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Implications of Conservation Agriculture for Men's and Women's Workloads Among Marginalized Farmers in the Central Middle Hills of Nepal

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Measures of gender-based labor distribution can contribute to understanding the feasibility of agricultural development in mountainous subsistence farming communities. Conservation agriculture (CA) can provide sustained crop yield and improved soil and water conservation in mountain areas prone to degradation and where few inputs are available. This study sought to measure the gendered labor impacts of CA practices and to assess their feasibility in remote farming communities. We surveyed farmers in 3 tribal villages in the Middle Hills of Nepal, where communities consist of smallholder (<2 ha) farmers cultivating highly sloping, marginal lands. Face-to-face interviews and time allocation surveys were used to quantify distribution of labor and to identify engagement in agricultural decision-making in 87% of the households. On-farm plots were used to measure differences between the gender-based labor demands of conventional and CA practices. Results show that women bear a disproportionate burden (53–55%) of on-farm labor. Field trials showed that women would predominantly manage increases in labor demands from CA, particularly where more labor for plowing, sowing, and harvesting is required, yet 51.3% indicated that they have limited control over adoption of new practices. In situations where women are already overburdened, technologies that require additional labor may prove unsustainable. It is crucial to adapt technologies to provide gender-sensitive solutions and meet the needs of the local community. Identifying the gendered constraints of CA is vital to improving understanding of agricultural livelihoods.

Keywords: *Conservation agriculture; gender; labor distribution; agriculture development; Nepal.*

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Introduction

Population growth, soil erosion, and the effects of climate change (Beniston 2003) exacerbate challenges to sustainable food production and food security in rural, mountainous regions. To combat hunger and environmental degradation in developing countries, innovative technologies such as conservation agriculture (CA) have been introduced to improve crop systems and promote sustainable development. CA includes the practices of minimum tillage, intercropping, and the use of cover crops that help to mitigate soil nutrient depletion and land degradation and increase yields (Hobbs et al 2008). CA was initially introduced for large-scale farms in developed countries, particularly the United States; however, it has been increasingly promoted in developing countries by various international agencies (Knowler and Bradshaw 2007). There are currently 72 million ha of CA systems worldwide, increasing at an average rate of about 7 million ha per year (Friedrich et al 2012).

CA practices are especially beneficial on sloping lands prone to degradation and erosion and small, rain-fed farming systems with low inputs (Shrestha et al 2004). Minimum tillage reduces the risk of degradation by minimizing soil disturbance and retaining soil structure. Field experiments have shown significant evidence that minimum tillage can reduce both runoff and soil loss (Tiwari et al 2009). Intercropping with leguminous crops benefits soil fertility through nitrogen fixation, provision of soil organic matter, and added soil cover (Thapa 1996). Both practices require little capital for implementation, making them ideal for resource-poor households. However, the impacts of CA practices on household labor and their gender-related constraints and opportunities remain insufficiently studied.

This article argues for the utility of a feminist approach to understanding the costs and benefits of CA for smallholder farmers in developing countries, as labor demands and gender issues have been identified as constraints to the adoption of new agricultural practices (Lee 2005). Increasing interest in quantifying rural women's engagement in the agriculture sector is apparent with the development of indices such as the USAID Women's Empowerment in Agriculture Index and the Gender Empowerment Measure (Pillarisetti and McGillivray 1998). Feminist scholars have pointed out gendered effects of agricultural interventions and the need for gender sensitivity in development interventions, including conservation practices. In particular, feminist political ecologists have shown that a household is not a single harmonious unit, as is often assumed, but rather a place of power relations where women's voices tend to be subjugated (Rocheleau et al 1996).

Of particular relevance to CA are feminist analyses of labor and time demands. One of the key insights in feminist theory is the notion of productive versus reproductive labor and how women often conduct the latter without being acknowledged. Reproductive tasks such as child-rearing and food preparation are typically carried out by women (Tancred 1995), while productive tasks include agriculture and are often shared by both genders. While both types of work are essential for livelihoods, reproductive work is often not considered or remunerated (Glenn 2001). This results in women shouldering a dual burden of productive and reproductive work, creating a gendered "time poverty" (Blackden and Wodon 2006). Particularly in rural subsistence communities, women have a high burden of labor due to this dual responsibility (Gurung et al 2005). It is important to recognize the impact that interventions will have on this burden.

