banana crop. Results further indicate that for the BTL component, household size had a positive coefficient and was significant at 5 %. When individual decision-making was modeled against joint decision making, three components of the technology were explored with respect to household decision making including: BTL, banana and Livestock, individual decisions were being influenced by livestock ownership. Results indicated that female headed households were more interested in banana plantations establishment and management. This was mainly attributed to the spouses being in charge of household food production. Livestock production was initiated and managed by the household heads. Men and women introduce innovations and benefit from them differently. 'Traditionally' households defined gendered divisions of labour as a key factor that shapes the characteristics of innovations that farmers adopt. Women are more likely to be engaged in subsistence farming, while men are more likely to be involved with cash crops [44]. This explains the higher uptake rate for food crop-related changes for women, while more men prefer cash crop-related changes, as highlighted in a range of case studies in innovation and extension literature [20]. It was realized that if livestock was not owned by the family then household decisions were skewed.

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Joint decisions making within the household was greatly influenced by household size, implying that the more members there were in the household, the better since consultations were made within the household members before making decisions.

For bananas, trees and livestock technology, joint decision making was influenced by household size. Decision making on type of labour used by the household for the banana, trees and livestock technology, individual decisions were influenced by age of the household head, whereas joint household decisions were greatly influenced by land ownership in hectares. Controlling for household, plot-level, institutional and other factors, the study found that household adoption decisions on inorganic fertilizer and improved maize were influenced by farmer characteristics, plot-level factors and market imperfections such as limited access to credit, input markets and production risks. This implied that family's deployment of household labour depended on the technologies being implemented by the household and their importance [45].

Results indicate that when individual decision-making verses joint decision making (Table 5) are modeled, the 3 combinations of the technologies were explored with respect to household decision making including Banana, trees and livestock the following. Results indicated that for banana and Livestock component individual decisions were positively influenced by being a livestock owner and was significant at 5% implying that livestock is owned by individuals within the household. Hence if livestock is not owned by the family, they do not have productive assets. Livestock also serves as a fall back asset when crops fail, and source of pride in communities. For banana production and with the declining soil fertility, farmers look at livestock as a source of manure to provide necessary nutrients for their banana plantations. Results indicate that joint decisions in the household were positively influenced by household size and significant at 5%. This implies that the more members in the household the more the decisions are made since there will be consultations before decisions are made hence more labour for technology implementation. Households with access to farm support, especially labour are more likely to participate in adopting new technologies. This is consistent with results of a study by Martey *et al.* [46] on Drought tolerant Maize (DTM) in Ghana where adoption was primarily driven by access to seed, extension service, labor availability and location of farm households. Joint decisions on the BTL technology, livestock owner decision making was influenced by household size [47]. Bonabana- Wabbi [48] analyzed household size as a measure of labor availability and determined adoption process. They found that a larger household had the capacity to relax the labor constraints required during introduction of new technology. Results indicate that the bananas, trees and livestock component, livestock ownership was negatively significant at 5% and influenced by household

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size. This implies that the smaller the size of the household the better the decision making. Decision making on type of labour used by the household, the banana, trees and livestock component for individual decisions were positively influenced by age of the household head and significant at 5%. Decision making on type of labour used by the household for the GBTL, individual decisions were influenced by age of the household head. Age is a determinant of new technology adoption. Older farmers tend to have acquired skills, knowledge and experience over time and can ably evaluate a new technology than younger farmers [49]. Joint household decisions were positively influenced by land ownership (Ha) and significant at 5%. This implies that land size is important in technology adoption for joint decisions. Farm size plays a big role in the choice and adoption of a new technology, for example, farm size can affect and in turn be affected by the other factors influencing adoption [50]. Some technologies are scale-dependent due to the importance of farm size in their adoption. Farmers with large farm sizes are likely to adopt a new technology as they can afford to devote part of their land to try new technologies unlike those with small farm size [51]. In addition, lumpy technologies such as mechanized equipment or animal traction require economies of size to ensure profitability.

