Tank Irrigation and Agricultural Practices in Tribal Communities: A Gender Perspectives

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Abstract

An examination of agricultural practices in tribal communities through tank irrigation with the phenomenon of gender inequality in labour force participation and resource management literature demonstrates the unequal effects on men and women, with female marginal worker and landless labour bearing the major brunt. Applying both quantitative and the narrative method of subjective inquiry the community perspectives of role of women in labour force participation and income generation in the rain-fed agriculture in Mayurbhanj District of Odisha. The findings suggest that tank irrigation supports women's participation in the intensive and extensive agriculture though they lack control over accumulated benefit of production and income, decision making to prioritize their need, differential access to the information and communication technology in countering the resilience and adaptation of the adverse impacts of climate shocks. This paper emphasized that vulnerability-sensitive interventions and policies must ensure male and female need and priorities to end the gender inequality in water resource livelihood outcomes.

MSC 2010: 62DXX, 03B48.

Keywords: Agriculture, Tank Irrigation, Gender participation, Tribal Community, Mayurbhanj.

Introduction

Agriculture is a gender subject since 1970s (Boserup 1970). An examination of agriculture with the phenomenon of gendered labour force participation and allied literature demonstrates the unequal effects on men and women, with female marginal worker and landless labour bearing the major brunt. Oxfam (2018) study showed that in India female owned only 13 percent of the land but around 80 percent of the agricultural work are performed by them. United Nations (UN) Committee on the Elimination of Discrimination Against Women (CEDAW, 2014) in their general recommendation addressed that "land rights discrimination is a violation of human rights". Still, 90 countries across the globe evidenced the fact that women lack equal rights to the ownership of land. The situation of the Indian State of Odisha is worst. Only around 4 percent of women are having land ownership still the state is one of the major agricultural dependent economy including mining and services. National Council of Applied Economic Research reported the statics that 85 percent of the rural female workforce are engaged in the agricultural sector and produce around 60 to 80 percent of the food(NCAER, 2018). Much of the women labour force in agriculture engage in the non-mechanized labor-intensive processes of farm occupations that include transplanting, sowing, winnowing, harvesting, head load transporting, procuring, shorting and what not (Oxfam 2013). According to the report of the Economic Survey of India (2017-18) that with growing number of rural to urban male migration female bear the brunt of household food security. There is the phenomenon of "feminization of labour" with large number of women performing multiple roles in agriculture sector as labourer, cultivator and micro-entrepreneurs within precarious condition of sources, resources and knowledge. According to IHD, New Delhi (2018)70 percent of such households are witnessed having male migration. India Human Development Survey (IHDS, 2018) in their report identified that the consequence of lack of recognition of these female agricultural worker is resulted with their exclusion from access to institutional credit, insurance, pension, irrigation etc. Higher rate of their participation in both the production and management of agriculture is a reality though do not necessarily consonant with their entitlement, decision-making, income generation, knowledge and communication skill etc. characterized by a strategic intervention gap to achieve distributional impacts and reduce women's vulnerabilities. However, the study on gender in agriculture in India have not been given adequate consideration to the need for research that apply holistic approach and both quantitative and the narrative method of subjective inquiry in the rain-fed agriculture region to document the

community perspectives of engagement in agriculture. Further, after having tank irrigation facility in Mayurbhanj District of Odisha how community engagement in intensive and extensive agricultural production have recognized women's labour force participation and income generation. The purpose of this study is to address the following three questions in a highly Santali tribal dominant rain-fed Mayurbhanj district of Odisha. Central to the debate on gender issues in agriculture in Odisha, the research confronts with the following three questions.

1. What roles do the men and women play in agriculture in the Santali tribal communities in a rapidly changing climatic condition?
2. How the tank irrigation system in the Santali communities reduced the vulnerabilities in agriculture and promoted women empowerment?
3. What are the socio-economic and gender implications of these interventions for a large number of women marginal workers and land less labourers of Mayurbhanj district in Odisha?