A new agricultural technique may change labor demands in significantly different ways for men and women. The distribution of household and agricultural labor plays a critical role in determining the feasibility of agricultural practices, as the inability to increase labor hours can be a factor in the failure to adopt practices despite their potential. Therefore, it is necessary to identify gender inequalities and labor demands at the household level (IFAD 2003). Moreover, equal participation in household decision-making is vital to improving the livelihoods of rural women, particularly in marginalized communities (Tulachan and Neupane 1999). However, there is a dearth of studies examining CA's gender-specific effects on workloads, its seasonal changes, and the dynamics of decision-making.

Analysis of CA and its impacts on smallholder farming communities in mountainous areas must consider the potentially uneven impacts of development interventions for men and women, as well as gendered distribution of household decision-making power. This article seeks to provide more detailed analysis of relations between types of CA practices and changes in the amount and types of labor than has been hitherto available. It aims to contribute in multiple ways. On a practical level, increases in labor requirements would hinder long-term adoption of CA despite its potential to increase food security, improve soil, and enhance livelihoods. On a policy level, if CA exacerbates the gender gap in time poverty, its blanket promotion in developing countries, particularly in erosion-prone regions, needs to be reconsidered. Furthermore, from a planning perspective, identified differences in costs and benefits of CA would strengthen the case for greater involvement of women in the design and implementation of CA-based projects.

Study area

More than one-third of Nepal's agricultural land is located in the central Middle Hills, supporting 44% of the country's population of 29.8 million (Thapa and Paudel 2002). For this reason, it has become a major area of focus for improving food security. Much of the region's agricultural production is from subsistence farming; however, growing populations and deteriorating land have led to an increased need for improved agricultural technologies to increase soil conservation as well as crop yields. Local nongovernmental organizations have been working to introduce improved cultivation methods, yet there exists a gap in research on the gender implications of such practices and how these may be beneficial or detrimental considering the distribution of labor. Research related to household dynamics in the Middle Hills has shown that labor tends to be divided more evenly between the genders in resource-poor households; however, variation exists due to agroecological conditions, individual expertise, and ethnicity (Gurung et al 2005). Many communities are highly influenced by traditional customs and Hindu patriarchal values (Bhushal 2008). Moreover, it has been documented that women in Nepal work significantly more hours than men, leading to physical and mental exhaustion (Pradhan and Shrestha 2010).

The Chepang people, who live in the Middle Hills region (Figure 1A), are an indigenous group identified as one of the most marginalized ethnic groups in Nepal in terms of geographic location and socioeconomic status (Luni et al 2012). Villages are isolated on mountainsides without direct access to road networks and markets, limiting opportunities for income generation, and few if any receive agricultural extension services. While outmigration is prevalent in much of Nepal, this is not a viable option or common practice among the Chepang people (UN RCHCO 2012). These communities rely on rain-fed systems with few inputs and cultivate highly sloping, stony fields (Figure 1B). Due to the topography, these areas are prone to erosion. Few Chepang

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FIGURE 1 Difficult farming conditions: (A) a Chepang farmer clearing maize stalks from a rocky field; (B) steep slopes in fields belonging to the Chepang study villages. (Photos by J. Halbrendt)

households are self-sufficient in agricultural production, and food scarcity exists for approximately 6 months of the year (Piya et al 2011). Insights about women's roles in agriculture in these communities may be relevant to similarly marginalized communities worldwide.

The research took place in 3 villages—Thumka (Gorkha District), Hyakrang (Dhading District), and Khola Gaun (Tanahun District), with 42, 30, and 26 households, respectively. The villages are within the central Middle Hills region with access by footpath to the nearest market of Mugling (latitude: 27°50′56″N; longitude: 84°33′03″E; Figure 2). These villages were selected due to their high risk for food insecurity from marginal, sloping agricultural lands and small landholdings. Agriculture in this area is characterized by subsistence farming, with less than 2 ha arable land per household and few opportunities for income generation. Farmers use continuous cultivation with terracing, draft plowing, and monocropping in a maize-based system.

