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Appropriate Scale Mechanization Consortium[1]

"*Now we can breathe*." The Impact of a Mechanical Maize Planter on Smallholder Women Farmers in Burkina Faso

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Introduction

Burkina Faso ranks 183 on the Human Development Index, with 67% of the working population making less than $3.10 a day (UNDP 2018). Ninety percent of the poor live in rural areas, and over 80% of the labor force is employed in the agriculture sector. The level of on-farm mechanization is low in Burkina Faso, with 70% of smallholder farmers relying on hand labor, less than 30% using draft animals, and less than two percent using tractor power. Mechanized power units are often solely used for plowing, while the other labor-intensive work of planting, weeding, crop care and harvest is by hand. Labor is increasingly scarce, yet many farmers are neither aware of alternative cropping methods, nor do they have affordable access to labor-saving mechanization. The Appropriate Scale Mechanization Consortium (ASMC) Burkina Faso Innovation Hub (IH), led by researchers at Nazi Boni University, developed appropriate mechanization technologies to benefit subsistence farmers in Burkina Faso. The IH included local and U.S. based entities working in collaboration with smallholder farmers to improve their quality of life while developing mechanization to advance the farming system and sustain the natural resource base.

Figure 1. Maize planting and weeding are tedious and labor-intensive tasks primarily done by women and children. Photo Credit: T. Harrigan

At the outset of the project, the IH conducted a stakeholder needs assessment to determine the agricultural tasks that could most benefit from improved mechanization in collaboration with government representatives, NGOs, farmers, service providers, and other stakeholders. In the assessment, land preparation, planting, and weed control - tasks accounting for most drudgery and labor, and primarily done by women and children - emerged as the top priorities

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for mechanization. Additionally, the stakeholder needs assessment identified a crosscutting need for improved, affordable tools for animal traction and conservation agriculture.

The burden of female farmers

In Burkina Faso, women are typically responsible for planting among other farming tasks such as weeding, harvesting, and post-harvest activities. These tasks are in addition to other household tasks such as collecting water, child-care, cooking, and fetching firewood, which could take up to 16 hours a day. While male farmers assist with planting, the task of planting is predominantly a role for women and young girls.

Women hand plant maize by using a short-handled hoe known as a 'daba' by bending over and placing two seeds every 16 inches (two seeds per pocket assure the successful germination of at least one plant resulting in few skips within the row). Many female farmers reported back pain from the hours of stooped labor. In addition to being labor-intensive, hand planting is also time intensive. Women explained that their roles in maize planting made it challenging to get to the weekly village market and conflicted with women's individual entrepreneurial efforts in harvesting shea and cashew nuts, and planting on their separate plots of land. They also mentioned the need for a rest period to recover from the exhaustion of planting further reduced the time available for attending to other household activities.

Figure 2. Women hand-plant maize using a 'daba', a short-handled hoe. Photo Credit: T. Harrigan

The challenges of hand planting are exacerbated by the need for concentrated labor during short and sporadic rainy seasons when planting time is limited. In addition to finding and managing a planting crew of 15-20 people, women are responsible for providing meals to the crew, increasing the overall workload. Female farmers also mentioned that the work of the crew was often poor quality with inconsistent seed spacing and variable seed depth – both of which affected plant population and yield potential. Planting crews cost, on average, 1,000 CFA per day per person (about 1.75 USD per person or 35 USD for the crew per day) with the crew planting one hectare in a day. Women also spoke of the conflicts that arose in the household with expectations to both be in the field to manage the planting crew and have meals ready on time.

Cropping system mechanization

In collaboration with local farmers, the team used a cropping system approach to develop an improved planter, an in-line ripper for seedbed tillage, and an improved ox yoke for animal comfort. In the development of the planter, the team used a process of adaptive management in evaluating a diverse set of technologies with varying levels of complexity compatible with the

local economic, social, and environmental conditions. In the case of the planter, the IH redesigned the locally available row-crop cultivator to retain protective crop residue and reduce soil erosion. These advances in mechanization ensured that the planter and other technologies improved local farming systems by balancing higher productivity and environmental sustainability.

The team also addressed reasons for potential technology failure, which included high cost, poor performance, and lack of timely availability by building the capacity of local fabricators. In the redesign and fabrication of the planter, in-line ripper, and weeder, local blacksmiths skills and abilities to design, build, evaluate, and repair tools and equipment increased. Building the capacity of the local blacksmiths also ensured the sustainability of the planter beyond the project lifetime and guaranteed that farmers had local access to skilled labor for planter repair and maintenance. Furthermore, this process helped reduce the material cost for the planter by more than 50%.