Section two deals with the literature review, introduces the role of Sansialinai water reservoir near Sansialinai village in the agriculture livelihoods. Section three discusses about the research design and data collection methods. Section four is precisely and accurately discuss in the result and research findings for decision-making of policy makers and academia. Section five concludes the study with inferences from both quantitative and case narrative. This is to advance new theory building in the gender-based agricultural research framework and inform the strategy to engage community participation.

Review of Literature

An examination of the phenomenon of gendered agricultural practice with rapidly changing climatic conditions in literature shows the negative impact of inequality on men and women and the nature of female labour force participation and income generation that leads to it. Despite a lack of appropriate mechanism across countries to access productive resources and sources, ensure joint entitlement to land, assets, credit, micro-insurance, technology, control over decision making, market, wage and income still women represent a large number of marginal and landless labourers (FAO 2011; ILO 2016; Indian Inequality Report: Oxfam 2018; Economic Survey of India 2017-18; NCAER, 2018). This has been characterized by a gender gap in ensuring the need and priorities to meet their basic and in distributional impacts to reduce vulnerabilities. Consequently,female bears the major brunt of its outcomes (Meinzen-Dick 2014; UN Women et al. 2015; Huyer 2016).

Choudhury et al. (2017) study in their research discussed the key gender barriers in agriculture are (1) Entitlement to agricultural land, assets and differential patterns and conditions (2) Poverty eradication and household food security (3) Sustainable livelihoods, and community perspectives on women land rights, and (4) Key challenges and recommends strategies for moving towards it.
A growing number of recent study around the globe inquired into the range of factors causes for declining of tank irrigation in India (Kumar et al. 2018). The issues which they have identified the "decline," are mainly the lack of social capital management of traditional community institutions (Reddy et. al. 2019) for regular maintenance of tank water. However, there are no studies that show that the most critical issues is on how to integrate the gender interest around the active engagement of women in the traditional water management which would not only help enhance the performance of tanks and community livelihood but also gender economic equality.

Traditional Water Harvesting System for Inclusive Community Engagement

Reddy and Behera study found that deterioration and degradation of tank irrigation directly affects the small and marginal farmers' livelihoods as well as food security and indirectly affects medium and large farmers in the form of declining groundwater tables(2009). Study shows that tanks are considered as useful life saving mechanism in the perennial water scarce areas that are categorized as Arid and Semi-Arid Tropics (Reddy and Behera 2009). Tanks provide not only water for irrigation, but also recharge the ground water table and hence raise availability of water in wells. The sustainability of tank irrigation is questionable unless these are well maintained, especially, due to ecological linkages between tanks and agriculture (Reddy and Behera, 2009). It should be pointed out that small and marginal farmers mainly depend on tank irrigation while medium and large farmers use ground water for irrigation (Balasubramanium, 2006). Turral et al., (2010) concludes that the options for new developments are limited, and that future investment will need to be more precisely targeted to specific niches in different agro-ecological and economic contexts. Investments in water storage and control will be important components of rural development strategies that respond to climate change. This means that contrary to the common practice of substitution for agricultural productivity there exist strong complementarities between tanks irrigation, community livelihood and recognition of men and women in this process, and this requires adequate attention in policies and actions at the local level (Acharya 2006; Agrawal 2009; Shiva 2009). Further, village 1evel studies are necessary to have proper understanding of both men

and women farmers'/users' perceptions about these linkages and their response to the same. Such efforts are also important as most of the existing studies lack evidence on the gender dimension of the use and management of the tank irrigation especially in a rain-fed agricultural region, and it is difficult to think of gender equality in the project interventions and particularly considering female agricultural participation otherwise.