Objectives

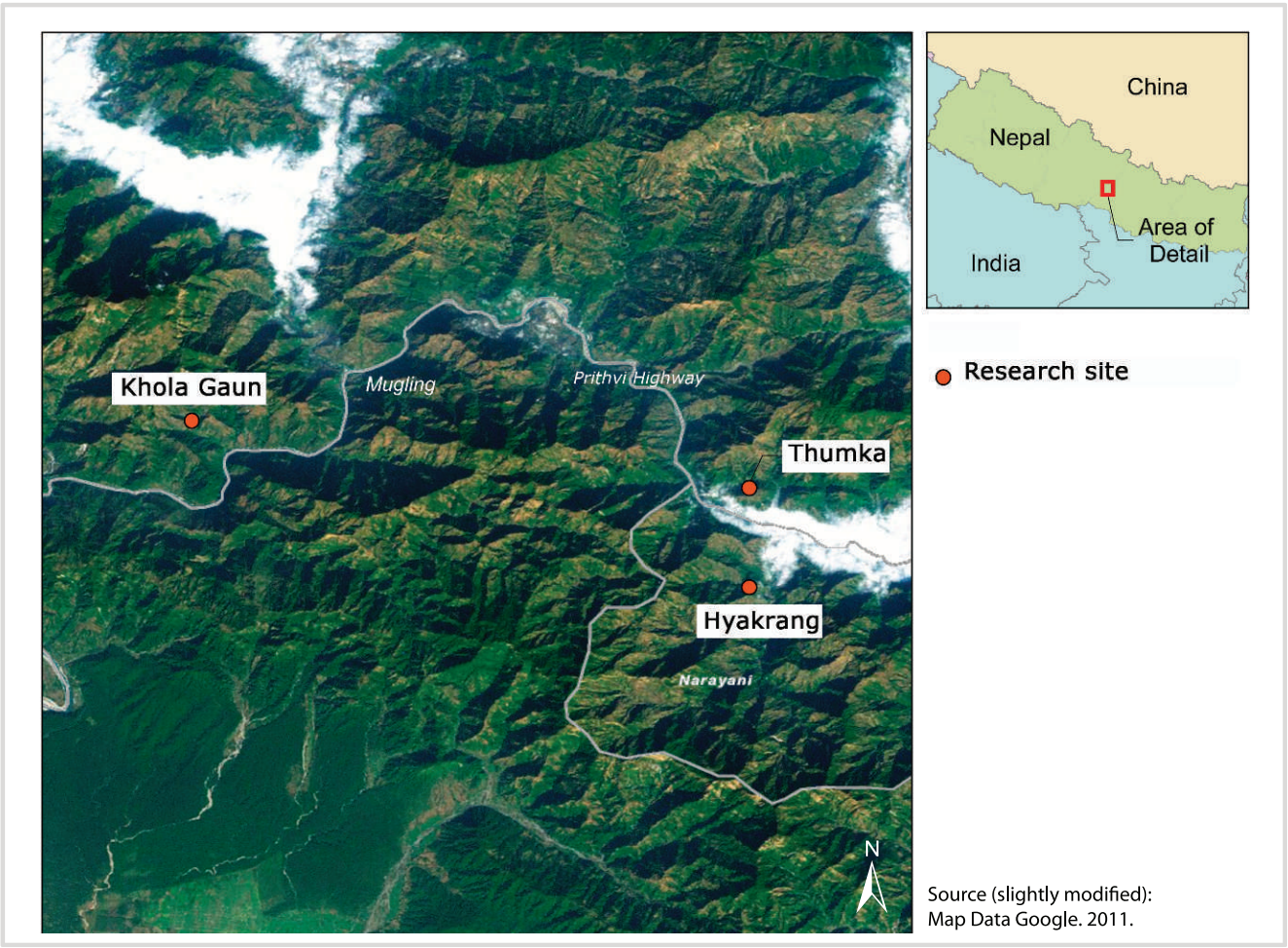
The objectives of this research were to (1) measure the gendered distribution of agricultural labor in the study villages, (2) estimate CA's likely effect on seasonal labor demands by gender, and (3) assess the implications of, and make policy recommendations for, optimizing the introduction of CA.

Methods

To quantify changes to the distribution of labor caused by CA, labor inputs for both traditional and CA practices were measured and compared. Since labor distribution varies at the local level, data were collected from individuals to develop an understanding of gender roles. Time-use surveys were used to estimate agricultural activities by gender and to measure the distribution of labor in the household and gain a better understanding of the adaptations made to accommodate changing practices (Beteta 2006). In June 2012, households in the 3 Chepang communities participated in an activities analysis (or time-use survey) that was differentiated by gender.

