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Contribution of Farmer-to-Farmer Video to Capital Assets Building: Evidence from Bangladesh

ATAHARUL HUQ CHOWDHURY[1], PAUL VAN MELE[2], and MICHAEL HAUSER[1]

[1] *Centre for Development Research, University of Natural Resources and Life Sciences, Vienna, Austria*

[2] *Agro–Insight, Ghent, Belgium (formerly Africa Rice Center, Benin)*

Sustainable agriculture requires suitable group learning approaches that trigger capital assets building. Drawing mainly on face-to-face extension, methods and approaches used in sustainable agricultural projects aim at triggering learning and capital assets building. To target and to reach out to a large number of resource-poor households the potential role of media, such as video, has received less attention. In Bangladesh, videos on sustainable rice seed practices were developed with farmers and then shown in multiple villages. This study reports on the contribution of farmer–to-farmer video-mediated group learning to capital assets building of women in resource-poor households. Data were collected using structured interviews with 140 randomly selected women in 28 video villages and 40 women in four control villages in north-west Bangladesh. Video-mediated group learning enhanced women's ability to apply and experiment with seed technologies. It also stimulated reciprocal sharing of new knowledge and skills between them, other farmers and service providers. Rice yields increased by 15%, which improved the women's social and economic status and intra-household decision-making. Over 20% of the households attained rice self-sufficiency, with no changes observed in control villages. This study has provided insights into the potential use

Address correspondence to Ataharul Huq Chowdhury, Centre for Development Research, University of Natural Resources and Life Sciences, Vienna, Austria. E-mail: atahar77@ yahoo. com and ataharulhuq.chowdhury@boku.ac.at

of farmer-to-farmer video in sustainable agriculture to strengthen human, social and financial capital and to reduce poverty.

KEYWORDS video, capital assets, rice, gender, self-sufficiency, Bangladesh

INTRODUCTION

Capacity is defined as the ability of an individual to perform an activity. Enhancing capacity of rural people to innovate and engage with evolving markets in an equitable and environmentally friendly way is an important concern (Zossou et al., 2009). It is necessary to provide opportunities for them to learn new knowledge and information through experimentation. Conventional training and extension methods are unlikely to enhance farmers' capacity on sustainable local agricultural innovations in Asian and African countries (Zossou et al., 2009; van den Ban & Samanta, 2006). These methods are more instrumental, their focus being on enhancing capacity through knowledge transfer (Röling & De Jong, 1998). Experiences on sustainable agricultural development suggest a shift from transferring of knowledge to facilitation of learning (Röling & Jiggins, 1998). More attention is now being given to training and extension tools and methods that serve learning for knowledge construction rather than absorption and reception of knowledge (Röling & De Jong, 1998).

Learning is individual when one acquires the ability to perform new practices and patterns of actions as related to new knowledge and skills. Learning is communicative when it takes place through discussion and sharing of individual learning content (Defoer, 2002; Leeuwis & Van den Ban, 2004). Methods like Farmers Field School (FFS), Integrated Pest Management Club (IPM club), Local Agricultural Research Committees (CIALs) that adopted principles of experiential learning (Kolb, 1984) were found effective in enhancing farmers' capacity to innovate local sustainable practices through individual and communicative learning (van de Fliert et al., 2007; Braun et al., 2000). But there are challenges to institutionalize these methods and to reach out to more farmers quickly. For instance, at times FFS has been criticized for being implemented as a standardized method lacking experiential learning components (Röling & De Jong, 1998; Nederlof & Odonkor, 2006). Furthermore, learning is not communicated beyond the participant and quality of facilitation deteriorates and relative cost increases when moving beyond the scope of pilot sites (Witt et al., 2008, Quizon et al., 2001, Feder et al., 2004; Snapp & Heong, 2003).