Case Study of Sansialinai village near Sansialinai Reservoir in Mayurbhanj District

In the Sansialinai village of DurduraGrampanchayat had around 98 percent Santali tribal population (Census 2011). Sansialinai is a typical tribal village located in the remote area near Sansialinai reservoir. The Sansialinai reservoir of Jashipur Block of Mayurbhanj District is named after the village. The community lifestyle had been confined within underdevelopment. However, after the implementation of the tribal development plan of the then Odisha government, the lives here taken a positive turn. In the year 1972 the foundation was laid by the then Chief Minister of Odisha Mr. Biju Patnayak and the work completed in 1984. There the women and men started irrigating, bathing, fishing and grazing. One of the village stakeholders said that villagers of the nearby Gram Panchayats had taken collective action against the poor working condition of tanks. Their written complaint had been considered for further action by the Chief Minister. They felt that this endeavor was a blessing for the communities located around tanks of the tribal area. Traditional water tank is the backbone for the agricultural development and food security. Next section discusses the research design and data collection methods.

Selection of Study Area, Data Collection and Research Methodology

Research Design

The study is carried out at the micro level empirically based on the primary data. Field study conducted in Mayurbhanj District of the Indian states of Odisha during the period of January 2020. The research teams during their initial stage of discussion with the community stakeholders have realized that they must move beyond the comfortable zone of only positivism approach and deductive method of inquiry. Hence, to acquire evidence and oral account of the respondents which might significantly address the research questions on why and how the key influential factors have shaped the community engagement especially female marginal workers' participation in the traditional agricultural practice in a rapidly climate changing condition in Odisha. Secondary

source of information gives an overall understanding of the district and village level gender disaggregated data and information available. The secondary sources of information collected from existing published articles, books and reports of various government databases like the Census of India 2011, Minor Irrigation Hand Book (Government of Odisha). Following paragraphs discuss in detail about the primary data collection approaches and methods.

Universe and Unit of the Study

Mayurbhanj district is the largest district of Odisha having a total number of 2, 38,772 cultivators of which 46.48 were agricultural labourer (Census 2011). As per 2011 census of the 7.68 percent of Schedule Tribe population (22.87 Odisha average) 88.39 percent resides in rural area and of the total 56.6 percent of Schedule Tribe population in the sample district (the rural ST population constitute of 97.26 percent. Out of 26 blocks in the district, five blocks (20 percent) namely Khuta, Jashipur, Karanjia, Bangiriposi and Tiring blocks has been randomly selected. In the second stage, two villages are selected in each block on the basis of the high proportion of households belong to *Santal* tribes. Thus, making the total number of ten villages namely Mahulia and Kamali (Khuta Block), Tangabhilla and Sansialinai (Jashipur Block), Pingu and Bajenisila (Karanjia Block), Tanigjabasa and Laxmiposi (Bangiriposi Block) and Dumatandi and Badasiajang (Tiring Block).

Sample

In the third stage, 20 agricultural families from each village are selected randomly with an aim to make each village equally representative. Since the study is to understand the male and female perception and experience of gender inequality in agricultural practice one male and one female member of each of the household were selected to participate in the interview process making 200numbers of sample households and 400 numbers of respondents. The basic criteria to select the sample households were those who have actively participating in agriculture and allied activities and agriculture is their major source of income. To understand the gender gap in agriculture equal proportion of male and female were given priorities to participate in the semi structured interview guide. Therefore, 200 male and 200 female respondents were interviewed.

Table: 1 Total Workers of Sample Villages (%)

