

## **How Beneficial has Water Technology been for Rural Nepalese Women?**

**Bhawana Upadhyay**

### **BACKGROUND**

In the literature on technological change, employment, productivity and income-distribution could be seen as influential and important paradigms (Bartsch, 1977; Whitehead, 1985). Acknowledging the extent of rural women's work as unpaid family laborers, particularly in developing countries, it is extremely important to consider the effects of technology on these women (ibid). However, traditional macroeconomic theories of technological change have been mainly concerned with impact analysis of technological change on the class distribution of income, which is inadequate in providing a framework for analyzing the question of technological change and rural women (Ahmed, 1985). Economists have tried to consider technical change mainly in terms of its impact on class distribution of income. For example, Hicks (1932) attempted to classify technological innovation in accordance with its impact on the functional distribution of income<sup>1</sup>. He argued that neutrality of technological change essentially implied an unaltered functional distribution of income. Likewise, Harrod (1948), following the same line of analysis, with new set of variables drew similar conclusion. Bhaduri (1985) argued that non-neutral technical change occurs when the class distribution of income alters as a consequence of technological change. Thus, he defines technological change as neutral if it leaves the pattern of income distribution among relevant groups unchanged, and technological change will be said to have a bias in favor of a particular group, if the pattern of income distribution is shifted in favor of that group. Whitehead (1985) suggests that there is a very large gap in literature dealing with technology and technological change specifically in reference to rural women. The much more recently developed literature on technological change and women is more or less forced to rely on descriptions of specific situations and on relatively low-level

---

<sup>1</sup> Using an aggregate neoclassical production function as the point of reference, Hicks considered technical progress to be neutral if, in effect, it left the ratio of profit rate to real wage unaltered at a given capital-labor ration before and after technical change. This criterion for neutrality was also adopted by Harrod (1948).

generalizations about empirical association of men with advanced technology and of women with backward technology. She also emphasizes two reasons on how traditional employment models fail to examine the processes affecting working conditions and work burdens of family labor. First, they lack a model for the propensity to work of household labor and secondly, they are unable to take account of the fact that family labor is primarily the labor of wives and children.

Women in Development (WID) analysis has often portrayed women as passive victims of both development and wider social subordination while gender analysts have been trying to understand not only the ways in which conjugal contracts disadvantage women but also how they struggle to improve their position, to renegotiate implicit contracts and social relations and in this access to technology plays a crucial role (Jackson, 1995). An example of the dilemmas in technology choice posed by gender analysis is illustrated by the debate about the welfare effects of mechanized grain milling in Asia. Some authors, for example Harris (1979), have seen this as negative on the grounds of the employment displacing effects on poor women and have argued for small scale intermediate technology approaches to milling (Ahmad and Jenkins, 1989).

Besides, it is often argued that technological change has unfavorable effects on rural women (Palmer, 1978; Dey, 1975; Whitehead, 1985). For example, on analyzing the effect of high yield variety (HYV) technology on women, Palmer (1978) argues that jobs like land preparation, harvesting and some processing are the easiest to mechanize and that where mechanization is introduced, female tasks become male jobs<sup>2</sup>. Likewise, hand pounding of grain—which used to be women’s job—has been replaced by rice mills which employ men, thereby displacing female labor in many developing countries.

In the literature on irrigation technology in Nepal, effects of irrigation technology on women is by and large missing. For example, studies by Shrestha (1981), Parajuli (1999), Shah et al (2000) and Koirala (2001) completely overlooked gender dimensions. Ramaswamy and Sengupta’s (2002) study on impact of treadle pumps on men and women’s lives in Nepal *terai* is relatively comprehensive. They argue that access (ownership and use) and exposure to technology has connected men to new knowledge

---

<sup>2</sup> For more on female labor displacement through introduction of mechanized food processing, see Collier et al. (1974), Timmer (1973) and Harriss (1977).

systems, enlarging their domains. A corresponding trend in women's lives appears to be slow to occur. However, treadle pump has influenced a segment of women by giving the larger roles in irrigation and marketing. Treadle pump also helped create new roles for women by enabling them to emerge as micro-entrepreneurs. The study suggests that the impact on poor farmers has been profound as the pump helps alleviate their economic hardships and bring marked shifts in their identities. They conclude that treadle pump is one of the few technologies to have broken the rigid gender division of labor.

In late 1970s and 1980s, some writers (Palmer, 1975; Germain, 1976; Stevens, 1985; Dey, 1975; Olin, 1977; Mies and Shiva, 1993) pointed the ways in which women are suffering negatively from technological and socio-economic changes brought by the development process. However, Ramaswamy and Sengupta (2002) argue that women who are empowered by the technological change would seek paths to forge ahead and therefore the impact is not universal, it is context specific. Though Ramaswamy and Sengupta (2002)'s study is relatively comprehensive, the study has overlooked the effects of treadle pump on the rural women of different classes and gender relations within the respective class. Moreover, the study has showed the general impact of treadle pump and completely overlooked the change brought by it in intra-household gender relations in terms of relative changes in access to income, food consumption and workloads. Complementing and deepening the study of Ramaswamy and Sengupta (2002), this study tries to address those concerns.

### **FRAMEWORK OF ANALYSIS**

Whitehead (1985), on the conceptual ground, argues that there is an analogy between class and gender as systems of inequality and hierarchy in rural societies and postulates that technological change is not indifferent to gender anymore than it is to the class. She adds that the most significant forms of technological change affecting women are not innovations aimed directly at them, but rather are the indirect consequences of planned and unplanned innovation in the rural production system. Whereas, Bhaduri (1985) suggests that there is a set of conditions identified for quantitatively capturing the impact of technological change on the welfare of rural women. This impact has been defined in

terms of income and time deposition comparisons, before and after the technological change. However, analyzing the impact of technological change using household as a unit of analysis would be misleading as it wrongly assumes that the needs and well-being of each family member regardless of sex, age or economic status get equal consideration and that each member gets an equal share of the household's supply of goods and services (Agrawal, 1984, 1985; Banerjee, 1985).

Agrawal (1980) argues that the introduction of agricultural modernization schemes has affected rural women in developing countries in general. If this modernization effect is seen at household level, the effect of technological changes on women may be overlooked since the effect on them may be different than on men. Therefore, Agrawal (1985) suggests that, as far as technological change or innovations and their impact on gender is concerned, it is important to look at three types of effect on women and men. Firstly, on their absolute and relative workloads; secondly, on their absolute and relative access to and control over income; and thirdly, on their absolute and relative access to consumption. She also clearly posits that these aspects, especially the latter two, have been largely been ignored in existing studies<sup>3</sup>. To examine these effects, she considered the women in the agricultural sector as belonging to three different socio-economic class—landless, small and large cultivator households.