Men and women heads of household were surveyed separately in face-to-face interviews to assess gender participation and labor demands for 5 categories of livelihood activities: household, livestock, agriculture, off-farm, and community. Questionnaires assessed time spent on all daily and seasonal activities conducted in the household by measuring the months per year, days per week, and hours per day spent on each activity. This approach of quantifying months, days, and hours allows a more accurate elicitation of total time allocation using a recall approach. Recognizing the risk of recall error from this survey approach, a large sample (77 surveys, covering 79% of households) was surveyed. Agriculture and

FIGURE 2 Map of study area. (Map by Linsey Shariq)



off-farm activities are seasonal, while household, livestock, and community activities occur throughout the year. Since only the labor inputs for agricultural activities are expected to change as a result of CA, these were the focus of analysis.

To estimate the impact of CA, the survey focused on 3 major crops: maize, millet, and legumes. Maize was selected for its importance as a staple crop, the capacity to integrate minimum tillage and intercropping, the soil and water conservation potential, and its benefits to food security. In a typical cropping season, maize is planted, followed by a relay leguminous crop around the time of maize harvest. The survey measured labor hours for conventional cultivation, representing a complete cropping season (conventional-tillage maize followed by legumes) at 5 stages: plowing, fertilizer application, sowing and transplanting, weeding, and harvest. On-farm experiments were conducted to measure labor shifts resulting from the introduction of 2 CA practices: intercropping (millet with cowpeas) and minimum tillage using a strip-till approach. Experimental plots were established on 8 representative fields in each village, and farmers' activities were recorded by gender for 2 CA treatments: (1) conventional-tillage maize followed by intercropped millet and cowpea and (2) minimum-tillage maize followed by intercropped millet and cowpea. Changes in labor distribution were measured based on the difference in work hours between conventional practice and the 2 CA practices. Based on the data from the CA experiments, we calculated percentage changes in labor hours from the conventional practice to each of the CA practices. These percentage changes were applied to the farm data for maize, millet, and legumes to calculate the changes in labor from CA in terms of hours at the whole farm level. This approach accounts for differences between the field size of the total farm and the smaller CA experimental plots.

A Likert scale was used to quantify self-reported feelings of control over decisions related to adoption of new agricultural practices. A range of no control, some control, equal control, a lot of control, and total control was used to assess men's and women's engagement in

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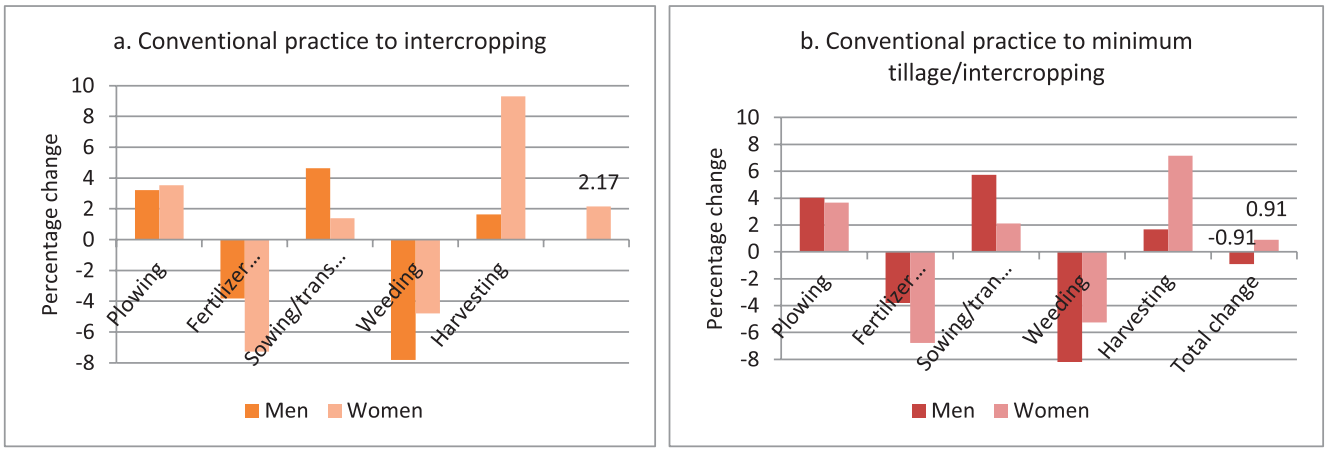
FIGURE 3 Percentage difference in labor inputs, by gender, between (a) conventional and (b) conservation agriculture practices.



agricultural decision-making. Focus groups and interviews were used to develop a seasonal calendar of livelihood activities, understand the cultural context and household dynamics, and validate the survey results.