The challenge is even more stringent to create learning opportunities and reach out to the marginalized, poor, and women. Women in South Asian

developing countries, including Bangladesh, depend more on subsistence farming than men due to gender inequalities in employment, education, literacy, knowledge and skills and access to productive resources like land and credit (Ramachandran, 2008). Women have less influence in decision-making about farming issues and men usually take over the economically potential farming activities (Al-amin et al., 2004; Huque & Chowdhury, 2006). Economically potential farming activities include cultivation of crops (e.g., cash crops such as rice grown for selling in the market) and crop enterprises (e.g., rice seed business) that bring immediate profit by selling in the market. Staff of agricultural advisory services are mainly men, and agricultural development interventions are often male biased (van den Ban & Samanta, 2006; Chowdhury, 2010). As a consequence, personal networks of women are less elaborate and transaction costs to access information, technologies, services, and markets are higher for them than for men and better-off farmers. Video can help to overcome this gender bias and reduce transaction costs, since it can be easily integrated with other learning approaches and development interventions (Van Mele, 2008).

Video-mediated rural learning is a new approach pioneered for scaling-out sustainable rice seed innovations in Bangladesh. Rice seed technologies and knowledge that were locally grounded through participatory learning and action formed the basis of a series of farmer-to-farmer videos. Selected experienced farmers showed and explained the innovations in front of the camera (Van Mele et al., 2005b). Early experiences in the years 2003–2004 indicated that video-mediated group learning had more effect on behavioral changes than interpersonal farmer-to-farmer extension (Van Mele et al., 2005a). After having reached out to more than 130,000 rural women within less than two years and at a very low cost, a subsequent survey showed that the rice videos had significantly improved women's capacity to innovate and become rural entrepreneurs (Van Mele et al., 2007). A conservative estimate of the gain of the video project was at least 17 times the total investment cost.

Capacity and capital building are intrinsically linked. By enhancing the capacity of a community, the capital base of that community and its use can be improved (Kamruzzaman & Takeya, 2008). Knowledge and information (embedded in local context) that are made available can play a catalytic role for enhancing different capital resources, e.g., human, social, financial, natural and physical (Chapman et al., 2003). Most agricultural capacity building programs in Asia and Africa (e.g., training and education) focus on human capital development (van den Ban & Samanta, 2006; Davis et al., 2008). But capital resource accumulation depends on trading of capitals from one to another (Ellis & Mdoe, 2003). Both human (e.g., knowledge and skills) and social capital (e.g., reciprocity and exchanges, networks) are critical for strengthening sustainable natural resource management (Pretty & Ward, 2001; Pretty, 2003). The success of a capacity building tool or method for

sustainable agriculture depends not only on enhancing knowledge, skills, motivation and action taken by the participants, but also on their ability to exchange knowledge and skills, help each other on specific problems and create networks for exchange of information and resources. Furthermore, Communities capitals are also linked to the production (food and income) and consumption (Kaaria et al., 2008), while an accumulation of capital gradually results in increased income (Ellis & Mdoe, 2003).

Previous studies on video-mediated learning (Van Mele, 2006; Van Mele et al., 2007; Zossou et al., 2009) presented its catalytic role to influence knowledge, attitude and practices of sustainable rice seed innovations, but did not address to what extent these behavioral changes contributed to rural livelihood changes. This paper presents the outcomes of the farmer-to-farmer rice seed videos on livelihood capital development of rural households in Bangladesh. The paper aims to answer the following questions:

- How does farmer-to-farmer video-mediated learning affect social and human capital on local rice production and post-harvest?
- Does the farmer-to-farmer video approach contribute to women's communication with local seed information sources?
- Does the farmer-to-farmer video contribute to gender equity and women's empowerment in decision-making about rice seed production, post-harvest and other crop related issues?
- What are the contributions of farmer-to-farmer video to the rice production and self-sufficiency status of the rural household?
- What are the factors that influence obtaining additional income from applying local rice seed production and post-harvest practices?

Farmer-to-Farmer Video on Rice Seed Production and Post-Harvest

Video as an adult learning tool was firstly tested and introduced in Bangladesh in 2003 under the Poverty Elimination Through Rice Research Assistance (PETRRA) project. CABI, UK in collaboration with Countrywise Communication trained two video teams comprising staff of the Rural Development Academy (RDA) and Thengamara Mohila Sabuj Sangha (TMSS), a national non-governmental organization (NGO). Based on discovery learning, local and scientific knowledge were incorporated to develop rice seed health technologies. Women were involved in developing and validating both the technologies and the video scripts. Finally four educational videos were developed on rice seed sorting, seed flotation, drying, and storage technologies (see Table 1). RDA is a national public sector organization having a strong mandate for training and action research. RDA was a partner in the seed health improvement sub-project of PETRRA that focused on participatory learning and action research with farmers. Findings