Women belonging to landless household category have basically insufficient land to fulfill family's subsistence needs. In addition to their roles as child bearers and as family domestic workers, these women would need to hire themselves out as wage laborers to help provide an adequate income for themselves and their families. This would not apply in the special instances where women of all classes might be physically secluded. Small cultivators belong to those households, which have adequate land for subsistence but have to depend essentially on family labor for cultivation. In this category women have to do their household chores and may also need to do some manual work on the family farm, although they do not have to hire themselves out as wage laborers. As

---

<sup>3</sup> The three types of effects discussed by Agrawal (1985) are very important because of lack of direct association between these three factors. For example, an increase in women's workload cannot automatically be assumed to increase their control over income or their consumption.

for women belonging to large cultivator households, much of the work in the fields is done by hired labor. Women of this class have household activities in common with poorer women, but the burden of domestic work is light in so far as help could be hired for such work. Furthermore, they do not usually need to do manual work in the fields, although they may perform some supervisory work in the fields (Agrawal, 1985). Following Agrawal's concept of classification, this paper tries to look at the effect of treadle pump, particularly on rural women of three different classes in terms of their absolute and relative access to income, food and workloads.

### **METHODS AND DATA**

There is growing recognition in the literature on development studies that a sensible combination of qualitative and quantitative methods can help solve problems that are associated with each type of method taken separately (White, 2002). Generally, qualitative methods are more appropriate for capturing the social, gender and institutional context of people's lives than quantitative methods (Booth *et al.*, 1998). In view of these considerations, the fieldwork research underlying this paper adopted a quantitative approach to gender division of labor additionally to qualitative components, which addressed women's activities, incomes, consumption, workloads, perception and vulnerability milieu at household level.

The study is based on primary data and on literature reviews and personal communications. Six villages, three each from two districts—Siraha and Sunsari of Nepal *terai*—were chosen to conduct case studies. In each village, participatory rural appraisal (PRA) wealth-ranking exercise was conducted, which identified three farmer groups—landless, small cultivators and large cultivators—that served as the sampling frame for case studies. Categorization of the farmers was done based on their existing average arable landholding size in the study villages. Small cultivators are those who have less than 0.5 ha of arable land, whereas, large cultivators are those who possess more than 0.5 ha of arable land. Likewise, farmers who do not possess any land legally were considered as landless category of farmers. A total of six case studies were done, two cases each representing landless, small cultivator and large cultivator categories.

Participant observation, in addition to random–spot observation<sup>4</sup>, was done to capture the time allocation pattern of working women and men of households over a 12-hour time period by visiting them randomly after 6 am and before 6 pm in each case study household. The study was limited to these districts primarily because Siraha has the highest number of treadle pump<sup>5</sup> adopters among the eighteen districts, where promotion and dissemination of the treadle pump programs had been done. As for Sunsari, treadle pump dissemination program for landless farmers has been implemented in the chosen villages with the help of Local Initiatives for Biodiversity Research and Development (LI-BIRD<sup>6</sup>). Treadle pumps in these districts are mainly used for irrigating vegetables. Technology promoting agencies in collaboration with local organizations are involved in the promotion of this irrigation technology with programs mainly focused on income generation and nutritional security. The capital investment required for the installation of the treadle pump used in the study locations was Nepalese Rupees (NRs) 1,500<sup>7</sup>, which is less than 1/10<sup>th</sup> of the cost of a diesel pump. Several focus group discussions were

---

<sup>4</sup> Random spot-observation mainly helps to get the accurate picture of gender division of labor in the farm and households of the case study villages. Random-spot observation of time allocation is a method of survey of each adult member of the household using random visits to work spots during a 12-hour period usually between 6.30 and 18.30 hours (Paolisso and Regmi, 1992).

<sup>5</sup> Treadle pump (TP) is studied in this research as an irrigation technology. TP is a simple human powered device particularly ideal for fragmented land common in developing countries. It operates as a suction pump to lift groundwater from shallow aquifers. It consists of a couple of pistons that are placed inside two cylinders. Once the operator stands on the treads and thereby presses the pistons up and down in a rhythmic motion, water gets lifted up to the pump and gets discharged. A seventy-six mm pump is capable of maintaining a discharge rate of one liter per second up to a suction limit of 8.5 m. A basic metabolic rate (BMR) of 92- 112 watts is required for comfortable pumping activity. Pumping for twenty minutes and resting for next ten minutes would allow a healthy person to pump comfortably for 5-6 hours a day, which means that up to 14 m<sup>3</sup> of water could be pumped in a day (Upadhyay, 2004; Orr et al, 1991; 2000, Mehta, 2004).

<sup>6</sup> LI-BIRD is a non-profit making, non-governmental organization (NGO) committed to capitalize on local initiatives for sustainable management of renewable natural resources and for improved livelihood of people.

<sup>7</sup> In 1995, US\$1 was equivalent to NRs. 51.89. In 2003 the rate has slid to US\$1= NRs. 74.35. In September 2004 US\$1 is equivalent to NRs.74.84.

done with the women farmers of landless and small cultivator households. The study mostly used unstructured questionnaires and informal group discussions to generate qualitative data which bear particular significance in relation to the need to analyze women's own perceptions and responses in relation to their work in general and the effect of use of treadle pump in particular. Qualitative research methods, with roots in anthropology and sociology, are particularly useful in generating new insights into processes involved in determining livelihood strategies and vulnerability (Korf, 2004).

## STUDY AREA PROFILE

Sunsari is one of the densely populated districts of Nepal. Total area covered by the district is 1,257 sq. km. and total population is 625,633. During the decade of 1991 to 2001, population growth rate per annum of the district was 3.5 per cent, which is more than the national average of 2.1 per cent. A total of 74,541 ha of arable land is available in Sunsari, where majority of the farmers grow paddy. During 2001-2002, farmers were unable to cultivate paddy even in the 39,000 ha of irrigated land due to the drying up of small earthen canals and tributaries, which are the main source of the Sunsari-Morang Irrigation Project (SMIP)<sup>8</sup>. The district is divided into three municipalities and forty-nine village development committees (VDCs). The area of Siraha district is 1,188 sq km with the total population of 572,000. Siraha comprises 108 VDCs and one municipality. All the sample villages represent the *terai*<sup>9</sup> ecological zone and are from the eastern development region of Nepal. A multi-caste society, which represents several ethnic groups like *Brahamin, Chettri, Yadav, Mahot, Chaudhary* and *Tharu*, is common in the

---

<sup>8</sup> SMIP is the district sector irrigation program and operates in the *terai* of south-eastern Nepal, and has about 65,000 ha under the command of the Chatara Main Canal (CMC), which is fed from the Koshi river—the largest river of Nepal. A series of secondary canals, running north to south, take the water from the CMC into the command area, which extends almost to the Nepal/India border, some twenty km to the south.

<sup>9</sup> The *terai* region refers to the southern lowlands of Nepal, which form part of the Gangetic plain. The total population of *terai* was 10.7 million in 2001, which was 39 per cent of the country's population then. The *terai* weather is characterised by hot and wet summer and mild winter. It was thinly populated prior to 1960s but after the eradication of malaria and government resettlement program, extensive migration from the middle hills has taken place, giving rise to significant deforestation in subsequent years.

study locations. Farmers make their living by subsistence rain-fed paddy cultivation, which provides the principal staple food. There is no significant difference in land use and cropping patterns between and among the six villages because they fall in the same agro-ecological zone. Wheat, maize, lentils, mustard and vegetables are other subsidiary crops. The arming system in the study villages is still guided by the traditional practices. *Inaar-dhenkul*, which is common in both districts, is the traditional water harvesting practice wherein farmers dig an open well and draw water with the *dhenkul*. Men operate the *dhenkul* with big buckets for lifting water from *inaars*—local name for wells— whereas women operate with small buckets from same *inaars*. In addition, few community wells are in operation, where farmers irrigate in collective form.