CONCLUSION, AND RECOMMENDATIONS FOR DEVELOPMENT

This study aimed at understanding gender specific decisions and their influence on household technology choice, which is critical and can greatly influence packaging of agricultural technologies and their adoption. Results indicated that farming households were able to take up either a single component, two components or all the components of the GBTL technologies. Hence, households could adopt a part of the technology that is suitable for food security more especially for women and income security for men. Technology choice and adoption was attributed to available land, labor and household objectives (food, income and nutrition security). An agricultural technology, such as the GBTL, that enhances sustainable production of food and fiber was critical for sustainable food security and economic development. Households' ability to avert the loss of production and/or assets was very varied and depended on household size. For non-business home expenses, decisions followed a gendered perspective where households with both male and female, had more participants involved in household decision making, households made decisions jointly when it came to purchases and sales. The study revealed that the majority of the household decisions were jointly made by the household heads and their spouses. Households had varying objectives for food, income and nutrition security. Technology adoption was influenced by , land ownership, land availability, and labor which were key in decisions regarding the adoption of the GBTL technology. Within the households, technology adoption was gendered

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where banana plantations establishment and management were initiated and implemented by the spouse with the objective of food security and Livestock production was initiated and managed by the household heads with the objective of income generation hence choices were made to benefit their livelihood objectives. Joint decision making was influenced by household size, labour, Farm size and individual decisions by age of the household head. When individual decision-making against joint decision making were modeled, individual decisions were influenced by being a livestock lone owner and Joint decisions were influenced by household size. Household size as a measure of labor availability, influenced the choice and adoption processes of a technology. Joint decisions were influenced by Land ownership in hectares. Male, Female, Male and female headed households make choices on agricultural technologies adoption differently and at different rates. This study brings out important policy implications. in order to ensure widespread adoption of improved technologies, there should be equitable access to complementary inputs, especially land and labour for females.In this study a bargaining model was used, for all the sites but site differences using the same model were not taken into consideration. The strengths and weaknesses of the model under different operational environments and its implication on gender was not tested. It is recommended that in further studies this should be taken into consideration.

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Table 1: Technology adopted by household type in Nakaseke, Kiboga and Sembabule districts, central Uganda

Technology adopted by farmer	Percentage of farmers by household head			
	Male and female (n=168)	Female only (n=44)	Male only (n=35)	Overall (n=247)
Banana and Livestock	50	50	48.57	49.8
Banana, Trees and Livestock (BTL)	23.8	20.45	31	24.29
Banana only	26.19	29.55	20	25.9

Source: Source: Household survey data (Kiboga, Nakaseke and Sembabule

Table 2: Characteristics of sampled households by household type in Nakaseke, Kiboga and Sembabule districts, Central Uganda

Variable Respondents		Male and female (n=168)	Female only (n=44)	Male only (n=35)	Overall (n=247)
Household size	Mean	4.92	4.66	4.31	4.79
	SD	1.89	1.89	1.95	1.91
Age of household head(years)	Mean	43.69	43.98	49.94	44.63
	SD	14.55	14.14	15.37	14.7
Land owned (ha)	Mean	1.83	1.14	1.52	1.66
	SD	1.6	1.08	1.66	1.54
Farmer rears goats	(%)	69.05	65.91	77.14	69.64
Farmer grows fodder trees	(%)	24.4	20.45	31.43	24.7

Source: Source: Household survey data (Kiboga, Nakaseke and Sembabule

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Table 3: Decision making among households by technology adopted in Nakaseke, Kiboga and Sembabule districts, Central Uganda

Who decides on	Decision maker	Percentage of households			
		Banana and Livestock	Banana, Livestock, and trees (BTL)	Banana only	Overall
Non-business home expenses	Male	30	30	27	29
	Female	27	33	25	28
	Male and female	43	37	48	43
Livestock sales and purchases	Male	22	27	22	23
	Female	46	35	30	39
	Male and Female	32	38	48	38
Crop production	Male	25	23	22	24
	Female	32	28	27	30
	Male and Female	43	49	52	47
crop produce sales	Male	23	29	16	23
	Female	28	31	33	30
	Male and Female	48	41	51	47