TABLE 1 Rice Seed Innovations Shown in the Bangladeshi Seed Videos

Brief description of technology	Learning message	Local knowledge and innovations
*Seedling production**		
Do germination test; treat seeds with the extract of black berry leaves; cover the soil of the seedbed by plastic sheet; make the seedbed soil muddy and apply ash in the Boro season; cover seedlings by plastic covering; fence the seed bed or scare away birds and animals	Seeds with good germination rate yield healthy seedlings; treating seed and soil destroys seed and soil borne pathogens; ash is a source of nutrient and helps uprooting without damaging seedlings; plastic covering helps protect seedlings from cold and fog in winter; good quality seedlings have better market price	Only a few farmers perform germination test; they hardly treat the seeds; farmers use ash as a source of nutrients; a few farmers cover seedling, locally made nets are used as fence and tin made tool is used to scare away animals; farmers sell seedlings in local market
Step by step care*		
Uproot and clean roots in water gently; dip seedlings in water mixed with 100g zinc before transplanting; transplant leaving a row space after every tenth row; transplant seedlings at the age of 30–35 days in Aman and 45–50 days in Boro season; transplant at a depth of one fourth of a finger; apply urea before tillering, control the weeds first 40 days; keep the water level up to 6cm until tillering and gradually increase from panicle initiation until milking stage of paddy; put bamboo stalks or light traps in the field to kill insects; use neem and tobacco extract as pesticide; rogue the field, collect paddy for seed from the middle part of the field	Rice seed production needs extra care; avoid injury to seedlings; dipping the seedling in zinc water meets the requirement of zinc fertilizer; line sowing helps field operations; old aged seedlings do not give good yield; transplanting at optimum depths gives more tillers; urea and water should be applied according to growth stage; use alternative pest management strategies; collecting paddy for seed from the middle of the field ensures varietal purity,	Farmer usually apply zinc in the field; few farmers take care about seedlings injury; farmers sow in lines, but few of them keep additional space after every tenth row; few farmers perform roguing and maintain isolation distance; some farmers use alternative pest management
*Threshing**		
Keep the paddy heap on the plastic sheet; Use table made from bamboo and gunny bags for threshing, thresh seed by striking paddy two and a half times	Threshing table reduces risk of admixture of soil, inert matter and pathogens; seeds separated after two and a half stroke are optimally matured, filled grains	Threshing table and method were developed with the full participation of local women and men

(*Continued*)

TABLE 1 (Continued)

Brief description of technology	Learning message	Local knowledge and innovations
*Seed sorting***		
Manually remove diseased seed	Spotted and discoloured seeds are unhealthy; these cannot be removed by winnowing or seed flotation; seed sorting improves yields; sorted seeds have more market price	Women have little knowledge about seed-borne pathogens
*Drying***		
Make a bamboo table or bench for drying rice; it can be quickly moved indoors in case of rain	Seeds absorb moisture from soil; wind helps in drying seed; a drying table has many other uses than just drying rice seed	Drying table were designed with the full participation of local women and men
*Storage***		
Paint an earthen pot; fill it with rice seed and do not leave a dead air space; and add leaves of *neem* or *bishkatali* (local plants); seal pot and place it off the ground	Pots absorb moisture, which paint prevents; completely filled pots are dryer than half empty ones; some kind of leaves reduce storage insect	Traditionally, some people sealed pores of earthen pots with used oil; only a few people use botanicals
*Flotation***		
Add salt or urea to a bucket of water until an egg floats; drop rice seed in the water and remove the bad ones that will float to the surface	Winnowing does not remove all insect-damaged and partially filled seed	Women already soak seed in water prior to sowing; flotation with salt or urea is a small modification of existing practice

*Videos developed in 2006.

**Videos developed during 2002–2003 (Modified from Van Mele et al., 2007).

of this project formed the basis of content of the rice seed health videos. RDA continues to regularly offer training on local level seed production and post-harvest techniques for farmers in the northwestern region. TMSS is a national NGO which works with 1.8 million women in 62 out of the 64 districts in Bangladesh. This is one of the NGOs with a strong focus on working with women farmer groups, especially resource-poor women. The organization manages income-generating activities, agriculture, credit, agroforestry, fisheries, and livestock among a number of other programs. They also collaborated in developing the videos.