### **IRRIGATION DEVELOPMENT AND EVOLUTION OF MICRO-IRRIGATION IN NEPAL**

With a view of estimating poverty, the Nepal Living Standard Survey (NLSS) revealed that forty-two percent of the population lived below the poverty line (NPC, 2004). Apart from its high incidence, poverty situation in Nepal is characterized by wide variations between urban and rural areas, ecological zones, development regions, gender, ethnic and caste groups. Many communities, particularly in rural areas, suffer from low literacy, widespread nutritional deficiencies and scant access to safe drinking water and sanitation, despite the fact that Nepal has surplus water resources for both surface and groundwater development. Only forty per cent of the total cultivated land is irrigated and the total cultivated area is 2,641,000 ha. Despite having abundant water, Nepal is making use of less than eight percent of its total water resources potential (Koirala and Thapa, 1997). Likewise, of 1.8 million ha available for irrigation, surface water infrastructure covers 0.9 million ha and groundwater about 168,000 ha.

*The development of irrigation in Nepal has been categorized into four phases; prior to mid 1950s; from 1956 to 1970s; from early 1970s to 1980s; and, from mid 1980s to present (Shah, 2001). In the first phase of irrigation development, farmers of both hills and terai had their own developed irrigation facilities. These systems were basically meant for supplementing irrigation of main crop and were managed by the community*



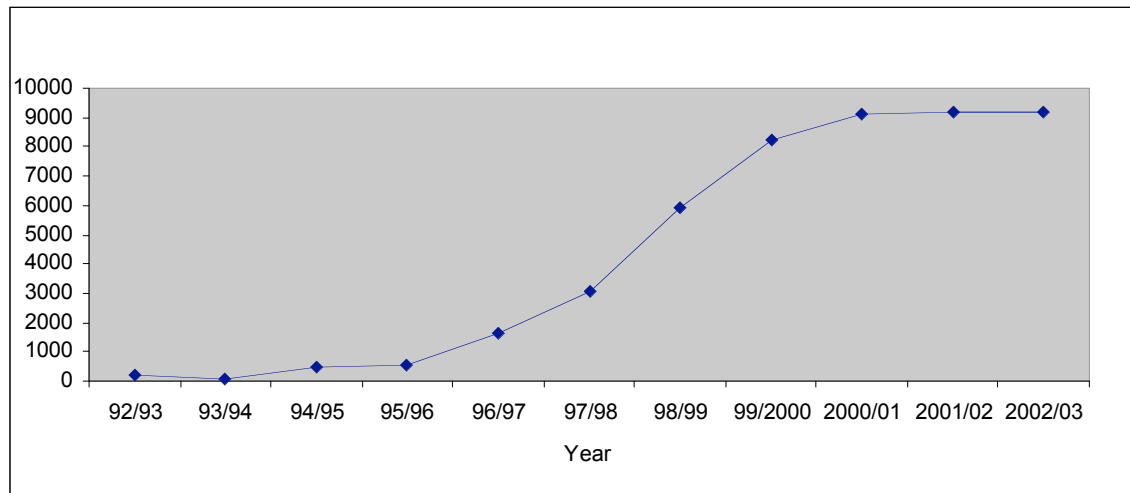
people with their developed norms and rules. These systems are still in existence in remote hills of Nepal. During the second phase, emphasis was on construction of irrigation infrastructure in the form of government-financed medium and large projects. Development of diversion weirs and main canal distribution systems followed the traditional farmer-developed model. Likewise, in the third phase, extensive development of command areas through the expansion of irrigation infrastructure and rehabilitation of farmer built and managed systems took place. Finally, in the fourth phase, focus has been on more integrated development of land and water resources, which incorporates—renovation and expansion of farmers-managed systems with beneficiary participation, development of groundwater where surface supplies are seasonal, use of other forms of improved agricultural technology and involvement of non-governmental organizations as implementing agencies. During this phase, his Majesty's Government of Nepal (HMGN) assigned Agricultural Development Bank, Nepal (ADB/N), the job of promoting micro-irrigation. International Development Enterprises (IDE), an international non-government organization (INGO), signed an accord with ADB/N in early 1990s to promote micro-irrigation. Since then IDE has been implementing the low cost drip irrigation program in Nepal for smallholders in collaboration with community-based organizations. And within the same framework, IDE has started the promotion and dissemination of the treadle pump program since 1992. IDE develops and markets low cost irrigation technologies that help rural men and women farmers enhance their income by increasing farm productivity. As the stepping-stone of its intervention strategy, IDE in Sunsari and Siraha districts has been motivating farmers, particularly women farmers, towards formation of self-help groups (SHGs) for vegetable cultivation using treadle pump.

### **THE TREADLE PUMP PROGRAM**

IDE began the testing of treadle pump in Nepal terai in 1993 and since 1994 it has gone for full scale marketing in 10 districts of central and eastern terai with the financial support from Inter Church Organization for Development Co-operation (ICCO). Treadle pump promotional and dissemination activities in Nepal terai were started in late 1993

and early 1994 in eighteen districts but the adoption rate upsurged only after 1995. The total number of adopters in year 1993/94 in Siraha was less than eighty, which was still highest compared to other districts then. Now, the total number of treadle pump in operation in Siraha and Sunsari is 11,491 and 1,290, respectively. There are more than 35,000 treadle pump users in eighteen districts of Nepal terai (IDE, 2004). The treadle pump irrigated area so far has been about 4,187 ha in these districts. The number of the leader farmers is thirty-six with twenty per cent of women representation. As of 2003, there were more than 400 SHGs formed in connection with vegetable farming training under treadle pump. These groups were able to accumulate sums equivalent to US\$ 50,000 in their saving accounts. In the early stage of the marketing, IDE developed the supply chain of three manufactures and now there are 274 dealers and 943 installers in total. For demand creation, IDE has adopted several promotional activities like, farmer's demonstration plot, target group meetings, motivation and interpersonal communication, coordination meeting with VDCs and line agencies and NGOs, farmer tour and agricultural support, follow up services, etc. During the period of 1992-94, IDE was only concerned about its marketing strategies of treadle pumps but later developed farmer supportive programs in collaboration with other local institutions to provide farmers with technical know-how on vegetable farming. This approach has been successful in motivating farmers for the adoption of the technology. Figure 1 depicts the rising trend of the rate of adoption since the treadle pump program started. After 1995/96 the trend has raised dramatically and remained stagnant from 2000 onwards. Since last two years, IDE has started Market Development Service Project (MDSP), wherein farmers are provided with market information. Fostering linkage and co-ordination between and among SHGs, input and output service providers and extension workers are among the strategies of MDSP. Besides, developing network among several stakeholders and pump installation demonstrations are done on a regular basis.

*Figure 1. Yearwise total number of adopters, Nepal terai*



Qualitative discussion with key informants revealed that the adoption rate in the study locations soared mainly due to the inducement of the organizations promoting the technology. A very few (less than two per cent) of farmers adopted the technology on their own. These beneficiaries reasoned that they were not informed by any organization but bought the system after considering neighbors' beneficial experience with the system. Data on districts, where adoption rate has been almost stagnant from the beginning of the program, indicates that there might have been inadequate information flow among the users.