Results

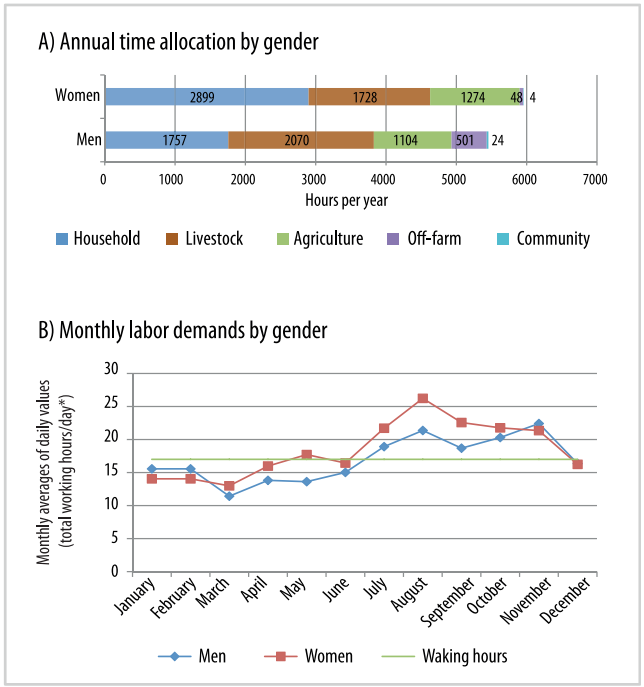
Changes in demand for labor with conservation agriculture

A total of 77 surveys (38 male, 39 female) were collected, comprising 79% of households. For the conventional, farming practice, men conducted 46.9% of total labor and women 53.1%. For the CA practices (intercropping and minimum tillage/intercropping), a similar trend was maintained, with men completing 44.7% and 46.0% of total labor and women 55.3% and 54.0%, respectively.

Labor inputs were measured by gender for conventional and CA practices, and the percentage of increase or decrease was calculated for each (Figure 3A, B). In all cases, shifting from conventional to CA practices led to greater total labor for women—2.17% in the case of intercropping and 0.91% in the case of minimum tillage and intercropping. Households with less labor availability were more likely to have an even distribution of labor between men and women for both conventional and CA practices.

Shifting from conventional to CA practices involved a distinct shift in labor requirements at different stages, with increases in plowing, sowing, and harvesting and decreases in fertilizer application and weeding for both genders. The increased labor for women in both CA treatments was largely in plowing and harvesting.

FIGURE 4 (A) Annual time allocation for livelihood activities by gender. (B) Monthly labor demands of livelihood activities by gender. *Hours per day exceed 24 in some cases due to concurrent activities (such as cooking and childcare).



Seasonal shifts in time allocation

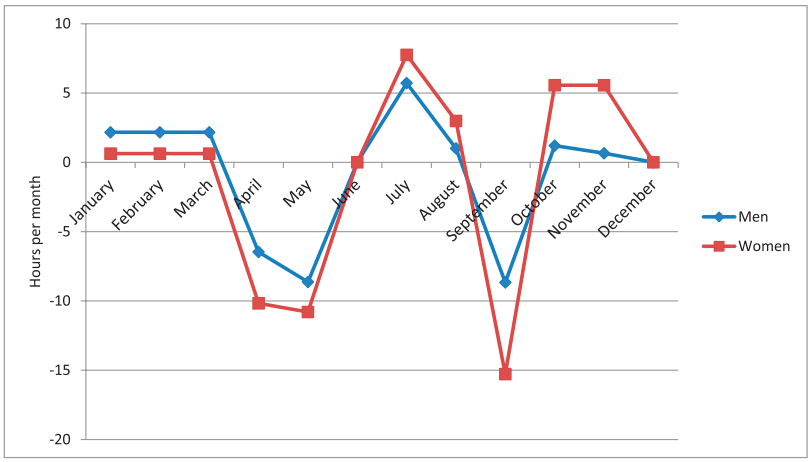
Total time allocation was calculated for 5 categories of livelihood activities (household, livestock, agriculture, off-farm, community). Data were analyzed using the mode as the measure of central tendency to reduce the influence of outliers. Women were found to perform 52.2% of total livelihood duties and men 47.8%, for an annual difference of 497 hours. Total waking hours can be estimated at 17 per day or 6205 per year. Figure 4A shows the breakdown of annual time allocation by gender and category. For women, the most time is spent on household duties (48.7% or 2899 h/y), with agriculture representing 21.4% (1274 h/y) of time. Tending to livestock is the predominant activity for men (32.2% or 2070 h/y), with 20.2% (1104 h/y) of time spent on agriculture. Personal free time and socializing activities account for additional waking hours.