Items	Khunta Block		Jashipur Block		Karanjia Block		Bangiriposi Block		Tiring Block	
	Mahulia	Kamali	Tangabhilla	Sansialinai	Pingu	Bajenisila	Tangjabasa	Laxmiposi	Duma Tandi	Badasiajang
Male	47.84	49.36	64.40	51.11	56.11	47.67	52.26	52.12	52.84	50.00
Female	52.15	50.63	35.59	48.80	43.88	52.32	47.73	47.87	28.19	50.00
Main Workers	28.60	44.14	65.21	50.71	30.06	33.72	3.51	5.31	42.18	44.23
Male	25.82	37.18	45.65	38.75	27.44	23.25	2.51	4.25	36.49	26.92
Female	2.78	6.96	19.56	11.96	2.62	10.46	1.00	1.06	5.68	17.30
Marginal Workers	71.39	55.85	34.78	49.28	69.93	66.27	96.48	94.68	57.81	55.76
Male	22.02	12.18	18.75	12.44	28.67	24.41	49.74	47.87	16.35	23.07
Female	49.36	43.67	16.03	36.84	41.25	41.86	46.73	46.80	41.46	32.69

Source: Census GoI, 2011

Data Collection

In addition to the questionnaire interview at a household level, key informant interviews and in-depth discussion with the stakeholders were conducted prior to the survey. The open-ended discussion by using narrative method of inquiry was conducted in Sansialinai village of Durdura gram panchayat to document the positive role of Sansialinai reservoir of Jashipur Block of Mayurbhanj District. Narrative method of inquiry draws evidence from the protagonists through a conversational mode of sharing their experience and perception about the topic which are important to situate the knowledge co-construction in a subjective manner. The narrative inquiry was conducted with 18 numbers of experienced respondents across all two villages to generate a series of case studies. This data collection process provided a deeper understanding of the socioeconomic and gender implications as well as institutional dynamics of the local level and to substantiate the findings of qualitative analysis.

Data Analysis

Specification of Model

In this study, we have analyzed the factors affecting or influencing the gender gap in work force participation in agricultural sector of Mayurbhanj district in Odisha using cross sectional data for the period 2018. Here, income is the dependent variable and how the explanatory variables (age, gender, education, landholding size, ownership of land, irrigation system, credit, decision making, pay structure, training programme, food security and market) are impacting income of the respondents and their standard of living, and it implication on gender gaps. For the primary survey analysis, we have taken two multiple linear regression models. Before the regression analysis we have to check some statistical tests as per the requirement of data such as, VIF test for multicollinearity, D-W test for autocorrelation and to check the accuracy and reliability of the data. Here the equations are,

$$Ym = \alpha + \beta 1\ age1 + \beta 2\ edu2 + \beta 3lhs3 + \beta 4Dosl4 + \beta 5Dif5 + \beta 6\ Dica6 + \beta 7\ Ddm7 + \beta 8\ Dpi8 + \beta 9\ Datdc9 + \beta 10\ fs\ 10 + \beta 11\ amk11 + e \quad \ldots\ldots\ldots\ldots\ldots\ldots \text{ Model (1)}$$

$$Yf = \alpha + \beta 1\ age1 + \beta 2\ edu2 + \beta 3lhs3 + \beta 4Dosl4 + \beta 5Dif5 + \beta 6\ Dica6 + \beta 7\ Ddm7 + \beta 8\ Dpi8 + \beta 9\ Datdc9 + \beta 10\ fs\ 10 + \beta 11\ amk11 + e \quad \ldots\ldots\ldots\ldots\ldots\ldots \text{ Model (2)}$$

where, Ym/f–respondent income from farming male/female, age1- age of the respondents, edu2 - years of education, lhs3–landholding size, Dosl4–ownership of land, Dif5–irrigation facilities, Dica6–institutional credit available, Ddm7–decision making, Dpi8–pay inequality, Datdc9–availing training on digital communication, fs10–food security, amk11–access to market.