### **CASE STUDY BACKGROUND**

Until recently, the promotional and dissemination programs have been on-going in the case study villages. These villages do not reflect high level of diversity in terms of agro-ecological, economic, social and cultural aspects because they are located close to the border of each other. The primary reason to select these villages is to capture impact of the technological change brought by treadle pump on three different classes of farmers in general, and on women in particular. Our preliminary discussion with the existing institutions in the region revealed that there are wide range of farmers of different socio-economic status including landless, migrants, well-off, women farmers, in these districts. Class-based differentiation was done primarily to explore the differential impact of technological change on women of different class. This will also allow the study not to

look at rural women as a homogenous group. The underlying assumption behind this is that the technological change which benefits men in a household may not always benefit women. Sometimes, it may even be detrimental to women in terms of their workload, access to income and consumption (Agrawal, 1985). It would have been therefore misleading, if the household was taken as a unit of analysis in the study. The common feature of all case study locations is that they share similar village economy. Livelihoods of the farmers of all the locations are predominately rain-fed agriculture based. The average age of female users of treadle pump was thirty and thirty-five years in Sunsari and Siraha respectively, with an average presence of six members in a household in both districts. Excluding landless category, the average land holding size was 0.5 ha with an area about 0.15 ha irrigated under treadle pump. Only five per cent of the adopters in the study locations belonged to large cultivator category with 0.676 ha of an average land holding size. This implies that majority of the treadle pump owners of all villages are small cultivators. Out-migration is common in all locations. No significant difference is observed in terms of gender division of labor and decision-making roles.

#### ***Case Study (CS) 1—Landless Household***

*Kokaram and Phuleshoridevi Chaudary are landless farmers of Chimdi VDC of Sunsari district. They live in a small hut with a daughter and a son. Kokaram works as daily wage laborer for living. They recalled that it was very rough life four years ago. “We used to feed the children only when I could bring some money after day’s work. The day when I did not bring anything, my wife has to go to the village to beg some food for children”, said Kokaram. “But, there has been considerable improvement in our lives since my wife has joined LI-BIRD group for vegetable farming. She was then endowed with a treadle pump and 0.067 ha of land”, he continued while Phuleshoridevi looked on. After participating in vegetable farming, Phuleshoridevi saves NRs 12,000 annually from vegetable selling. Just after a year of participation, Phuleshoridevi was able to invest her savings in opening a small tea stall for her husband. After three years in vegetable business, they were able to lease a plot of 0.33 ha and send their son to school. Now, in the new land both of them cultivate wheat and paddy for consumption. She even pedals*

*treadle pump for hours to irrigate their paddy field when required. She believes that treadle pump has been an important irrigation technology to harness the groundwater potential, though one has to take rest in between.*

“We noted that our livelihood has been changed and we are happy about this diversification. Earlier, despite our request for credit, villagers used to decline pointing out our vulnerability. However, these days everyone is ready to support us. Because of this change, we have received recognition from the community people”, Phuleshoridevi said. Upon further questioning, she elaborated, “I would like to give credit for this development to LI-BIRD and the pump. Because without owning a land and having irrigation facility how could we imagine to grow tons of vegetables? More importantly, I am managing the vegetable business and have full control over the revenues. My husband does not bother since he controls income which is generated from tea business.”

#### **Case Study (CS) 2 –Landless Household**

*Sebaki Chaudhary, a resident of Amahibelaha VDC, Sunsari district, is one of the beneficiaries of LI-BIRD program. She grows vegetables since last four years and she does that for living. Mushroom is among her main crops and she confirmed that in the last year she was able to earn NRs 14,000 from sales. She wants to cultivate mushroom in large scale. When asked her about treadle pump, she admitted that she is happy with the pump as it was quite strenuous to irrigate without it. Her husband helps her especially when he does not have to go for work. Now her husband is also planning to quit working as a wage earner to help Sebaki expand mushroom cultivation. They are planning to lease more land for the mushroom cultivation because Sebaki felt that there is a huge demand for mushroom in nearby cities.*

**During our discussion, Sebaki recalled her earlier days when she had to sleep without enough food. Now, she is**

happy because she not only has savings but also has gained reputation in the community. Now she enjoys memberships of Nepal Agriculture Cooperative Chimdi, a village level micro finance organization, and a local women group. Sebaki does all the marketing transactions. As she has direct access to cash generated by vegetable selling, she takes care of all household expenses and children's needs. Her husband regularly out-migrates and gets back only after monsoon when the job of laborer can be availed in the village. She feels that all this would have been impossible if farming opportunity under treadle pump had not been offered to her.

### ***Case Study (CS) 3—Small Cultivator Household***

*Jaya Yadav of Chimdi VDC of Sunsari district used to live with his wife and mother. He owned only 0.169 ha of land, used for rainfed paddy cultivation. As land used to remain furrow most of the year, he worked as a seasonal laborer to sustain the family. With the passage of time, his family got extended to six members but the income source remained the same. He had problems in feeding his family so he decided to leave for India in search of work.*

*His family members somehow sustained their livelihood with the inadequate and untimely remittances they received. Three years later, he got back from India with some savings, which he had to spend on his mother's gallbladder stone removal. He again realized that he had trouble in sustaining the livelihood. In the mean time, he knew that a local institution called LI-BIRD is offering membership to women for their empowerment through the irrigation technology. He encouraged his wife, Bhubaneshwori, to get the membership as he realized that his wife can receive a loan of NRs 5,000 from the institution for the installation of treadle pump for vegetable cultivation.*

*Bhubaneshwori and her husband decided to install treadle pump. The family made about NRs 24,000 as net income from vegetable selling in eighteen months. Now, their three kids are going to school and Bhubaneshwori and her husband spend most of their time in the vegetable farm. Bhubaneshwori shared, "Earlier, I did not have any productive work but still felt that I had many household chores to attend to. But, ever since I bought the pump, I feel that I have become more efficient in managing my time. Thus, installation of pump has not increased my workload rather it has taught me how to manage my time effectively. I am very happy and feel that my valuable material asset is the pump."*

*Jaya has realized that the fate of his household has improved due to his wife's contribution to vegetable farming, so she should have full access not only to the income generated but also control over it. Bhubaneshwori said, "My husband has given full*

*authority to me to spend the cash. He even asks me for money when he has to smoke. I take all the decisions regarding households and farm activities.”*

### ***Case Study (CS 4)—Small Cultivator Household***

*Sudi Chaudhari, twenty-four, of Durgapur village of Siraha district, is happy with the adoption of treadle pump. She uses the pump in growing vegetables in their plot of 0.169 ha. She stays with her husband Kuhatu, eleven months old son Vim and her inlaws. Their plot remains mostly barren except for monsoon when the family manages to cultivate wheat and paddy.*

Sudi explained that her husband used to buy vegetables from the wholesale market and sell them in the village with a very narrow margin. This was the only means of their livelihood. When she came to know about treadle pump through her self-help group, she brought this issue into Kuhatu's attention. Kuhatu did not listen to her then and continued doing his business. She was very keen to adopt the system thinking that she can devote some time for seasonal vegetable farming for household consumption and selling for extra income. Sudi narrated, “I was pregnant then and was unhappy with our vegetable consumption pattern. Kuhatu hardly used to bring back the remaining vegetables from the market. He always had the feeling that if he could sell more, he can swiftly repay the credit of the wholesaler. Our thinking was very different: I always think of family's needs whereas, he has a feeling that if cash is generated we could easily buy vegetables, which never happened.”