Labor demands over the year were determined for each gender by calculating the seasonal agricultural and

FIGURE 5 A Chepang woman processes maize while caring for her child. (Photo by J. Halbrendt)

off-farm activities for each month and compiling them with the year-round household, livestock, and community activities. Figure 4B shows the different daily labor demands for men and women as they shift throughout the year. In some cases the hours spent per day exceed the waking hours. This can be attributed to activities that may occur concurrently, for example, harvesting and childrearing (Figure 5). Nevertheless, all activities were calculated in the same manner for both genders and therefore reflect disparities in labor demands. Major increases in labor demands for both men and women occur from July to November, the primary growing season for millet, legumes, rice, and vegetables. Maize cultivation occurs earlier in the year, from January to August. Off-

FIGURE 6 Projected changes to labor requirements from integration of conservation agriculture (CA) practices. Positive values show increased labor demands, while negative values indicate labor savings.



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farm wage earning, primarily by men, occurs from November to February.

Figure 6 shows the likely changes to labor requirements with the integration of CA. This was determined by applying the percentage change in labor from the experimental CA plots to the seasonal agricultural labor demands for each gender. The difference between results for the two CA practices (intercropping and minimum till with intercropping) was negligible for both men and women, less than 4 hours over the year. For this reason, the results of the 2 treatments were averaged in Figure 6 and will be discussed jointly. The greatest labor savings for both men and women are projected to occur in April and May, during plowing, fertilizing, and weeding of maize, and in September, during weeding and fertilizing of legumes. Women benefit more than men during these months, with labor savings of 10–15 h/mo. Over the same months, men show savings of 6.5–8.5 h/mo. Labor demands show the greatest increases during July, the time of the maize harvest and plowing and sowing for millet and legumes, and during October and November, due to increases in harvesting of millet and legumes. Labor increases were shown to be more significant for women at this time, requiring 5.5–8 h/mo of additional labor. Over the same period, men's labor increased by 1–5.5 h/mo.

Access to agricultural decision-making

The surveys of men and women heads of household measured self-reported engagement in decision-making regarding adoption of agricultural practices. The majority of survey respondents (60.5% of men, 46.2% of women) said they shared agricultural decision-making equally. Nevertheless, a number of men stated they had "a lot of control" (28.9%) or "total control" (15.8%) over decision-making, while a large proportion of women reported only "some control" (28.2%) or "no control/unsure" (23.1%). Interviews showed that household decision-making is highly influenced by patriarchal traditions, where men tend to make final decisions regardless of male or female tasks. This tended to be most prevalent where the heads of household were older and where women had less education. The most important factors for the hierarchy of decision-making were indicated as being male and older, though expertise and experience were also factors. Nevertheless, where men are not present due to off-farm obligations, it was often acceptable for women to lead decision-making. Some households had clear delineations for control over decision-making, with male tasks decided by men and female tasks by women.

Discussion

Impact of conservation agriculture on labor demands

From the analysis, it is evident that women carry out a greater proportion of agricultural labor, which increases with the addition of CA. Overall, while men manage plowing, women conduct the majority of fertilizer application, weeding, and harvesting. While sowing and transplanting were predominantly women's tasks in conventional farming practices, the work was more evenly distributed between men and women in the CA practices, where time required for sowing increased due to intercropping. Both CA options showed a total increase in labor for women; however, the shift from conventionally grown millet to minimum tillage/intercropping created less of an increase (0.91% compared with 2.17%). Physically tasking activities such as weeding are also reduced with this practice. Though the labor difference is slight, this decrease in more physically demanding activities can reduce some of the physical burden on women (Pradhan and Shrestha 2010). For men, both practices reduce total labor, and shifting to an intercrop-only practice creates a greater reduction.

Increased demands for plowing with CA can be attributed to the use of hand tools rather than conventional draft plowing, which is men's work, while increased harvesting requirements may be due to the second crop introduced through intercropping. While increased harvests can lead to greater food security and income, they also increase the demand for postharvest processing, which was not measured in this study. Though overall labor demand increases from CA are small, they could inhibit its long-term use, given other labor demands such as reproductive work. For this reason, it is important to assess the CA-related changes within the context of total labor requirements, as heavy existing workloads may prohibit the adoption of practices that require increased labor. Conversely, reduced demands for labor may allow the diversification or improvement of other agricultural fields, as well as increased time for off-farm activities.

