

Research Article

Zero till in wheat from the gender perspective in Nepal

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ABSTRACT

Different tillage practices such as zero-till direct-seeded rice (ZTDSR), zero-till maize (ZTM), and zero-till wheat (ZTW) were implemented in the farmer's field of Sunsari district were evaluated. However, the focus was on ZTW because of high competitiveness with cheaper wheat from abroad. Focus Group Discussion (FGD), Farmers households keeping records, field monitoring, key informant interviews were the primary source of data whereas literature and desktop review were done for secondary data. Zero till wheat operation scale out of the machine use had been increased, by 61.25% out of 109.63ha land in Bhokraha and 66.49 % out of 55.3ha of land in Kaptangunj. Whereas, a new node Chitaha was established with the initiation of non-respondent farmer's where the area occupied 26ha in the year of 2019 respectively as compared to the base year that of 2014. Yield advantage was not much higher with ZTW, the additional benefit of almost 34% over conventional till wheat (CTW) was sufficient enough for the farmers to decide to adopt zero tillage technology. Farmers perceived about 17% saving in seed requirement, 13% saving in irrigation amount and time, and 44% saving in total labor cost with ZTW to make it more profitable as compared to CTW. Among different methods of extension, farmers' field day with 63% and field trial with 48% with women's participation shows the most effective method to create awareness. Although the percentage of the working hour for the female worker is higher the number of the total hour has been decreased for both the man and women and the total 303.64hr/ha has been saved.

Keywords: Conventional till, gender, SRFSI, wheat, zero till

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INTRODUCTION

Indo Gangetic plains are the most fertile land that includes around 255 million ha across four countries India, Nepal, Pakistan, and Bangladesh (Soneja *et al.*, 2016). Nepal is facing labour problems in the agricultural field due to the increasing number of youth migration. With changing technology, and different kinds of demands peoples are changing their roles from

agri-based to an advanced type of works. Wheat is the second major cereal crop for the Terai region of Nepal and the data shows wheat production in Nepal increased from 2651000 tonnes in 1970 to 17861000 tonnes in 2019 growing at an average annual rate of 4.74% (World Data Atlas, 2019), area is increasing by 3.67 % (Gairhe *et al.*, 2019) and productivity is growing at the rate of 2.52 percent per annum (Gairhe *et al.*, 2018) where agriculture is the major GDP contributing sector. Lack of quality inputs, machinery, the problem of labour shortage has been reported and the majority of the farmers in this region are adopting conventional agricultural practices where water, capital, energy use were intensive and also pose a serious threat to the sustainability of the cereal-based farming system (Bhatt *et al.*, 2016). Conservation agriculture (CA) is an approach to managing agro-ecosystem for improved and sustained productivity, increased profits, and food security while preserving and enhancing resource base and the environment. In CA technology, there are advantages of continuous minimum soil disturbance, permanent organic soil cover, and diversification of crop species. Zero tillage is one of the CA technology. All tested RCTs like zero tillage, reduced tillage with power tiller and surface seeding technologies provided great reduction in the cost of cultivation, higher yield and benefit over farmers' conventional tillage (Tripathi, 2010). Mechanization is relatively limited but is now emerging and is in governmental priority through various programs and projects. Low levels of mechanization, high labour requirements and the high costs of irrigation and labour, production costs are high and farm profits are low.

It is reported that the labor migration by Nepalese youth is extensive and male-dominated. The regions with the highest rates of labor outmigration are rural Terai, rural Hills, and Mountains. Female labor migration is mostly within Nepal, whereas male labor migration is mostly to other countries. Male youth labor migration has negative effects on the likelihood of employment and hours worked for female and male youth household members who remain at home, although the effects are not consistently significant (Laurent and Anastasiya, 2018). The new agricultural techniques may change labor demands in significantly different ways for men and women. Distribution of household and agricultural labor plays a critical role in determining the feasibility of agricultural practices to minimize the gender disparities, as the inability to increase labor hours can be a factor in the failure to adopt practices despite their potential. Nepal Census 2011 shows that about 65.6 percent of people are dependent on agriculture. Whereas women contributed around 65 percent of labour in the total labour requirement of agricultural practices.