*“Despite my interest in adopting the system, I was not able to get one because I had hardly any savings then. Later, Kuhatu came to know about treadle pump from the village farmers' meeting and decided to adopt even without consulting me. Five years ago, he brought and installed treadle pump in our farm. Since then, I have been using it for vegetable production and taking full responsibility of handling the pump. All the farm related activities are done by me and my mother-in-law, including irrigating the vegetable field. Since we harvest the produce, we first set aside our weekly needs of vegetables for consumption and then let Kuhatu bring the remaining for selling. Kuhatu*



*is responsible for marketing the produce. As he sells the produce, he has complete control over income from the vegetables”, she added.*

Sudi thinks that if she had the control over income, she would definitely have installed another pump to lease additional land for vegetables farming. She imagines selling vegetables and saving money that she gets from the sale. Her desire is to send her son to good school so that he does not have to suffer as his parents did due to illiteracy. “The main problem with me is I do not have access to cash despite my full involvement in the vegetable farm. But I am still happy that our vegetable consumption level has improved and vegetable farming has not affected my household chores”, she explained.

### ***Case Study (CS) 5—Large Cultivator Household***

*Renu lives with her husband and in-laws in Sishwani VDC of Siraha district. Her father-in-law owns four ha of land and Renu’s husband is the only son, Kashab, who is the heir of the ancestral property. Kashab owns two treadle pumps and one diesel pump. He hires laborers for both rainfed and irrigated agricultural activities. Renu never does farm activity, she passes her time undertaking household chores, rearing children, caring in-laws and attending visitors. The only farm related activities she has done so far is supervising the hired laborers and cooking meals for them. Supervising is done only during the absence of male members in the house. Renu belongs to the Brahmin caste and she is brought up with the notion that her main duty is to take care of her family and in-laws. She knows about the agricultural implements that the family has but she has never used them. She said, “I did not directly experience any difference any agricultural technology has made to me.”*

She has to ask her husband for cash even for small purchases. She wishes that she had her own small enterprise from which she could have made some money. She has brought her concern to Kashab but he has ignored her idea simply saying that Brahmin women are not allowed to work outside the house. She feels helpless. She does not own even a small piece of land legally. She admits that though she does not have to face any difficulty in the house, she is not satisfied with her position in the family. She shared, “whenever I feel to help my parents in any way we could, my husband does not like that.

He says that I am not allowed to spend for my parents. At times I feel very disappointed and cursed myself of being a woman.”

### **Case Study (CS) 6—Large Cultivator Household**

*Shanta, forty-two, lives with her husband and children in a joint family in Chimdi VDC of Sunsari district. She has three school going children and most of her time is passed attending to household chores and children’s needs. In her spare time, she tries to mingle with her matrilineal relatives. Ramesh, Shanta’s husband, looks after the family and the their farm of seven ha. The family owns a diesel pump for irrigating paddy and a treadle pump for homestead vegetable farming.*

*When Shanta was asked about the changes she experienced after buying treadle pump, she said that the pump was given to a koiri—local name for a professional vegetable grower—along with the homestead plot on lease. Prior to leasing out, Shanta used to look after homestead farm for seasonal vegetable growing for household consumption with the help of her female domestic helper. Now she does not have direct access to the farm and vegetables.*

*Shanta shared that she has never experienced any positive change that treadle pump has brought to her life. In fact, the farm she has been using as kitchen garden has been given to koiri and now the family has to buy vegetables. Now, she has to ask her mother in law or Ramesh for money to buy vegetables. This change has negatively affected their habit of eating fresh vegetable from the farm. Shanta’s access to income and workload remain the same despite the adoption of the technology.*

## **DIFFERENTIAL IMPACTS ON RURAL WOMEN OF DIFFERENT CLASS**

### **Landless and Small Cultivators**

*Past studies have shown that women of landless and small cultivator households have to work longer hours compared to the women of large cultivator groups. For example, in Pakistan, women from small peasant households are observed to work for an average of fifteen hours per day, even during the non-peak season (Khan and Bilquees, 1976). Likewise, in Indian state of Haryana, in the peak wheat harvest season women spend an*

average of 15 –16 hours or more a day on arduous manual work at home and in the fields and get little time to rest, whereas men do no housework and are able to take some rest in the afternoon, and perhaps even have a game of cards (Chakravorty, 1975). There are substantial evidences showing that women of landless and small cultivator households have very little time to rest. And, in this circumstance, if the introduced technology neither addresses their work burden nor improves their relative access to food and income, then the technology is likely to exacerbate the problems of women rather than alleviating them.

Both case studies (CS1 and CS2) of landless revealed that the treadle pump has brought positive change particularly to women’s lives and their families in general, whereas, cases of small cultivators (CS3 and CS4) reveal mixed effects. On the one hand CS3 suggests the positive effects of adoption of pump on women’s absolute access to income and daily consumption pattern. While on the other, CS4 does not show any differential impact on female members’ absolute and relative access to income though there was an improvement in consumption of nutritious foods. However, the workload got increased in both cases but was manageable with an additional family labor. Initially, the intervention campaign of treadle pump in the case study villages had overlooked the landless farmers. These landless farmers are basically the migrants from other parts of the country and belong to lower caste. They settle down illegally at any available piece of public land and start making their living with whatever opportunity they get. These farmers do not command any respect from the other strata of the community. They are the most marginalized and vulnerable segment of the society. They hardly mingle with other social groups. Women and men of this category work as cheap laborers and often get exploited by their employers. It was only years later when LI-BIRD made an effort to include these landless families, particularly women, in its capacity building and empowerment program with the strategy of disseminating TP free of charge to each family and providing land for seasonal vegetable farming. The program was initiated by providing a pump and 0.067 ha of leased land to each family by making a homogenous group of twelve households per cluster. An executive committee of three—comprising fellow group members—is formed for every group to ensure proper compliance to the

rules and obligations and to resolve conflicts, if any. Our qualitative discussion revealed that so far no conflicts have surfaced and group members are satisfied with the performance of the committees. Women explained how they take turns among fellow group members to pedal, as continuous pedaling by single person was often painful for the lower part of the body. They maintained that LI-BIRD program has been very effective in improving their livelihoods and treadle pump has been a valuable irrigation asset.

In pursuit of information on post project impact on landless farmers, informal focus group discussions and unstructured interview sessions were organized with those farmers who had been into the program for last seven years. Data suggest that of the total interviewed farmers<sup>10</sup>, majority had been doing vegetable farming by leasing land on their own. This positive impact of the program has been taken seriously by the donor agencies, which is shown by their commitment for more funds for the implementation of similar programs in other pockets particularly for the women of landless families. However, the energy intensive issue that is associated with treadle pump has been neglected so far. A development policy agenda envisages labor intensive economic growth as playing a synergistic role in both sustainable development and poverty alleviation. Ultimately, there is a need for better understanding of both manual and mental work intensity in order to link work with well-being meaningfully (ibid).