Source: Source: Household survey data (Kiboga, Nakaseke and Sembabule)

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Table 4: Multinomial Logit (MNL)model of technology adoption (Combined) in Nakaseke, Kiboga and Sembabule districts, Central Uganda

Banana_and_Livestock (Base outcome) Variable	Coef.	Std.err	z	P>z
Banana, Trees and Livestock_(BTL)				
Joint Decision making	-0.229	0.381	-0.6	0.548
Age	-0.001	0.001	-1.15	0.249
Livestock lone owner	0.604	0.396	1.53	0.127
Wife controls access to land	-0.149	0.52	-0.29	0.775
Distance to the market	0.063	0.116	0.54	0.588
FSC_2015	-0.003	0.005	-0.54	0.592
Off farm income	0.001	0.005	0.2	0.84
Household size	-0.029	0.091	-0.32	0.748
Type of Labour				
Both family and hired	0.025	0.337	0.07	0.942
Age of household head	0.104	0.068	1.53	0.127
Land ownership (Ha)	0.243	0.106	2.29	0.022
Constant	-4.277	1.709	-2.5	0.012
Bananas only				
Joint Decision making	-0.008	0.376	-0.02	0.983
Age	0	0.001	-0.3	0.76
Livestock lone owner	-0.26	0.347	-0.75	0.453
Wife controls access to land	-0.265	0.503	-0.53	0.599
Distance to the market	-0.164	0.151	-1.08	0.279
FSC_2015	-0.002	0.005	-0.48	0.633
Off farm income	0.001	0.004	0.27	0.791
Household size	-0.203	0.089	-2.28	0.023
Type of Labour				
Both family and hired	-0.275	0.326	-0.84	0.399
Age of household head	0.008	0.056	0.14	0.892
Land ownership (Ha)	-0.089	0.133	-0.66	0.507
Constant	0.9	1.309	0.69	0.492
Banana, trees and Livestock combination				
Joint Decision making	0.008	0.375581	0.02	0.983
Age	0	0.000584	0.3	0.76
Livestock lone owner	0.26	0.346899	0.75	0.453
Wife controls access to land	0.265	0.50348	0.53	0.599
Distance to the market	0.164	0.151477	1.08	0.279
FSC_2015	0.002	0.004798	0.48	0.633
Off farm income	-0.001	0.004464	-0.27	0.791
Household size	0.203	0.088941	2.28	0.023
Type of Labour				
Both family and hired	0.275408	0.326394	0.84	0.399
Age of household head	-0.00754	0.055504	-0.14	0.892
Land ownership (Ha)	0.089	0.133398	0.66	0.507
Constant	-0.9	1.309245	-0.69	0.492

Source: Household survey data (Kiboga, Nakaseke and Sembabule)

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Table 5: Model results for technology adoption in Nakaseke, Kiboga and Sembabule districts, Central Uganda