Table: 2 Description of Variables used in Analysis

Variables	Classification	Sign
Dependent Variable		
Income of the Respondent	Respondent Income from Farming (Yearly)	Positive
Explanatory Variables		
Gender	Gender of the Respondent, Dummy Variable=1 for male and 0=otherwise	Positive
Age	Age of the Respondent (Years)	Positive
Education	Years of education of the Respondent	Positive
Landholding Size	Landholding size of the respondent (in acres)	Positive
Ownership of land	Owner of the land, Dummy Variable=1 if the respondent owner of the land and 0=otherwise	Positive
Irrigation Facilities	Dummy variable=1, if the respondents get facility and 0=otherwise	Positive
Institutional credit Available	Dummy variable=1, if the respondents avail institutional credit and 0=otherwise	Positive
Decision Making	Dummy variable=1, if the respondents take a decision in agricultural activities and 0=otherwise	Positive
Pay Inequality	Dummy variable=1, if the respondents take pay equality in agricultural activities and 0=otherwise	Positive/Negative
Availing Training on Digital communication	Dummy variable=1, if the respondents availing training on digital communication regarding agricultural information and 0=otherwise	Positive
Food Security	Number of days in a year that the respondents secure their food	Positive
Access to Market	Distance of market from respondent's residence (km)	Positive/Negative

Table: 3 Regression Result for Gender Disparity in Agricultural Sector

Variables	Model-1 (Male)	Model-2 (Female)
Age (age_1)	0.466**	0.398*
Years of Education (edu_2)	1.501*	0.200
Landholding Size (lhs_3)	0.671**	0.432*
Ownership of land ($Dosl_4$)	0.648**	0.470*
Irrigation Facility (Dif_5)	0.747**	0.699**
Institutional credit available ($Dica_6$)	0.688**	0.503**
Decision Making (Ddm_7)	0.721**	0.145
Pay Inequality ($DpiX_8$)	0.821**	-0.532**
Availing Training on Digital communication ($Datdc_9$)	0.067	0.182
Food Security (fs_{10})	0.489*	0.332*
Access to Market (amk_{11})	-0.431*	-0.561*
Number of Observation	200	200
R Square	0.8277	0.7892

Note: ***p<0.01, **p<0.05, *p<0.1

Source: Field Survey, 2019

Result and Discussion

The value of R square is 0.8277 for male and 0.7892 for female depicts that the explanatory variables are 82 percent and 78 percent describe the dependent variable (Table-2). In this model, nine variables are positive or negative (pay inequality and access to market) and significant and it is affecting the dependent variable whereas two variables such as education (for female) and training are positive impact upon income but it is not statistically significant.

Age of the respondents is positive and the coefficient of male respondents is 0.466 and for female is 0.398 while both the models are found significant at 5 and 1 percent level. It is indicating that women respondents in their age group of 20-30 are very actively participating in agriculture and allied activities and their participation slow down after they reach the age of 50.

It is seen that if the education of male respondents increase by one year, the income would increase by 1.501 thousand of rupees. The result found to be significant as the P value for their coefficient is 0.062. But in case of female respondents, education is insignificant while it has positive impact

on income. In the study areas the ratio of female literacy rate is around one third of male literacy rate. However, most of the male respondents have completed only primary education and most of their female counters are illiterates.

It is seen that if landholding size of the respondent increases their yearly income increase by rupees 671 thousand for male and rupees 432 thousand for female. Hence, it is positive and has significant impact on income at 5 percent and 1 percent level. This study found that most the respondents are belong to small and marginal farmer. Only 9 percent of female possess less than half a hector of land as compared to their male counters who possess half a hector to two hectors of land. In case of land ownership the coefficient value is 648 for male and 470for female. It shows that impact of the ownership of land on the income is better for male farmers than the female farmers. If the irrigation facility goes up by one unit, the income of the farmers would go up by 0.747 units and 0.699 units of male and female respectively. Hence, there is a positive relationship between irrigation facility and has significantly impacted farmers income. However, female lack ownership over the most valuable agricultural land has disadvantages of enjoying direct income after livelihood diversification occurred through Sansialinai Reserve water.

Institutional credit is positively affecting both male and female farmers' capital requirements for diversifying their livelihood activities. The positive impact of credit on income found to be statistically significant at 5 percent and 10 percent level. The SHG members said that the main source of small credit for female is their revolving fund. However, male farmers and landless laborers depend upon the tribal development and small farmer's loan schemes, middlemen and Mahajan for their credit requirement.