### **Large Cultivators**

As far as introduction of HYV-irrigation package is concerned, Agrawal (1998) argued that large households have clearly gained from this introduction in general and women in such households would have gained in terms of their absolute levels of consumption and perhaps even cash income, although not necessarily relative to men. However, there is not much literature on the effects of technology on women of large cultivator households in Asian context. The CS5 and CS6 represent the plight of women of large cultivator households. These large cultivators in the study locations are mainly upper caste people like *Bhrahmin* and *Chettri* and the family of both cases represent *Bhrahmin* caste. Renu's

---

<sup>10</sup> The total number of these farmers was twelve because of difficulty in locating them. Once they are out of the program, they either migrate to other villages or resettle somewhere else.

case (CS5) clearly points that the adoption of treadle neither helped change her workload and consumption pattern nor her absolute and relative access to income. Likewise, in Shanta's case (C6), her position remained the same in terms of access to income. Though her workload reduced as the homestead farm was leased out to *koiri*, but it had negative implication on vegetable consumption pattern of the family, as Shanta did not have direct access to the vegetable farm after it was given to the *koiri*. From both large cultivators cases, it can be inferred that the changes whatsoever treadle pump brought in the family did not necessarily have positive effects on female members (Renu and Shanta) of the family, which, implies that women of these households category had not benefited directly from the adoption of the pump. Nevertheless, the effect of technological change is always context specific. But, if one argues in favor of women's specific access to and control over financial resources, the longstanding assumption of economic theory and development policy of seeing household as a unitary model can always be questioned.

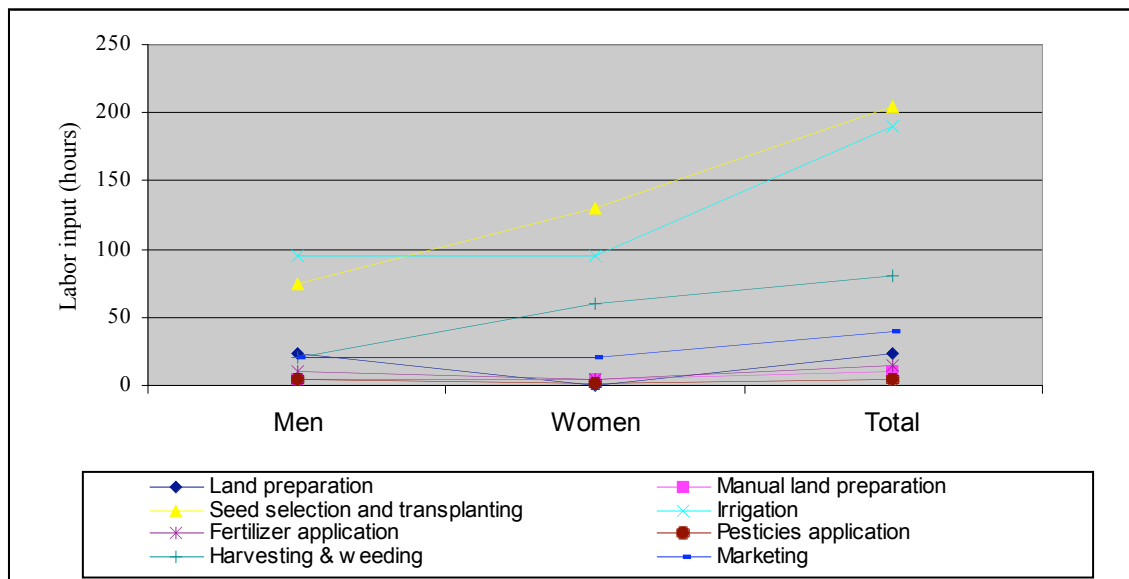
### **GENDER DIVISION OF LABOR**

Our informal discussion and random-spot observation revealed that women of landless and small cultivator households are involved in pedaling. However, as pedaling for longer hours results in thigh pain, they take breaks in between and avoid pedaling especially during the menstruation period. It takes up to 5-6 hours of pedaling to irrigate 0.067 ha depending on the water requirement of vegetable crops. These women pedaled for about two hours daily with a break every 15-20 minutes in between. As figure 2 depicts, there is no difference in pedaling hours between men and women. In fact, women were found to be more involved than men in overall activities related to vegetable farming. However, this is true only with landless and small cultivator women as these families have limited livelihood choices and surplus family labor. Labor endowments are central to the well-being of the poor (Sen, 1981; Dasgupta, 1993) and assumptions about labor allocation within households are also central to a great many development interventions.

Women of large cultivator households were found primarily engaged in household chores and supervised hired labor especially during the absence of male

members in the family. They do not work as family labor but cook meals for hired labor, whenever required to do so. Large cultivators in the study location belonged to high caste and are relatively well-off. Though women of landless and small cultivator category were happy with the pump, their preferences were diesel pumps mainly due to physical stress associated with the former. The electric pump option is ruled out as the villagers have been waiting for electrification for a long time. As far as the diesel pump is concerned, landless farmers simply find it unaffordable while small cultivators felt that they had been able to irrigate following traditional techniques anyway and did not thus feel the need to spend on it so far. However, these respondents were keen in suggesting institutional support for the adoption of diesel pumps so that more hectares can be brought under irrigation. Interestingly, few cases were found where women had their treadle pumps modified according to their convenience and needs, as one woman got her pump modified as a hand pump for drinking water purpose.

Figure 2. Gender division of labor in vegetable farming in winter season in 0.160 ha



**It was noted that treadle pump helped women become productive and take a leading role in household management. Considering the fact that male members of these communities increasingly prefer to out-migrate to Indian cities for work, the pump has given women an access to a comprehensible technology that has opened up avenues for income generation from a venture they are familiar with. Even when men are around, involvement of women is undoubtedly dominant in the treadle pump based vegetable farming. However, a majority of them believed that the technology is labor intensive. These rural women, who are generally confined to their households in patriarchal communities, now have an opportunity to come out in the marketplace and transact business. The field observation shows that while patriarchal sentiments may tend to regulate the use of technologies, technology use in turn might lead to a shift in gender power relation, particularly if the technological innovation is made with adequate gender consideration and institutional support. For example, in villages that were part of this study, men participated in promotional activities of intervening agencies and took a unilateral decision of installing the technology in their houses but once the technology got installed, women became the primary users of the technology (Upadhyay, 2004).**

*Our informal discussion revealed that male farmers realized that women are better vegetable growers than themselves. In the villages that were part of the study, women start their day at 4.30 in the morning with household chores and thereafter, they head to the field and spend their time in farm until early afternoon and return home to take care of household chores. They go back to the field after feeding the family members and remain there until late evening. They do almost every agricultural activity except for ploughing.*

### **Rural Women of Different Class: Commonalities and Differences**

**The study shed light on a number of effects that the technological change has brought to the rural women of three different class—landless, small and large cultivators. Table 1 outlines some differences and commonalities that the women of different classes**

experienced due to the use and effect of treadle pump as observed in six research locations.

Everts (1998) argues that technology plays a central role in the development process. As far as the impact of agricultural technology on rural women is concerned, many authors (Palmer, 1978; Whitehead, 1985, Mies and Shiva, 1993) argue that technology has done more harm than benefits to rural women. However, it can be argued that the harmful and beneficial aspects of technology are context specific and should not be considered universal. But, more importantly, as far as the effect of agricultural technological change on women is concerned, it primarily depends on intra-household gender relationships. Besides, culture and gender ideology are also crucial factors affecting women's access to innovations. Perceived roles, responsibilities and relationships of every individual in rural communities of Nepal are rooted in the complex socio-cultural matrix. Challenging and replacing any traditionally perceived role is not a simple process. The commonality among these cases is that regardless of beneficiary's class status, overall benefits of the adoption of the pump had been positive. However, the cases do not corroborate with the aforesaid findings of positive benefits if seen exclusively from a gender perspective. For example, Phuleshoridevi, Sebaki and Bhubaneshwori (CS1, CS2 and CS3) not only benefited from the adoption in terms of their and family's consumption pattern, but their access to household and cash resources had also been relatively improved.