	Individual decision making				Joint decision making			
Technology	**Coef.**	**Std. Err.**	**z**	**P>z**	**Coef.**	**Std.er r**	**z**	**P>z**
Banana, and Livestock								
Age	-0.001	0.001	-0.610	0.543	0.000	0.001	0.380	0.702
Livestock lone owner	1.482	0.668	2.220	0.027	-0.167	0.429	-0.390	0.697
Wife controls access to land	-0.240	0.632	-0.380	0.704	0.940	1.169	0.800	0.421
Distance to the market	7.191	586.670	0.010	0.990	0.014	0.176	0.080	0.937
FSC_2015	-0.006	0.009	-0.720	0.471	0.007	0.006	1.170	0.241
Off farm income	0.008	0.008	1.010	0.311	-0.007	0.006	-1.180	0.238
Household size	0.143	0.176	0.810	0.415	0.215	0.109	1.970	0.049
Type of Labour								
Both family and hired	0.132	0.588	0.220	0.822	0.149	0.412	0.360	0.717
Age of household head	0.080	0.122	0.650	0.516	-0.011	0.067	-0.160	0.871
Land ownership (Ha)	0.092	0.256	0.360	0.718	0.078	0.163	0.480	0.631
Constant	-3.113	2.888	-1.080	0.281	-0.610	1.469	-0.420	0.678
Banana, trees and Livestock (BTL)								
Age	-0.002	0.002	-1.460	0.143	0.000	0.001	-0.170	0.862
Livestock lone owner	1.479	0.808	1.830	0.067	0.686	0.561	1.220	0.222
Wife controls access to land	-0.232	0.754	-0.310	0.759	0.624	1.478	0.420	0.673
Distance to the market	7.164	586.670	0.010	0.990	0.157	0.198	0.800	0.426
FSC_2015	0.000	0.010	0.050	0.963	-0.002	0.008	-0.320	0.751
Off farm income	0.008	0.009	0.890	0.375	-0.003	0.007	-0.400	0.688
Household size	-0.064	0.209	-0.300	0.760	0.260	0.131	1.980	0.048
Type of Labour								
Both family and hired	0.189	0.703	0.270	0.788	0.158	0.499	0.320	0.751
Age of household head	0.286	0.161	1.770	0.076	0.050	0.092	0.550	0.585
Land ownership (Ha)	0.255	0.246	1.040	0.299	0.363	0.177	2.050	0.040
Constant	-9.658	4.110	-2.350	0.019	-4.358	2.110	-2.070	0.039
Banana only (baseoutcome)								

Source: Household survey data (Kiboga, Nakaseke and Sembabule)

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ISSN 1684 5374

REFERENCES

1. **Haddad L, John H and A Harold** Intrahousehold resource allocation in developing countries: models, methods and policies. (1997). http://hdl.handle.net/10919/68709 *Accessed September 2023.*

2. **Sheahan M, Barrett CB and SB Megan** Understanding the agricultural input landscape in sub-Saharan Africa: Recent plot, household, and community-level evidence. World Bank Policy Research Working Paper 7014 (2014).

3. **Khan A, Rashid HQ, Rashid AK and Q Hassan** Technology adoption theories and models. Adoption of LMS in Higher Educational Institutions of the Middle East (2021): 27-48.

4. **Ruttan V and T Colin** The role of Demand and Supply in the Generation and Diffusion of Technical Change. Vol. 21. Routledge, 2014.

5. **Comer S, Enefiok E, Safdar M, Surendra PS and T Fisseha** Sustainable and conventional farmers: A comparison of socio-economic characteristics, attitude, and beliefs. *Journal of Sustainable Agriculture*. 1999;**15(1):** 29-45.

6. **Lampkin N and S Padel** The economics of organic farming: an international perspective. (No Title) (2004).

7. **Rigby D, Trevor Y and B Michael** The development of and prospects for organic farming in the UK. *Food Policy.* 2001; **26(6):** 599-613.

8. **Rigby D, Trevor Y and B Michael** The development of and prospects for organic farming in the UK. *Food Policy.* 2001; **26(6):** 599-613. https://doi.org/10.1111/1467-9523.00169

9. **Allendorf K** Do women's land rights promote empowerment and child health in Nepal. *World development.* 2007; **35(11):** 1975-1988. https://doi.org/10.1016/j.worlddev.2006.12.005

10. **Connelly R, Kenneth R and Z Zhenzhen** The impact of circular migration on the position of married women in rural China. *Feminist Economics.* 2010; **16(1):** 3-41. https://doi.org/10.1080/13545700903382752

11. **Malapit HJ, Kathryn S, Chiara K, Ruth SM, Agnes RQ, Farzana R, Emily H and A Sabina** Measuring progress toward empowerment: Women's empowerment in agriculture index: Baseline report. *Intl Food Policy Res Inst*. 2014.

12. **Kebede B, Marcela T, Alistair M and V Arjan** Intra-household efficiency: An experimental study from Ethiopia. *Journal of African Economies.* 2014; **23(1):** 105-150. https://doi.org/10.1093/jae/ejt019

13. **Bertocchi G, Marianna B and T Costanza** Who holds the purse strings within the household? The determinants of intra-family decision making. *Journal of Economic Behavior & Organization.* 2014; **101:** 65-86. https://doi.org/10.1016/j.jebo.2014.02.012

14. **Chiappori P and M Costas** Literature Review Article: Household Labor Economics. Edward Elgar Publishing Limited, 2021.