The rice seed videos focus mainly on local post-harvest processing and storage techniques. Post-harvest processing significantly affects quality of rice seed retained by smallholders in Bangladesh, and thereby production in subsequent years. At present about half of the total paddy is produced in the dry season (called *Boro* season; November to April) in Bangladesh

(MOA, 2005). Harvesting this rice is tricky as heavy rains and extreme humid conditions follow (May-October). Since more that 90% of the rice seed is farmer-saved seed in Bangladesh (MOA, 2005), maintaining the quality through proper post-harvest management is important to increase rice seed production and subsistence.

In early 2005, the partnership was extended to engage another small NGO, the Agricultural Advisory Service (AAS). Twelve districts were chosen based on the working areas of the partners. Farmers of the unions (lower administrative unit) selected usually practiced double rice cropping. In each union, four villages were selected randomly. In each village 25 resource–poor women were selected and organized in a group on the basis of their poverty status, involvement in rice cultivation and willingness to take part in the study. Video shows followed by group discussion were organized in either the courtyard of one of the women, government primary schools, non-government primary schools, and non-formal education schools of the country's largest NGO, the Bangladesh Rural Advancement Committee (BRAC). In addition, video Compact Discs (CDs) were supplied to the group so that they could watch and learn the innovations at their own convenience. All the groups had easy access to locally available television (TV) and CD player.

The teams also collected additional local innovations and asked people for feedback on the videos during each video show. In 2006, RDA collaborated with the Bangladesh TV (BTV) to regularly broadcast 3-minute version of the films. The films developed during the first project were further refined based on the feedback and additional innovations. In addition, three more videos on rice seedling production, seedling raising and seed harvesting were developed in 2006 (Table 1). At this stage, BTV produced the videos in collaboration with RDA. The CDs were supplied to the partner organizations for further distribution to the groups and relevant organizations. BTV continued regular broadcasting of short video clips until 2007 and continues to broadcast them when there is a time slot in their regular program called Mati-O-Manus (soil and human).

METHODOLOGY

From December 2008 to February 2009, 140 female farmers were randomly selected from 28 villages in six northwestern districts in Bangladesh where RDA and TMSS operated. The districts were Bogra, Sirajganj, Naogaon, Joypurhat, Gaibandha and Dinajpur. Similarly, 40 women were selected from four control villages in the same region.

Data collection started with focus group discussions (to get an idea about farmers' rice seed production and post-harvest practices), observations (to see how women applied the learning from the videos) and in

depth-interviews (to understand various socio-cultural dimensions of rice seed as a rural enterprise). A structured interview schedule was prepared based on insights from the qualitative phase and experiences from previous studies (Chowdhury, 2007). The interview schedule contained questions on: (i) personal characteristics; (ii) household characteristics; (iii) rice and seed production statistics; (iv) gender and intra-household decision-making on crop and seed issues; (v) social and human capital; and (vi) communication with local seed information sources. For the items (iii) to (vi), the recall method was used, since there was no baseline data on these aspects (Kaaria et al., 2008). Indicators and local units were formulated based on discussions with the respondents during preliminary steps so that they could easily compare their present (2008) and previous (2005) status.

Social and human capital impacts were assessed using self assessment of changes in women's capabilities. Women were asked to rate their ability today and three years ago in various areas, such as i) use of local innovations and doing own experiments; ii) helping others to use the innovations and conduct experiments; iii) exploring sources to sell rice seed; iv) bargaining price; v) managing organizational support for seed; and vi) asking additional information on seed. All these aspects directly relate to the content of the videos. A score of zero was given if their abilities were not good, 1 if their abilities were good and 2 if their abilities were very good. A capability index was developed, dividing actual scores by possible scores for an item. The index ranged from 0 to 1.

$$\text{Capability index} = \frac{(0 \times \text{number of respondents rated not good}) + (1 \times \text{number of respondents rated good}) + (2 \times \text{number of respondents rated very good})}{2 \times \text{total number of respondent in the survey}}$$

A similar communication index was developed for local seed communication exposure, indicating how frequently respondents contact different sources for necessary crop seed related information. Women were asked to rate their interaction with several local sources, which mainly included family members, neighbors, progressive farmers, local seed dealers, extension agents and project staff. A score of zero was given if they had seldom or no contact (once or no contacts in a year), 1 if they had contact sometime (1 to 2 times/cropping season), 2 if they had contact often (1 to 2 times/month). The communication index divided actual scores by possible scores for each source, and ranged from 0 to 1. Communication might take place on a general level or on a more specific question and problem-solving issue. Subedi & Garforth (1996) defined general communication on a regular basis as 'discussion' and purposive and need-based information seeking on specific aspect(s) as 'consultation.' Communication exposure includes both types which might take place simultaneously or independently with the same or different sources. In this study we aimed at understanding gendered

patterns of communication either for 'consultation' or 'discussion' with above mentioned sources.