Decision making coefficient of the male farmers which is 0.721haspositive and significant influence on their income and livelihood activities whereas the coefficient of female farmers is 0.145, which indicate that the relationship between female low decision making power and their income earning opportunity In the study area, male respondents found to take major decisions in the agriculture activities related to purchase of agricultural equipment, selection of agricultural inputs like seeds, fertiliser, selling crops and vegetables as compared to the female participation in

the production process and household chores, compounded with their less years of education, lack of confidence and care mobility to the market

The gender pay gap has impact on both male and female income in the agriculture and allied work. The coefficient of male respondents towards wage is 0.821 and it is significant at 5 percent level whereas the coefficient of female respondents is -0.532 and is significant. Further analysis depicts that gender pay gap in agricultural farming for male found to be 821 more than female in a year. If the pay inequality increases by one unit the income of the female respondents will decrease by 0.532 units. It is found that even with equal work performance and more backbreaking work women receive half the wage than men.

If the food security increases by one unit, the income would raise by 0.489 units for male farmers and 0.332 units for female farmers. Thus, both the coefficients are positive and significant at 10 percent level. In case of male respondents, the coefficient value is bit higher than the female.

Whereas inverse situation in case of access to market. If the distance of market increases by one unit, the income will decrease by 0.431 units for male farmers and 0.561 units for female famers. Both the variables are statistically significant at 10 percent level but it is negative impact on income of the farmers.

Thus, in this section clearly indicates that, the R square is higher in case of male respondents as compare to the female respondents. The coefficient value of the male respondents is significant except the coefficient value of training program on digital communication whereas the female respondents, the coefficient values of three variables are not significant out of 11 variables. The coefficient value is also high in case of male farmers as compared to female.

Gender Gap in Labour Force Participation and Livelihood

It is observed that primary occupation of a large number of the households of the Sansialinai village is agriculture and livestock rearing. It is clear to us during the focus group discussion with the Self-Help Group members and in-depth interview with the key informants that men represent a better percent of the main agricultural workforce and some of them are also run small businesses while 84 percent female represent marginal workers and daily laborers, men do ploughing, leveling,

sowing, irrigation, manure and fertilizer application, pesticides applications while women mostly do seed cleaning, uprooting of seedlings, transplanting, weeding, winnowing, drying and storage of the production. \SHG member said that if both husband and wife go for a work, the landlord gives her payment to her husband in front of her and that is around 30 percent less than her husband. The SHG secretary Sulochana said that she argued with the owner and requested him to give both the wages to her as her husband waste their hard earning for *hanndia* (countryside beer).Landlord was surprised at her and suggested her to solve their personal conflict in their home. Other SHG members slowly opened up to share their daily bitter experience about the discriminatory wage practices.

Sansialinai reservoir water facilitated both male and female to grow vegetables and leafy vegetables, and rear poultry, goat and livestock of their own or as wage labourers. In addition, they collect Non-Timber Forest Produces, fodders and leaves including some confectionary items and brew rice to produce *Handia*.

Problems before the Tank

Previously, the people of this Sansialinai area used to face several problems. During floods there was accumulation of silt in the nearby farm lands which also deteriorated the communication between the villages. The summer season brought new set of issues as there is immense water scarcity making cultivation impossible. Women responsible for water, cleaning, bathing, cooking and maintaining household sanitation and hygiene are vulnerable of such water scarcity or during the flood. Overall before the tank, agriculture in this area faced adverse situations giving the economy a major setback.