15. **Goussé M, Nicolas J and R Jean-Marc** Marriage, labor supply, and home production. *Econometrica.* 2017; **85(6):** 1873-1919.

16. **Bwanga EK and C Kabonesa** The relationship between intrahousehold decision making dynamics and household savings investment decisions: A feminist economics perspective. *International Journal of Economics and Finance (IJEF).* 2015; **1(3):** 102-121.

17. **Basu B and M Pushkar** Intra-household bargaining power and household expenditure allocation: Evidence from Iran. *Review of Development Economics.* 2020; **24(2):** 606-627.

18. **Almås I, Orazio A and C Pedro** Household decisions and intra-household distributions. *Handbook of the Economics of the Family*, 2023; **1(1):** 111-149. North-Holland,.

19. **Anderson CL, Travis WR and GK Mary** Husband and wife perspectives on farm household decision-making authority and evidence on intra-household accord in rural Tanzania. *World development.* 2017; **90:** 169-183.

20. **Shibata R, Sarah C and D Peter** Gendered intra-household decision-making dynamics in agricultural innovation processes: assets, norms and bargaining power. *Journal of International Development*. 2020; **32(7):** 1101-1125.

21. **Ambler K, Cheryl D, Caitlin K and P Simone** He says, she says: Spousal disagreement in survey measures of bargaining power. *Economic Development and Cultural Change*. 2021; **69(2):** 765-788.

22. **Gómez-Valle R and H Nathalie** Incomes, employment and gender roles: understanding women's intrahousehold decision-making participation in Nicaragua. *Fulbright Review of Economics and Policy.* 2022; **2(1):** 61-91.

23. **Miller G and MA Mushfiq** Gender differences in preferences, intra-household externalities, and low demand for improved cookstoves. No. w18964. National Bureau of Economic Research, 2013.

24. **Ghuman SJ, Helen JL and SL Herbert** Measurement of women's autonomy according to women and their husbands: Results from five Asian countries. *Social Science Research.* 2006; **35(1):** 1-28. https://doi.org/10.1016/j.ssresearch.2004.06.001

25. **Bradshaw S** Women's decision-making in rural and urban households in Nicaragua: the influence of income and ideology. *Environment and Urbanization*. 2013; **25(1):** 81-94. https://doi.org/10.1177/0956247813477361

26. **Domencich TA and D McFadden** Urban travel demand-a behavioral analysis. No. Monograph. 1975.

27. **McFadden Daniel** The measurement of urban travel demand. *Journal of Public Economics.* 1974; **3(4):** 303-328. https://doi.org/10.1016/0047-2727(74)90003-6

28. **Przepiorka W and D Andreas** Binding contracts, non-binding promises and social feedback in the intertemporal common-pool resource game. Games 2020; **11(1):** 5.

29. **Chavas J, Eleonora M, Martina M and P Federico** Bargaining in the Family. CHILD, Centre for Household, Income, Labour and Demographic Economics, Collegio Carlo Alberto, Università degli studi di Torino, 2021.

30. **Lundberg S** Gender and household decision-making. *Frontiers in the Economics of Gender.* pp. 132-150. Routledge, 2008.

31. **Kooreman P and K Arie** On the empirical implementation of some game theoretic models of household labor supply. *Journal of Human Resources.* 1990; 584-598.

32. **Loevinsohn M, James S, Aliou D and W Stephen** Under what circumstances and conditions does adoption of technology result in increased agricultural productivity? A Systematic Review. (2013). https://opendocs.ids.ac.uk/opendocs/handle/20.500.12413/3208 *Accessed November 2023.*

33. **Tambo JA and M Jonathan** Differential impacts of conservation agriculture technology options on household income in Sub-Saharan Africa. *Ecological Economics.* 2018; **151:** 95-105. https://doi.org/10.1016/j.ecolecon.2018.05.00

34. **Pittelkow CM, Bruce AL, Mark EL, Xinqiang L, Kees Jan VG, Juhwan L, Natasja V, Johan S, Rodney TV and V Chris** When does no-till yield more? A global meta-analysis. *Field Crops Research.* 2015; **183:** 156-168. https://doi.org/10.1016/j.fcr.2015.07.020

35. **Lowenberg-DeBoer J** Comment on" Site-Specific Crop Management: Adoption Patterns and Incentives. *Review of agricultural economics.* 2000; **22(1):** 245-247.