Since rice is central to the livelihoods of rural Bangladesh, we used the rice self-sufficiency index (RSSI) to get insights into the food security status of the households. RSSI was calculated using the following formula, modified from Page et al. (2009).

$$\text{Rice Self-Sufficiency Index} = \frac{\text{Actual yield (kg/ha)} \times \text{Landholding (ha)}}{\text{Annual paddy requirement (kg)}} \times 100$$

The annual paddy requirement (unprocessed) for each household was calculated taking into account the number of dependent adults, adolescents and children under 10 years and Food and Agriculture Organization's (FAO) recommendation of energy intake (annual intake is 365 kg of unprocessed paddy rice for adult, 274 kg for adolescent child over 10 years and 183 kg for a child under 10 years). The farmer's own yield data in terms of kg of paddy/ha (derived after converting the local unit maund/bigha) was used to calculate the RSSI for each household. In cases where the farming families were sharecropping, the amount of grain due to the landlord was subtracted from the actual yield. Food security is a complex concept which corresponds to availability, access and utilization of food. The concept is associated to social, economical and production factors. Food security at household level strongly correlates to the ability of individual households to meet daily food needs from own production, or the means to obtain food from off-farm sources (FAO, 1997). In Bangladesh rice self-sufficient households are recognized as food secure households. This is because livelihoods of households, especially in rural Bangladesh, are mainly dependent on rice production (FAO, 2004; Hossain & Bayes, 2009). Every year agricultural labor market declines between transplantation and harvest period of paddy in the northwest Bangladesh. This is one of the reasons for seasonal income and food crisis in this region (Zug, 2006).

Data were analyzed using descriptive statistics. Paired *t*-test was computed to assess the change of rice production and self-sufficiency index. A binomial logistic regression was used to understand the factors influencing additional income from rice seed production and post-harvest activities of rural women. In addition, narratives were recorded, coded and included manually in the analysis according to their relevance to the interpretation of a phenomenon addressed in the study.

RESULTS

The average age of the women in the video villages was 34.1 ± 8.1 years and that of the control villages was 34.7 ± 7.9 years. About 45 % of the women in the video villages were illiterate and 40 % had less than five

years of schooling. In the control villages 55 % of the women were illiterate. Most of the households in both villages were male headed. The principal livelihood activity was rice farming with households practicing double rice cropping. The rice cultivation seasons are called *Aman* (June/July to October/November) and *Boro* (November/December to March/April). Farmer-retained seed is one of the major sources of rice seed in all villages. Households of video and control villages had on average about 0.5 ha of cultivable land.

Women reported that they watched the videos on various occasions and on average 6.2 ± 1.7 times. At least one video show was organized in each village by the project. A CD was supplied to the group leader, usually the husband of a participating woman. Further shows were organized by the group members, usually in the home yard of the group leader or a member. They watched 2.4 ± 1.0 times with the group members only; 1.9 ± 1.1 times with group members and neighbors or villagers; 0.9 ± 0.8 times with family members and neighbors; and 0.8 ± 0.8 times during TV broadcasting. Although the videos were expected to be mainly watched by the group members, neighbors and community members equally attended the shows, indicating they collectively watched the videos.

How does Farmer-to-Farmer Video Affect Social and Human Capital on Local Rice Production and Post-harvest?

Women's abilities changed significantly as a result of the video-mediated group learning. In the last three years, capability indices about using local rice seed innovations and conducting own experiments more than doubled in the video villages, contrary to the control villages (Figure 1).