In focus groups, interviews, and farmer preference studies, farmers have indicated that increasing yields and income are high priorities. Given the existing food scarcity, there is clearly a need for new cultivation methods. However, any solutions will have to involve labor demands that are feasible.

Implications of seasonal shifts in time allocation

The most labor-intensive agricultural season, during which farmers would benefit most from labor-saving practices, is July–November, with labor demand exceeding 17 waking hours per day. The potential labor savings from CA are greatest during weeding and fertilizing of legumes, with approximately 15 fewer labor hours per month for women and 8.5 fewer hours per month for men. This presents a high potential benefit for farmers, especially women, as these are some of the most physically taxing components of cultivation (Pradhan and Shrestha 2010). However, increased labor demands during harvest and plowing for intercropping, when existing labor requirements are already high, may create a barrier

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to adoption of CA practices. The increases in labor for sowing under CA are shared by men and women; however, the majority of the increased harvesting demands fall to women. This may be attributed to men's involvement in cultivation being higher at the start of the cropping season and tapering later in the season. Introducing efficiencies during sowing and harvesting may reduce the overall labor requirement and make CA feasible. These may include determinate crop varieties, which may have more uniform growth patterns, and cultivation methods to regulate crop height, a streamlined harvesting process, or hand tools designed for efficient line planting.

Impact of access to agricultural decision-making

While many households report equal involvement in agricultural decision-making, 51.3% of women reported having less control than their male counterparts. As reported in individual interviews, this could be attributed to cultural expectations of male-dominated decision-making and feelings of inferiority by women who lack education. While participation in agricultural decision-making tended to vary from household to household, the overall trend was to defer to the male head of household for final decisions. Given that women conduct the majority of farm labor and will experience increased labor from CA, women's lack of input on adoption may result in decisions that do not consider its practical feasibility, creating a barrier to long-term implementation.

Conclusions

As evidenced in this study, CA practices can have varying effects on labor demands. Such changes can result in an inequitable or impractical redistribution of labor between men and women; thus, it is crucial to assess the gender impacts and feasibility of introduced practices. These changes are likely to be locally specific, depending on culture and environment. Nevertheless, the framework provided here could be used to measure potential labor shifts in other mountain regions where smallholder farms are common.

Additionally, one should consider this research within the larger household and community context. Other agricultural activities and household obligations may restrict the capacity to absorb the shifts in labor that would result from adopting CA. A practice that causes little or no change to labor demands can be more feasible, particularly where existing labor demands are high.

Seasonality of labor demands is another important factor affecting the feasibility of a practice. Finally, opportunity costs in terms of potential for off-farm wage earning are important to consider in the overall benefits of agricultural labor saving. Further research should investigate the sociocultural determinants of agricultural division of labor and the dynamics of decision-making to better understand communities' adaptability to changing agricultural systems.

The results demonstrate that CA's benefits are contextual and may benefit some more than others. Given the gendered pattern of labor and decision-making power, this calls for an intentional involvement of women in the execution of CA projects. If CA is adopted without consideration of women's workloads and other concerns, it runs the risk of demanding more labor from women who are already overworked and physically exhausted. As women tend to shoulder much of the reproductive work in the household, the additional time requirement for them may result in a tradeoff between agriculture and vital household responsibilities, including preparation of food. In the long run, not only is participation by women in the design and implementation of CA projects important in and of itself as a way to achieve gender justice, but equal participation in household decision-making is a critical part of improving the livelihoods of rural women (Tulachan and Neupane 1999).

In sum, this research has demonstrated the importance of integrating gender sensitivity and an understanding of gender-based agricultural division of labor in the planning process for agricultural development projects, to promote both community equity and increased adoption. Policy-makers and development practitioners must apply an interdisciplinary approach, considering the gender, economic, and environmental impacts of introduced practices to develop practical approaches and better understand farmers' conditions. With continued work in this area, projects can be better designed to consider gender dimensions and improve long-term development.

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REFERENCES

Beniston M. 2003. Climatic change in mountain regions: A review of possible impacts. *Climatic Change* 59(1–2):5–31.

Beteta CH. 2006. What is missing in measures of Women's Empowerment? *Journal of Human Development* 7(2):221–241.

Bhushal S. 2008. Educational and socio-cultural status of Nepali women. *Himalayan Journal of Sociology and Anthropology* 3:139–147.