Almost all female respondents said that with a dominating underdeveloped tribal demography, many schemes and policies have remained unheard to them and in this region. Untouched with the urban modern world, blind faith and superstition is prevalent in the area. The girl child was not encouraged to pursue education and kept engaged in farm and household activities. Even the boys were not allowed to go to school, thus reflecting the ignorant mindset about education. Unfortunately, addiction to intoxicating substances is a major hindrance among adolescent boys and elderly male in the region which obstructs the advancement of responsible behavior among the male heads. Similarly progress in health and sanitation were also negligible those adversely

affect all and especially malnutrition persists among the pregnant mother and newborn child. The village "*Gunia*" (Witchcraft) or a person who has strong belief in witch or ghost sprit was relied upon for treatments.

Changes after the Tank

Traditional water harvesting structures such as tanks and ponds were found to be as insurance that ensure water security for cultivation, livestock rearing and other major work to local communities particularly during droughts and dry spells. Deterioration of this system has affected both livelihoods and food security of poor people. The causes of deterioration of tank irrigation system in Odisha are relatively less known. Both male and female participants of the village reported that after renovation of the Sansialinai they are using this tank to fulfill various purposes. Primarily the rain-fade area around the tank has been converted into agricultural activities. This tank supplements community production process. Households having land near Sansialinai reservoir are now engaged in the diversified agriculture production. Further, tank has roll in controlling floods that occurred often before. People are using the canal ring road for transportation now, however in rainy days this road becomes muddy and create problems for communication.

Social Changes

Changes in Education: In Sansialinai village male and female literacy rate is 27.15 percent and 13.71 percent respectively out of 41 percent in the village (Census 2011). Female literacy rate is less and half of the male literate. Maximum number of literates is below seventh standard. The elementary students can hardly read and write a paragraph. It is found that the level of education is still inferior in this region, which is mostly due to the poor connectivity of the region, since few decades. Before, the reservoir the tribal families are not conscious about the necessity of education, which partly is due to the poor financial condition of the region, as they believe that earning by working in field is more necessary for survival than going to school. The economic situation here thus influences their social standing. This decision is also influenced by the problem of alcohol addiction in this region. However, it is evident that 22 percent of the households of the village have improved their social and financial position and they want to provide their children good health and education.

Changes in health and sanitation: The access to health care and sanitation in the villages improved in presence of the ASHA workers. People received awareness training and Swachh Bharat Abhiyan movement reached to this corner of the village though local officer, teacher and media communication. However most of the people especially women are still stuck in their old superstitious beliefs and still turn to the Vaidya for ailments and not government. This hinders the progress of health development initiatives and thus requires special attention.

Advantages: The villagers informed that cultivation has improved with the introduction of better irrigation facilities. Previously there were severe water scarcity issues during summer but now irrigation manages the cultivation issue by providing enough water. Tanks promote vegetation which is helpful for Cattle grazing in the summer, thus supplementing the farmers' income. Farmers are also provided with other sources of income from the tank like collection of fish, snail, crabs etc. ameliorating their income. Tanks have not only solved the issue of water scarcity but also improve crop diversification. With the help of this tank some farmers can cultivate both paddy as well as vegetables in the *rabi* season, thus augmenting their income. Women play a greater role in these improved agriculture practices and 40 percent of them have recognized and respected by family and community members.

Infrastructure and Market Facility Related Challenges

The transportation of the goods and services, electricity and water connectivity are poor and worst during the monsoon season. Villagers can catch bus only after a three kilometer of travel in the *kachha* road. Women farmers carrying head load of agricultural products to the market in rainy season is difficult. Hence, not having own bullock cart or two-wheeler and other technological gadgets compelled them to depend upon male to sale their product consequently ended up with distressed sale. Both male and female respondents have shown their concern that in case of medical emergencies or delivering a child in the hospital or even if continuing higher schooling especially for the girls is highly challenging. The market structure in the area is in a deplorable state, which is a result of the poor infrastructure in the area. Very few traders can reach this place due to the defective connectivity. Commercial transactions get the farmers very low prices, leaving them discouraged for next production. However, high dependence on the local weekly market/village *hatta* platform to sale their products found to be less profitable. Mobility to distance market for the female producers during the rainy and summer season is restricted.