A study conducted in Pakistan shows women's working activities in agriculture may improve their livelihood and nutritional status, but could also have an adverse impact on their health status due to overwork (Balagamwala *et al.*, 2015; Butt *et al.*, 2010). Therefore, the inclusion of women in the food security programs, especially in livestock and crops, needs a gender-sensitive method (Andaleeb *et al.*, 2017). Women's literacy, especially mothers; about healthy food has a significant effect on food expenditure and consumption, which is important for food security outcomes (Amin *et al.*, 2009). 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 & Neupane, 1999). However, very few study examining CA's gender-specific effects on workloads, its seasonal changes, and the dynamics of decision-making and its impact on livelihood. Therefore, the study was carried out with the objective to assess adoption, farm profitability potentials of zero till wheat in scale farming

from gender perspective in four locations of Sunsari district namely Salbani, Bhokara, Kaptangunj, and Chitaha laying at eastern Terai of Nepal.

MATERIALS AND METHODS

Sustainable and Resilient Farming Systems Intensification in the Eastern Gangetic Plains (SRFSI) the project with the collaboration of International Maize and Wheat Improvement Center (CIMMYT), Department of Agriculture (DoA), and Nepal Agricultural Research Council (NARC) was started in ten nodes of Sunsari and Dhanusha districts of eastern Terai region of Nepal from 2014 summer season with the major objective to assess whether conservative agricultural practices (CA) would be beneficial to smallholder farmers through efficient use of water resources and resilience. The project focused on innovativeness and strengthens machinery supply and adaptive ideas to link the farmers with markets and support services. With the time gender mainstreaming has got momentum and the project included the ideas and starts to segregate gender-related issues from the Conservation Agriculture and System Intensification Technology such as ZTDSR, ZTM, and ZTW which were implemented in the farmer's field since 2014. The data was collected and compiled for 2014 to 2018. Selected districts have pre-dominant rice-wheat cropping system with a dense population and a higher concentration of rural poverty. Farming systems of the study area comprised of subsistence, less competitive, shrinking arable land due to increased urbanization, fragmenting land, and smallholding with low cropping intensity. Production uncertainty due to climate change is increasing incidence of drought, flooding, erratic rainfall, cold waves, and rise of temperature. Increasing youth migration from rural to city area and city to abroad be labour scarce in leading to the high cost of production but the remittances are believed to reduce poverty.

Total surveyed sample were 240 households where 80 households were adopter and 160 were non-adopters, within 80 adopters; 31 farmers have more than 1 ha of land and are the target group of the study. To collect the data regarding the issue; farmers' group discussion, farmers households keeping records, field monitoring, and key informant interviews were the primary sources. Literature and desktop review was done for secondary data. But due to time, budgetary, and different unaddressed issues of adoption constraints of other CA technology the study prioritized only for zero-till wheat crop from a gender perspective. The socio-economic structure of the study area, the trend line of adoption status, total cost, gross margin, net income, and cost-benefit had been calculated and elaborated.

RESULTS AND DISCUSSION

The study was comprised of two different components that are the status of adoption of CA technology focused on zero-till wheat and the methods followed by the project to find out the status of women farmers due to the project. This study focused on what was gender, why needs to address gender. The reasons behind the inclusion of gender in the project and the development studies are covered in the study.

Characteristics of districts and nodes

It is reported that a 10% increase in the share of remittances in a country's GDP can lead to a 1.2% decline in poverty (Adams & Page, 2005; Pant, 2013). It is reported that in the year 2018/19 total of 7030 male population and 669 female population has been out migrated from sunsari district (GoN, 2020) which forces the female population to shift the workload and skill

which was being done by the male population in the previous days. Besides this, the trend of migration of the female population has been increasing leads to pressure to the rest of the population otherwise the farm can be unutilized. To cope with such the detrimental effect of migration various extension methods were used by the project.