36. **Ouma JO, Festus MM, Wilfred M, Hugo V, Macharia G and D Hugo** Adoption of maize seed and fertilizer technologies in Embu district, Kenya. (2002).

37. **Sauerborn R, Alayne A and H Maurice** Household strategies to cope with the economic costs of illness. *Social Science & Medicine.* 1996; **43(3):** 291-301. https://doi.org/10.1016/0277-9536(95)00375-4

38. **Ghale Y, Kailash NP, Durga D, Krishna PP and PT Netra** Gender dimensions of food security, the right to food and food sovereignty in Nepal. *Journal of International Women's Studies*. 2018; *19(4):* 15-31.

39. **Sell M and M Nicholas** What factors explain women's empowerment? decision-making among small-scale farmers in Uganda. *Women's Studies International Forum.* 2018; **71:** 46-55. Pergamon.

40. **Razavi S** Liberalisation and the debates on women's access to land. *Market-Led Agrarian Reform.* 2013; 63-84. Routledge.

41. **Meijer SS, Delia C, Gudeta WS and N Maarten** Tree planting by smallholder farmers in Malawi: Using the theory of planned behaviour to examine the relationship between attitudes and behaviour. *Journal of Environmental Psychology.* 2015; **43:** 1-12. https://doi.org/10.1016/j.jenvp.2015.05.008

42. **Osanya J, Rahma IA, David JO, Rose N and J Moti** An analysis of the respective contributions of husband and wife in farming households in Kenya to decisions regarding the use of income: A multinomial logit approach. *Women's Studies International Forum.* 2020; **83:** 102419. Pergamon, 2020. https://doi.org/10.1016/j.wsif.2020.102419

43. **Thangata PH, Peter EH and HG Christina** Modeling agroforestry adoption and household decision making in Malawi. *African Studies Quarterly*. 2002; **6(1):** 271-293.

44. **Zakaria H** The drivers of women farmers' participation in cash crop production: the case of women smallholder farmers in Northern Ghana. *The Journal of Agricultural Education and Extension*. 2017; **23(2):** 141-158.

45. **Yesuf M** Market imperfections and farm technology adoption decisions: an empirical analysis. (2023).

46. **Martey E, Prince ME and KMJ Kuwornu** Economic impacts of smallholder farmers' adoption of drought-tolerant maize varieties. *Land use Policy*. 2020; **94:** 104524. https://doi.org/10.1016/j.landusepol.2020.104524

47. **Gecho Y, Gezahegn A, Tesfaye L and D Alemu** Rural household livelihood strategies: Options and determinants in the case of Wolaita Zone, Southern Ethiopia. *Social Sciences.* 2014; **3(3):** 92-104.

48. **Bonabana-Wabbi J** Assessing factors affecting adoption of agricultural technologies: The case of Integrated Pest Management (IPM) in Kumi District, Eastern Uganda. *PhD diss.,* Virginia Tech, 2002.

49. **Tamene L, Powell M, Ndengu G and J Kihara** Assessment of maize yield gap and major determinant factors between smallholder farmers in the Dedza district of Malawi. *Nutrient Cycling in Agroecosystems.* 2016; **105:** 291-308.

50. **Lavison R** Factors influencing the adoption of organic fertilizers in vegetable production in Accra, Gahna. *Journal of Agriculture*. 2013; **8(3):** 34-57.

51. **Giller KE, Thomas D, João VS, Katrien D, Gerrie V, Antonius GTS and VW Mark** The future of farming: Who will produce our food?. *Food Security*. 2021; **13(5):** 1073-1099.