Conversely, Sudi's (CS4) case presents an example of neutral effect of technology on women. Despite, Sudi's significant involvement in vegetables farming, her absolute and relative access to financial resources had not been affected by the technology adoption. She wanted to have her own pump not only in terms of mere ownership but also in terms of the power to have full access and control over pump and revenues generated from it. She agreed that the adoption has helped the family in the time of financial crunch and family's consumption pattern of green vegetables has improved. Large cultivators' cases revealed that both Renu's and Shanta's (CS5 and CS6) position in the household remained the same in terms of their access to income despite the adoption. Likewise, no significant improvement in their consumption pattern was



observed. In fact Shanta (CS6) lost her access to the homestead farm, which resulted in declining access to fresh vegetables though there was a reduction in her workload too.

These cases from micro perspectives give rise to a number of significant questions. For example, why was Sudi's desire of getting another pump not met? And, why did she not have access to resources generated by the adoption of the technology despite her significant labor contribution? How can the technological change help transform the lives of these women? The Nepalese situation reveals the complex web of social and cultural factors that influence women's access to and ownership of any agriculture related innovations, which eventually influence women's access to income, food, workloads and livelihood options. The main difference among these cases is the economic class, which is the major factor assumed by the study to look at the changes brought by treadle pump. However, the case studies have shown that despite being in same class category—for example, small cultivator (CS3 and CS4)—the changes that women experienced were very different. For example, Bhunasenhwori and Sudi belong to the same class and community but the changes brought by the adoption had differential impact on them. This is attributed to their intra household gender relationship. This is attributed to their intra household gender relationship. Had Sudi's husband been like Mr. Yadav—Bhubanshwori's husband—it would not be wrong to assume that Sudi would have also undergone similar positive changes. This suggests that in cases CS1, CS2 and CS3 the intra-household gender relation is quite egalitarian whereas in CS4, CS5 and C6 it is patriarchal.

Table 1. Differential impact of technology adoption on rural women

<u>Case No.</u>	<u>Socio-economic class</u>	<u>Differential impacts on women</u>		
		<u>Income</u>	<u>Consumption</u>	<u>Workload</u>
<u>C1</u>	<u>Landless</u>	<u>Enhancement in access to and control over income</u>	<u>Overall improvement in normal food intake</u>	<u>Workload has been increased</u>

<u>C2</u>		<u>Significant improvement in overall household income which resulted in social recognition in the community</u>	<u>Progress in vegetable and other food grain intakes</u>	<u>A little change in working hours, however, no evidence of increasing workload</u>
<u>C3</u>	<u>Small cultivators</u>	<u>Access to income and control over it has helped improve family status; male out-migration had stopped</u>	<u>Positive change in daily eating habits</u>	<u>Have become efficient and effective in managing time</u>
<u>C4</u>		<u>No change in terms of access to income</u>	<u>Change in eating habits with more focus on green vegetables and fruits</u>	<u>Slight increase in workload but manageable with additional family labor.</u>
<u>C5</u>	<u>Large cultivators</u>	<u>The situation remains unchanged</u>	<u>No significant change in consumption pattern</u>	<u>No change in workload</u>
<u>C6</u>		<u>No change in access to income</u>	<u>Decline in green vegetable consumption</u>	<u>No change in workload</u>

The study suggests that even within the smallest social setting—i.e., a household—neither the interest of all members are similar nor their power and status. And these differences effect individual family member’s absolute and relative access to income, consumption and workloads. This implies that class difference may not be the only reason of differential impact of technological change but the change is also affected by the nature of male and female relationship in the household. In other words, the effects of technological change on rural women may not only differ by class but also by intra-household gender relationship. This relationship depends on the degree of association or bond to which economic and social interest of husbands and wives are congruent. At this

point, I fully agree with Agrawal's (1998: 53) argument that "economic self-interest plays a significant role in intra-family gender relations, which would be revealed with particular starkness in gender conflict over a critical form of property such as land." I extend it further by identifying that the critical form of property cannot be limited to land but to other productive resources like intermediate irrigation technology and agricultural implements. It is also true that this form of resource may not be valuable as land but can be used as an alternative livelihood means by resource poor peasant families in general and by women in particular.

### CONCLUSION

The findings of this study indicate that the effects of treadle pump as a technological change on rural women of Nepal *terai* are highly complex and contextual. Therefore, one should be careful in making sweeping generalizations across women of different socio-economic classes. The findings broadly suggest that by studying the effects of technological change on rural women, it is necessary to deepen the focus to intra-household gender relations rather than looking at mere categorization based on socio-economic class. Cases of small holders are the examples, which clearly depict how intra-household gender relation does matter when it comes to female members' absolute and relative access to income. Thus, a generalization of the effect of the technological change on women of any particular class category is unreasonable as the effects of any technological change largely depend on intra-household gender relation, which is governed by complex socio-cultural principles and ideology that are rooted in the social structure of rural Nepalese community. Case studies have shown that gender identities prevail over class-based identities even in a small social setting.

The cases of landless farmers (CS1 and CS2) reveal that these families could also be the potential beneficiaries of the technology if given opportunities. With adequate institutional support mechanism, women of this category benefited immensely in all three aspects (income, consumption and workload). This implies that overlooking the problem of landless farmers by any technology intervening agency or development organization may further marginalize them, as these families often do not have access to technology as

smallholders and large cultivators do. Access to the technology for large cultivator households does not necessarily mean that women of these households have benefited by the adoption. Despite the adoption of treadle pump, the position of women of these households remained unchanged. In fact CS6 reveals negative impact on consumption patterns after the adoption.

### **Acknowledgements**

This paper is based on preliminary findings of on-going comparative study of South Asian countries led by myself. The project is funded by International Water Management Institute (IWMI). I would like to thank the participating respondents of all the case study households and field office teams of LI-BIRD and IDE in Sunsari and Siraha. Special thanks are due to the participants of Agricongress 04, Kuala Lumpur, Malaysia (4-7 October 2004) and ITP Workshop, Anand, India (29-30 March 2004) for their feedback on earlier versions of this work which I presented in these venues. I am grateful to N. Pant, L. Maarse, S. Phansalkar, M. Samad, T. Shah, M. Giordano and D. Adhikary for comments and to P. Patel, N. Rajput and P. Reghu for research assistance.

### **REFERENCES**

Agrawal, B. (1980) 'Technical Change and Rural Women in Third World Agriculture: Some Analytical Issues and an Empirical Analysis'. London: University of Sussex, Institute of Development Studies.

Agrawal, B. (1984) 'Rural Women and The High Yielding Variety Rice Technology'. *Economic and Political Weekly* 19 (13).

Agrawal, B. (1985) 'Women and Technological Change in Agriculture: The Asian and African Experience', in I. Ahmed (ed) *Technology and Rural Women: Conceptual and Empirical Issues*, London: George Allen and Unwin Ltd.