Extension and Awareness program

Extension and awareness program at village-level especially with the smallholding farmers, local governments, machine supplier in regards to beneficial aspects of Zero-till was launched by formation and capacity building of farmers club. Dissemination to the agriculture community to access improved technologies, and strong market linkages. Farmer's field days, field trials, focus group discussion, exposure visit, scale-out, training and workshop were the means of extension and awareness programs followed. Among these extension and awareness methods, farmer's field day with 63% and field trials with 48% of women's participation showed the most effective method to make women farmers in the field level. For the increased adoption with the aim of gender balance; instead of farmer's seed, new and improved wheat varieties Gautam, NL297 and Aditya were used. These activities require less travel from home and allow flexibility of participation on the part of the women participants. On the other hand, scale-out activities, and training and workshops were less participated by women farmers. Adoption index was found higher in outreach (OR) sites and increasing its number greatly helps to adopt improved technologies (Timsina *et al.*, 2016).

Gender and gender analysis framework

The state of being male or female normally used with reference to social and cultural differences rather than biological ones is gender. Nepal is a country with vast differences in socio-ethnic values and norms. It varies with different ecology. With the change in community, the role of women varies from production to marketing process. The decisive power of women varies with age and the rank within the family. Women's role differs within the women's status also. In the community, mostly women have a more decisive role and control over the assets increase when they becomes senior and their husband becomes head of the household.

Gender participation, integration and identification of women's livelihood

Eastern Gangetic Plain (EGP) records one of the highest concentrations of rural poverty at about 300 million people. High poverty with dense male youth migration leads to the transfer of responsibility to women. To empower the women varies with the situation is very important to overcome the problem of youth migration of the country. Similar to other countries the role of women in farming has long been neglected in many parts of Nepal. That is the 'triple burden' of work to support the productive, reproductive and social spheres. This work 'overload' is mostly unpaid and unrecognized and restricts women's well-being and their engagement in activities of value, including remunerative activities. In the base year, 2014, only 2% of women farmers participated in different project activities. Women participation was encouraged to actively involved in different field activities, focus group discussion, farmer field days and exposure visits were done among them highest rate of participation by women farmers was field trials, having 48% combined participation.

Strategies followed for the increased women participation

Setting a target quota of 50-50 for both women and men were the first attempts done to assure women's participation. To encourage joint participation of both male and female heads of households in field trial and scale-out activities was the second strategy. Whereas, the third

step was training and workshops, closer to the farmer's community. Fourth, consider women's domestic and household activities aside from farming activities in scheduling project activities to improve the likelihood of attendance among women farmers. Lastly, by engaging women trainers especially in scale-out activities to encourage the participation of women. Women inclusive activities: fix the quota system was the most effective way to mainstream gender in the issue. In the case of field trial, total respondents were 31 out of the 23% were female participation while 39% were the joint participation. 100% of male farmers are involved in scale-out activities. In the case of ZT machine in wheat production due to time-saving technology; especially in irrigation that is 18% time incurred is less required in comparison to 55 hrs in the conventional technology, and cost of production reduction by 7%. It's both labour and cost-saving technology, Heavy operation practice and male-focused training in the preliminary phase of project, only male farmers are in scale-out process. While women farmers are supporting their male counterparts in cooking food for the skilled labour in wheat production time but in harvesting still the workload is as it is.

Promotion of CASI

Zero till direct-seeded rice, Zero till maize, and Zero till wheat were the type of Conservation agriculture and system intensification interventions in the area. Improved seed with new wheat varieties Gautam with 5t/ha, NL297 with 4t/ha, and Aditya with 4.8t/ha were used. Figure 1 depicted the program was initiated in 2014 where Zero till wheat were not in practice but with the time the practice of growing of wheat through zero till in the practiced area was increased by 61.25% in Bhokraha and 66.49% in Kaptanganj of 109.63 and 55.3 in Kaptanganj. Whereas a new node Chitaha was established with the initiation of non-respondent farmer's where the area occupied was 26 ha in the year 2019.