Blackden CM, Wodon Q, editors. 2006. *Gender, Time Use, and Poverty in Sub-Saharan Africa.* World Bank Working Paper 73. Washington, DC: International Bank for Reconstruction and Development/World Bank.

Friedrich T, Derpsch R, Kassam A. 2012. Overview of the global spread of conservation agriculture. *Field Actions Science Reports* 6:1–7.

Glenn EN. 2001 Gender, race, and the organization of reproductive labor. *In:* Baldoz R, Koeber C, Kraft P, editors. *The Critical Study of Work*. Philadelphia, PA: Temple University Press, pp 71–82.

Gurung K, Tulachan PM, Gauchan D. 2005. *Gender and Social Dynamics in Livestock Management: A Case Study From Three Ecological Zones in Nepal*. Kathmandu, Nepal: Center for Mountain Research Development. http://r4d.dfid.gov.uk/PDF/Outputs/Livestock/ZC0286-Case-Study-Nepal.pdf; accessed on 1 June 2013.

Hobbs PR, Sayre K, Gupta R. 2008. The role of conservation agriculture in sustainable agriculture. *Philosophical Transactions of the Royal Society* 363: 543–555.

IFAD [International Fund for Agricultural Development]. 2003. *Operationalizing the Strategic Framework for IFAD 2002–2006, Mainstreaming a Gender Perspective in IFAD's Operations: Plan of Action 2002–2006*. Approved by the 78th Session of the executive board in April 2003. [No place: no publisher]. http://www.ifad.org/gender/policy/action.pdf; accessed on 5 March 2014.

Knowler D, Bradshaw B. 2007. Farmers' adoption of conservation agriculture: A review and synthesis of recent research. *Food Policy* 32(1):25–48.

Lee DR. 2005. Agricultural sustainability and technology adoption: Issues and policies for developing countries. *American Journal of Agricultural Economics* 87(5):1325–1334.

Luni P, Maharjan KL, Joshi NP. 2012. Perceptions and realities of climate change among the Chepang communities in rural mid-hills of Nepal. *Journal of Contemporary India Studies: Space and Society, Hiroshima University* 2:35–50.

Pillarisetti JR, McGillivray M. 1998. Human development and gender empowerment: Methodological and measurement issues. *Development Policy Review* 16:197–203.

Piya L, Maharjan KL, Joshi NP. 2011. Forest and food security of indigenous people: A case of Chepangs in Nepal. *Journal of International Development and Cooperation* 17(1):113–135.

Pradhan A, Shrestha N. 2010. Working hour and its impact on backache from gender perspective. *Dhaulagiri Journal of Sociology and Anthropology* 4:235–246.

Rocheleau D, Thomas-Slayter B, Wangari E. 1996. Gender and environment. *In:* Rocheleau D, Thomas-Slayter B, Wangari E, editors. *Feminist Political Ecology: Global Issues and Local Experiences*. New York, NY: Routledge, pp 3–22.

Shrestha DP, Zinck JA, Van Ranst E. 2004. Modelling land degradation in the Nepalese Himalaya. *Catena* 57(2):135–156.

Tancred P. 1995. Women's work: A challenge to the sociology of work. *Gender, Work & Organization* 2(1):11–20.

Thapa GB. 1996. Land use, land management and environment in a subsistence mountain economy in Nepal. *Agriculture, Ecosystem, & Environment* 57:57–71.

Thapa GB, Paudel GS. 2002. Farmland degradation in the mountains of Nepal: A study of watersheds 'with' and 'without' external intervention. *Land Degradation and Development* 13:479–493.

Tiwari KR, Sitaula BK, Bajracharya RM, Børrensen T. 2009. Runoff and soil loss responses to rainfall, land use, terracing and management practices in the middle mountains of Nepal. *Acta Agriculturae Scandinavica, Section B* 59(3): 197–207.

Tulachan P, Neupane A. 1999. *Livestock in Mixed Farming Systems of the Hindu-Kush Himalayas: Trends and Sustainability*. Kathmandu, Nepal: International Centre for Integrated Mountain Development (ICIMOD); Rome, Italy: Food and Agriculture Organization of the United Nations (FAO).

UN RCHCO [United Nations Resident and Humanitarian Coordinator's Office]. 2012. *Field Bulletin: Chepangs' Struggle for Survival: Views From Makwanpur and Chitwan Districts*. Issue 47, September 2012. Kathmandu, Nepal: United Nations Resident and Humanitarian Coordinator's Office.

http://dx.doi.org/10.1659/MRD-JOURNAL-D-13-00083.1