Figure 3. Local artisans learned to build and repair planters and in-line subsoilers using locally available materials. Photo Credit: M. Jones

Specific redesign features of the ASMC planter include a low-cost seed plate drive mechanism, a furrow opener suitable for minimally tilled soil and uniform depth of seed placement, and a furrow closer/press-wheel system suited for low-disturbance, soil stabilizing zone tillage. These features enabled the seeds to be placed at a uniform depth and spacing, which ensured that seeds germinated faster and at a consistent rate. Experiments in farmer's fields showed that using the planter increased maize grain yield by 50 - 150% compared to hand planting. Farmers who tested the ASMC planter with their maize crop for one to two years also mentioned that birds did not consume the planted seeds because they could not find them! Using the planter had the added advantage of reducing the need to plant twice – which was often required when planting by hand because of a low germination efficacy. Additionally, it enabled farmers to plant early before the rains.

Enabling women to access planters

The ASMC IH worked with female farmers to ensure that women benefitted from the technologies through engagement in demonstrations, training, and on-farm assistance. The IH provided a one-day demonstration/training session for the first cohort of five farm families in 2018, and a second half-day session for the 2019 cohort of 20 farm families before the planting season. The IH also provided on-farm assistance to all the families. Additionally, a gender

technology assessment[2] was conducted on the planter to understand gender dynamics that could impact adoption. Faculty and students from Nazi Boni University joined the ASMC Gender Specialist in conducting a gender technology assessment[3] to understand gender dynamics that could affect women's access to the planter, use of the planter and ultimate adoption. The gender assessment considered planter design, women's access to information to learn about new technologies, and barriers and enablers to adoption including prevalent socio-cultural norms that dictated whether women could use mechanized technologies.

At a debriefing session with 25 farm families, women cited the time and labor-saving impact of the ASMC planter on their lives. A female farmer reported that with a family of three and a team of oxen, she could accomplish the work of a hand planting crew of 15-20. Ms. Kay Moussokoura, a farmer near Bobo-Dioulasso, said, *"Here, women and children do the planting. I worked with the planter, and it was very easy to use. With the planter, it is much faster."* The women used the time saved to accomplish domestic tasks such as cooking, fetching water, child-care, and going to the market. They also used the time for the income-generating activities of gathering and processing shea or cashew nuts. Female farmers using the planter also reported having more time to tend their land—income from their land and enterprises funded children's schooling, food, and clothing. Women also saved the money from their enterprises for unexpected expenses such as medical care and other family expenses.

Figure 4. Processing cashew nuts. Use of the planter saved time which was re-employed in income generating activities and invested back into the household. Photo Credit: T. Harrigan

The ASMC planter also affected intra-household dynamics by making planting a household task rather than a woman-only task. Many women farmers preferred not to handle oxen, considering it too dangerous. This unease with handling oxen echoes findings of the gender technology assessment, which identified access and use of oxen to operate the planter as a gender barrier. In the eight households represented at the November debriefing session, farmers overcame this barrier with women operating the planter and men (household or hired) handling the oxen. Women also reported difficulty in turning the planter at the end of the cropping rows and suggested lowering the height of the planter's handles. Other suggestions made by female

[2] The Gender Technology Assessment identified gender barriers and enablers to adoption of the planter, and women's roles in technology adoption. The assessment also identified strategies for better design, dissemination, and adoption by studying intra-household gender dynamics. The report can be accessed here: https://uofi.box.com/s/frjuh867ntio42atoabbsq3vgyvwzjw1

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farmers included modifications to enable planting of other crops (ranked by importance after maize) cowpeas, groundnuts, soybean, and sorghum. Women were also very interested in better tools for land preparation and weeding. The ASMC team has modified the final prototype for scaling up to include height-adjustable handles. ASMC Phase II will create an alternative planter prototype that uses donkey draft power to improve gender accessibility for women farmers.

Advancing farm mechanization advances gender equity

The ASMC planter has design, process, and gendered benefits for subsistence farmers in Burkina Faso. Design benefits include efficient and effective planting (improved grain yield); process benefits include accessibility, affordability and reparability, and gender benefits of time and labor-saving for women farmers. The planter's benefits were enabled by linking the innovation to social processes, and by using a participatory approach involving farmers (male and female), educators, and local fabricators.

Figure 5. Young woman farmer trying the planter after a field demonstration. Photo Credit: M. Jones

The development of the ASMC planter has shown that it is essential to evaluate mechanized innovations both in technical terms and within social, cultural, and economic contexts. Specifically, it is crucial to consider agricultural mechanization and technologies through a gender lens to ensure that they reach, benefit, and, when possible – empower female smallholder farmers. In the case of the ASMC planter, women save time and labor, which is re-employed toward domestic and income-generating activities - which are ultimately invested back into the household. As the women farmers exclaimed to the team, **"God will thank you for what you have done for us. Please do not forget about the women. Now we can breathe."**

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