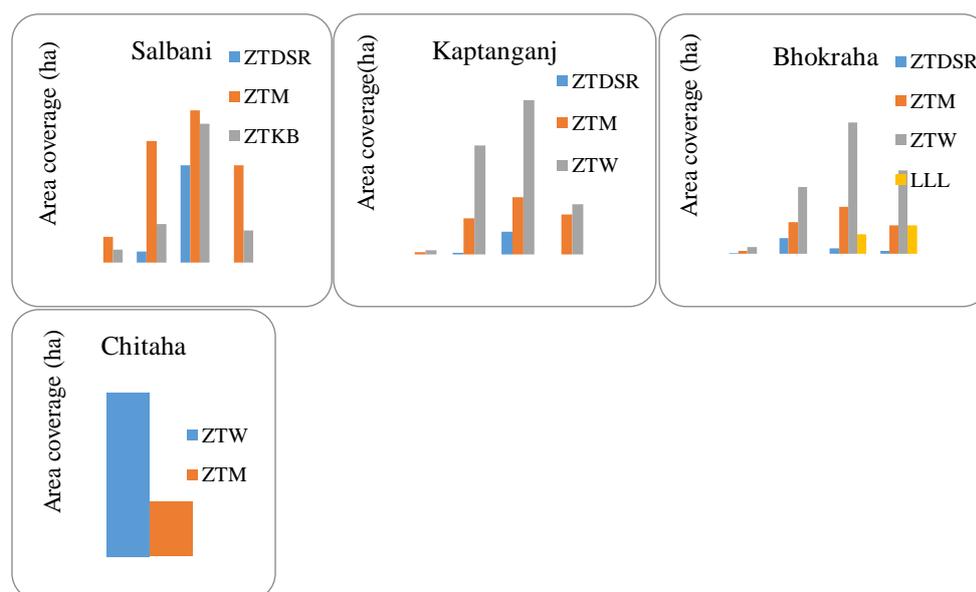


Figure 1: Status of adoption of CASI technology

Comparing conventional practice with zero till wheat production

Table 1 and table 2 depicted the difference in wheat production through conventional to zero-till wheat practice. Awareness of farmers, availability of the machine, repair and maintenance, skilled manpower to operate zero-till machine, unavailability of spare parts were the major constrains to operate the machine on its full demand.

Table 1: Conventional practice on wheat production per hectare

Particular	Unit	Conventional practice		
		Quantity	Rate (Rs)	Total
Machinery use	h	9.4	1500	14100
Seed	kg	185	52	9620
Irrigation	h	55	100	5500
Urea	kg	110	19	2090
Potash	kg	40	36	1440
DAP	kg	93	48	4464
Glyphosate	L			0
Pendimithaline	L			0
Other herbicide	L			0
Labour				
a. Cooking food for labour		5	60	300
b. Seed cleaning		2	60	120
c. Marketing of seed and fertilizer		2	60	120
d. Field labour		255	60	15300
Total cost				53054
Gross income		2380	26.59	63284.2
Net income				10230.2
B:C ratio				1.192

Source: Field Survey, 2018

C:B analysis shows that the producer can save approximately NRs.4000/ha during cultivation practices whereas NRs. 9842/ha can be saved from a hectare of the land after harvesting the product. Therefore, zero-till wheat is profitable technology for Sunsari district. Introduction of zero-till replaced the plough empowered the producer through increased income.