Agrawal, B. (1998) *A Field of One's Own: Gender and Land Rights in South Asia*. London: Cambridge University Press.

Ahmed, I. (1985) *Technology and Rural Women: Conceptual and Empirical Issues*. London: George Allen and Unwin Ltd.

Ahmad, M. and Jenkins, A. (1989) 'Traditional Paddy Husking-an Appropriate Technology Under Pressure', in M. Carr (ed) *Women and the Food Cycle*, London: Intermediate Technology Press.

Bhaduri, A. (1985) 'Technological Change and Rural Women: A Conceptual Analysis', in I. Ahmed (ed.), *Technology and Rural Women: Conceptual and Empirical Issues*, London: George Allen and Unwin Ltd.

Banerjee, J. (1985) 'Implications of Technology for Women in Rural Sector', in S.C Jain (ed), *Women and Technology*, India: Rawat Publications.

Bartsch, W. H. (1977) *Employment and Technology in Asian Agriculture*. New York: Praeger.

[Booth, D., et al. \(1998\) 'Participation and Combined Methods in African Poverty Assessment: Renewing the Agenda', London: Social Development Division, Department for International Development \(DIFD\).](#)

Chakravorty, S. (1975) 'Farm Women Labor: Waste and Exploitation's Social Change', New Delhi: New Delhi Council for Social Development.

Collier, W.L., et al. (1974) 'Choice of Technique in Rice Milling in Java: A Comment', New York: Agricultural Development Council, Research and Training Network.

Dasgupta, P. (1993) *An Inquiry into Well-being and Destitution*. Oxford: Clarendon Press.

Dey, J. (1975) 'Role of Women in Third World Countries', MA thesis, London: Agricultural Extension and Rural Development Center, University of Reading.

Everts, S. (1998) 'Gender and Technology: Empowering Women, Engendering and Development', Amsterdam: TOOL Consult.

Germain, A. (1976) 'Women's Role in Bangladesh Development: A Program Assessment', Dhaka: Ford Foundation.

Harriss, B. (1979) 'Post Harvest Processing Systems in Rural Bangladesh: Technology, Economics and Employment. Bangladesh', *Journal of Agricultural Economics* 2(1): 23-50.

Hariss, B. (1977) 'Paddy-milling: Problems in Policy and the Choice of Technology, in B.H. Farmer (ed), *The Green Revolution? Technology and Change in Rice-growing Areas of Tamilnadu and Sri Lanka*, London: Macmillan.

Harrod, R. F. (1948) *Towards a Dynamic Economics*. London: Macmillan.

IDE. (2004) 'Regional Office Progress Report', Lahan, Nepal: International Development Enterprises.

Hicks, J.R. (1932) *The Theory of Wages*. London: Macmillan.

Jackson, C. (1995) 'From Conjugal Contracts to Environmental Relations: Some Thoughts on Labour and Technology', *Institute of Development Studies Bulletin* No. 26. London: Institute of Development Studies.

Koirala, G. P. (2001) 'Shallow Groundwater Irrigation in the Nepal Terai: Constraints and Opportunities', *Water Nepal* 8 (1/2):13-37.

Khan, A. S. and F. Bilquees (1976) 'The Environment, Attitudes and Activities of Rural Women: A Case Study of a Village in Punjab, Pakistan', *Development Review* 15 (3).

Korf, B. (2004). 'War, Livelihoods and Vulnerability in Sri Lanka', *Development and Change* 32 (2): 275-295.

Koirala, G. P. and G. B. Thapa (1997) 'Food Security Challenges: Where Does Nepal Stand?' Winrock Research Report 36. Kathmandu.: Winrock International Institute for Agricultural Development.

Metha, R. (2004) 'The IDE Way to Customer Creation', New Delhi: International Development Enterprises.

Mies, M. and V. Shiva (1993) *Eco-feminism*. London: Z Books.

NPC (2004) 'The Tenth Plan (Poverty Reduction Strategy Paper) Summary', Kathmandu: National Planning Commission.

Olin, U. (1977) 'Integration of Women in Development: Program Guidelines', New York: United Nations Development Program.

Orr, A., A.S.M.N. Islam and G. Barnes (1991) 'The Treadle Pump: Manual Irrigation for Small Farmers in Bangladesh' Dhaka: Rangpur Dinajpur Rural Service.

[Paolisso, M.; Regmi, C. S. \(1992\) 'Gender and the Commercialization of Subsistence Agriculture in Nepal' Washington, D. C., and Kathmandu, Nepal: International Center for Research on Women and New ERA.](#)

Palmer, I. (1978) 'Women and Green Revolution' Paper presented to the Conference on the Continuing Subordination of Women in the Development Process, London: Sussex Institute of Development Studies (17-22 September).

Palmer, I. (1975) 'The New Rice in the Philippines: Studies on the Green Revolution' United Nations Research Institute for Social Development Report 10.

Palmer-Jones, R. W. (1993) 'Agricultural Wages in Bangladesh: What the Figures Really Show?', *Development Studies* 29(2): 227-300.

Parajuli, U. N. (1999) 'Agro-ecology and Irrigation Technology: Comparative Research on Farmer Managed Irrigation Systems in the Mid-hills of Nepal', PhD Thesis, The Netherlands: Wageningen University.

Ramaswamy V. and S. Sengupta (2002) 'The Treadle Pump Changing the Lives of Women and Men', Bangalore: Human and Institutional Development Forum.

Sen, A. (1981) *Poverty and Famines: An Essay on Entitlement and Deprivation*. London: Oxford University Press.

Shrestha, M. M. (1981) 'Irrigation Technology in Nepal and its Impact on Rural Poor', in Greeley M. and M. Howes (eds.), *Rural Technology, Rural Institutions and the Rural Poorest*. Bangladesh: Center on Integrated Rural Development for Asia and Pacific.

[Shah, S.G. \(2001\) 'Irrigation Development in Nepal', Kathmandu: Asian Development Bank.](#)

Shah, T., et al. (2000). 'Pedaling out of Poverty: Social Impact of a Manual Irrigation Technology in South Asia', IWMI Research Report 45. Colombo: International Water Management Institute.



Stevens, Y. (1985) 'Improved Technologies for Rural Women: Problems and Prospects in Sierra Leone', in Ahmed, I., (ed.), *Technology and Rural Women: Conceptual and Empirical Issues*, London; Allen & Unwin, London.

Timmer, P.C. (1973) 'Choice of Technique in Rice Milling in Java', *Bulletin of Indonesian Economic Studies* 9 (2), Canberra: Australian National University.

Upadhyay, B. (2004) 'Traedle Pumps Trigger Rural Transformation in Nepal Terai', *Appropriate Technology* 31 (4) (forthcoming).

Upadhyay, B. (2004) 'Gender Aspects of Smallholder Irrigation Technology: Insights from Nepal', *Journal of Applied Irrigation Science* 39 (2): 315-327.

Whitehead, A. (1985) 'Effects of Technological Change on Rural Women: A Review of Analysis and Concepts', in I Ahmed (ed.), *Technology and Rural Women: Conceptual and Empirical Issues*, London: George Allen and Unwin Ltd.

White, H. (2002) 'Combining Quantitative and Qualitative Approaches in Poverty Analysis' *World Development* 30 (3): 511-522.