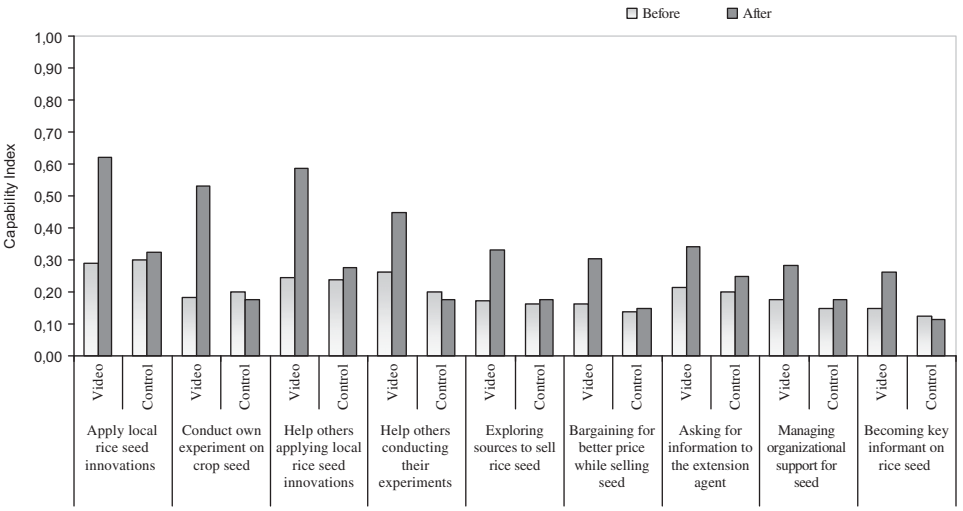

FIGURE 1 Women's capability in video and control villages in northwest Bangladesh in 2005 (before videos were introduced) and 2008 (after videos were introduced).

Women indicated that earlier they did not know the principles behind drying and storing the seeds. From the video they learnt the importance and ways to maintain seed moisture and keep the seeds free from different insect pests and inert matters. Video-mediated group learning sessions helped to understand the 'why' and 'how' of the relevant practices, which not only enhanced ease of applying the innovations, but also their capability to try out new things. Only when they realized the potential of the innovations did they start to experiment with other similar local techniques. For instance, some women started using paint from fruit of wild mangosteen (*Diospyrous pregrina*) and banana to make earthen pots airtight. They also started experimenting with nishinda (*Vitex negundo*) and bamboo leaves as a botanical insecticide in storage containers. When they grasped the principles behind drying above the ground some women used different surface, e.g., table or platform called macha, mats, straw heaps, jute bags rather than the drying table shown in the video.

Women's capability index on helping group members and neighbors to use the innovations also more than doubled (0.25 to 0.59). Their capability to help others to conduct their experiments also increased substantially. A similar shift in capability index was observed about being a key informant. Women's ability in these areas did not change substantially in control villages. Video-mediated learning not only triggered women's ability to use innovations or experiment with new things, but it also strengthened their capacities to share this new knowledge and skills with others in the community. A woman from a video village mentioned this during the group discussion:

> 'My neighbors usually retain vegetable seeds, such as bean seeds. They used to preserve the seeds with whole pods. When I came to know the importance of properly drying the rice seeds, we discussed this issue (. . .) we observed that the skin of pods contained moisture and hosted insects and pests. Now they store bean seeds after separating them from the pods, and store them in airtight containers after properly drying.'

Another woman inferred during the interview:

> 'We used to thresh the paddy by striking the heap three to four times on an open surface (e.g. raised soils or woods, added by the authors for clarification). We did not notice that unfilled and deformed grains could be separated at the third and fourth stroke. Grains threshed in open surface are usually mixed with soil and other inert matter. (. . .) we were pouring germs in the seed lot. After watching the videos we realized the necessity of a threshing table and optimum stroke while separating seed grains. (. . .) most farmers living next door also apply two and a half stroke now.'

Farmers started applying some of the rice seed sorting, flotation, drying, and storage innovations to other crop seeds. Two-thirds of the women mentioned that they tried the innovations with other crops: mostly for vegetable seeds, 13% for other cereals such as maize and wheat, while 5% applied them to different pulse crops like lentil and gram.

Related to both human and social capital development (e.g., exploring sources, bargaining better price, and managing organization support), the capability of women in video villages increased substantially, contrary to the control villages. Women mentioned that they could bargain better prices with the local agents and buyers while selling seeds. During the video shows (either in a group or in a neighbor's house), other farmers and local agents often watched from the side. This helped to convey the importance of quality rice seed production using simple local innovations and convinced others to pay an extra premium for quality seeds.