Challenges to improve Gender Responsiveness on Agriculture

It is found that lack of entitlement to land is a strict barrier to empowerment of these tribal women cultivators because ownership is required for availing resources, sources and technology. Further, gender stereotype of work, knowledge and communication skill inhibits the female member and marginal labourers from using and operating digital information and their participation in the farm mechanization process. Female member of the community observe from a distance either the operation or management of these technological and digital application by the male extension officer or family member from a distance and often ignore that belong to male knowledge domains. FGD member said that not because women are not interested but they forgotten what they learnt in the training, as there is no scope for them to operate such machine or gadgets, which would be definitely helpful for better production and income the impact of availing capacity building training and digital communication has advantages for improving female income however, frequent power cut, lack of infrastructure and affordable capacity to buy digital gadgets are the barriers.

Motivation to avail credit and insurance policy depend upon own confidence to utilize it for productive purpose and repay the loan in time. The major obstacle for female is that their access is confined only to the local market. Common problem among the SHGs members found are the way to utilize credit from formal and informal institutions, computer and financial literacy and appropriate skill and capacity building. Further, lack of financial literacy will reduce the confidence and motivation level to sustain their micro-business ventures. National Agricultural Bank for Rural Development and local Non-Government Organization can play important role to promote these SHGs.

Conclusion

Declining state of agricultural productivity and dependency on agricultural supply chain are curse to the small and marginal farmer, and landless labour in Odisha. An examination of agriculture with the phenomenon of gender inequality in labour force participation and allied literature demonstrates its unequal effects on men and women, with women marginal worker and landless labour bearing the major brunt. Higher rate of their participation in both the production and management of agriculture is a reality though do not necessarily consonant with their entitlement,

decision-making, income generation, knowledge and communication skill etc. characterized by a strategic intervention gap to achieve distributional impacts and reduce women's vulnerabilities.

Applying both quantitative and the narrative method of subjective inquiry in Santali tribe majority villages of Mayurbhanj District of Odisha, the present paper documents the community perspectives of engagement and promotion to achieve gender equality in labour force participation and income generation. The findings suggest that female labour force participation has increased after the repairing and maintenance of the Sansialinai reservoir. They are actively supporting the intensive and extensive agriculture activities, however they lack control over accumulated benefit of production and income. Addressing their challenges indecision making, prioritizing of female farmer and landless labour's strategic interest and gender differential access to market and technology are some challenges in countering their resilience and adaptation of the adverse impacts of climate shocks and irrigation. Reduction in the monopoly of middlemen and equal participation in the household decision making are prerequisite to improve Sansialinai women's economic condition and social positioning.

Farmer's vulnerability increases for each 1°C rise in temperature during growing season of the crops. Farmer suicides often studied as a male phenomenon. However, the study found that female agricultural labour and female with limited control over land and agricultural assets of a rural household are more susceptible to the climate change related agricultural crises. The precarious condition impact their food, fuel, fodder and water security and service providing roles and performances. This paper emphasized that vulnerability-sensitive interventions and policies must ensure men and women need and strategic interest to end the gender inequality in livelihood outcomes (FAO 2013).

A gender responsive tribal agriculture framework has significance to address the gendered influential factors. This framework must consider the gender relationship in equal participation and decision making in the agricultural cycle, mobility to market, skill set and financial literacy, local innovation in technology and e-business operation.. Transformative process towards 'holistic' approach is therefore requires in collectivising Santali male and female farmers performances through a strategic community entrepreneurial resource planning. Further research may be conducted to investigate the potential of livelihood promotion of such micro-tribal dominant communities through agro-producer Company. Hence training to the SHGs and farmers on

agroecology, agro-forestry, climate-smart agriculture and technological transfer, which must build upon the indigenous water harvesting governance and environmental sustainability

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