Table 2: Zero till practice in wheat per hectare

Particular	Unit	Zero tillage		
		Quantity	Rate (Rs)	Total
Machinery use	h	6.65	1500	9975
Seed	kg	1.49	52	7748
Irrigation	h	45	100	4500
Urea	kg	114	19	2166
Potash	kg	57	36	2052
DAP	kg	95	48	4560
Glyphosate	L	1.85	680	1258
Pendimithaline	L	1.71	750	1282.5
Other herbicide	L	1	400	400
Labour	h	252	60	
a. Cooking food for labour		4	60	240
b. Seed cleaning		1	60	60
c. Marketing of seed and fertilizer		2	60	120
d. Field labour		245	60	14700
Total cost				49061.5
Gross income	kg	2600	26.59	69134
Net income				20072.5
B:C ratio				1.409

Source: Field Survey, 2018

Changing gender's role due to introduction of zero till

Introduction of zero-till changed the mechanism of working replacing plough by machine by 100% in the selected sites. Both males and females have been empowered through increased income by 18% of total investment in the conventional method and 20% of total investment in Zero till operation. Although the percentage of the working hours for the female workers is higher the number of the total hours has been decreased for both the man and women and the total 303.64hr/ha has been saved by the use of zero-till machines. The socio-economic context of the farm community has been changed because the entire female labour has changed their role from farmworker to household work that is cooking food for a male workers like drivers. By involved at community-level females have shifted the role for the marketing of seed and fertilizers and the vegetables grown in the leisure period gained by saved time due to use of zero-till in wheat. Few male farmers have a new responsibility that is due to change in work from labour to machine supplier. But the major workloads for woman farmers were during wheat harvesting which is untouched.

Table 3: Gender wise differences in role and time associated with Zero till wheat (M = male, F = Female) per hectare

Particular	Unit	Conventional practice				Zero till practice			
		M%	F%	M	F	M%	F%	M	F
Machinery use	h	80	20	7.52	1.88	100%		6.65%	
Irrigation	h	75	25	41.25	25				
a. Cooking food for labour	h		100		5	100	4		
b. Marketing of seed and fertilizer	h	100		2			100		1
c. Field labour	h	80	20	204	51	80	20	196	49
Total hour	h	75.45	24.55	254.77	82.88	48.13	51.87	16.37	17.64
Total time differences (ZT with CT)	h			337.65				34.01	303.64
Total difference in men workload	h			220.76					
Total differences in women workload	h			65.24					

Source: Field Survey, 2018

Gender perspective (Leadership development)

A case of a trial participant that's a woman farmer could be a good eventual service provider. Sanju Chaudhary a leader farmer of Bhaluwa node of Sunsari district from Tharu community having only, secondary level education, with severe economic problems, agriculture as a family legacy. She would be quite worried about many problems labor in the peak season, irrigation, lack of other inputs like seed and fertilizers, technical know-how hence very low productivity of crops. As a result, her family would face food insecurity for more than 3 months a year. She would be always looking for a way out of this problem. SRFSI staffs approached her community to orient about the conservation agriculture, mechanization and cropping systems intensification, she overtook all the male fellows and took the lead in implementing the project activities. She even encouraged more and more women to come forward and participate in SRFSI activities.

CONCLUSION

Opportunity to expand wheat from Zero tillage operation production in Sunsari exists because of high profitability from wheat with low labour use. However, this will require improving farmers' access to both the men and women to high-yielding seeds, fertilizer/manure and pesticides, credit, and ZT machines. The introduction of machines are highly encouraging due to the increasing number of participants including women in the training program of ZT wheat. Although the ZT machine was less labour-consuming; moreover; women's role of wheat harvesting by manual was remained untouched, therefore; the introduction of reaper for wheat harvest is recommended to reduce the workload of the women farmers. Efforts to scale wheat need to isolate the gendered based constraints from general barriers in order to address gendered implications for adoption and expansion of wheat at the farm level. Some small package could be introduced as gendered incentives to participate at post-production levels of the wheat value chain.

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Author's Contributions

S Sapkota designed the research plan. S Sapkota, S Shrestha, SP Adhikari, S Jha and S Gairhe collected data and S Sapkota finalize the manuscript with the comments and feedback from all the coauthors. The final form of the manuscript was approved by all authors.

Conflict of Interest

The authors declare that there is no conflict of interest with the present publication.

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