Exploring sources and managing additional support (packaging, and credit for seed production) necessitate distribution of benefits from social capital (reciprocity, networks). RDA is a national training and research organization having continuous initiatives (training, research and policy lobbying) for local seed system development for about a decade. TMSS is a national NGO having their operating network for social and group mobilization activities all over Bangladesh for the past decade. They also work with micro-credit and have (since its involvement in the first rice seed video project) a separate commercial seed department. Women mentioned that TMSS started providing credit for seed production, which they did not consider before. Both organizations also supported some of the group members for packaging rice seed. One woman mentioned during the group discussion:

> 'There were credit group members of the NGO (TMSS) for the last four years in our village (. . .) they used to provide credit for small-scale business, livestock, poultry, crop production but not for seed production (. . .) one day the responsible field worker watched the videos with us (. . .) he was convinced that rice seed production would be a potential enterprise. (. . .) two of our group members received credit and packaging support from the office.'

In what follows, we explore how video-mediated learning helped to trigger communicative learning and contributed to an accumulation of human and social capital.

How does Farmer-to-Farmer Video Contribute to Women's Communication with Local Seed Information Sources?

An important hypothesis for applying farmer-to-farmer video approach is that it will create interest and motivation of the resource poor women

for further sharing, seeking and applying rice seed innovations as a rural enterprise. Exposure to different communication sources is an important input for distribution of the benefits of human capital and building social capital. In this study we assessed farmers' interaction with different local sources as an indicator of their change in communication exposure. The findings (see Figure 2) indicate that women's interaction with all the important local rice seed communication sources has been increased.

The communication index of women almost doubled in relation to neighbors, family members and experienced farmers in their own village. Women increasingly discussed and consulted about any farming issues with these sources. Rice seed production and post-harvest became an important topic to discuss with the farmers living next door after the video exposure. Interaction of women in the video villages more than doubled for some of the sources beyond the villages (TMSS and RDA field worker). TMSS had their credit groups in most of the villages and their field workers had intensively interacted with the women clients for different social and group mobilization activities. But after the video they also started discussing about rice seed production and post-harvest activities. RDA being a national training and research organization had less permanent networks and contacts at the community level. Nevertheless, field workers of RDA started interacting during and after the video learning activities. A woman stated during an interview:

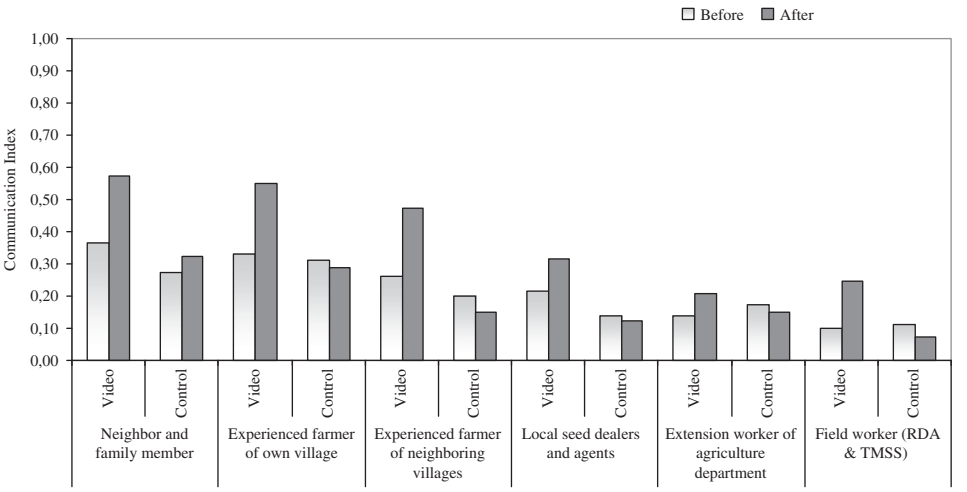

FIGURE 2 Women's communication with local seed information sources in video and control villages in northwest Bangladesh in 2005 (before videos were introduced) and 2008 (after videos were introduced).

> 'We did not know that the Rural Development Academy helps farmers about farming issues such as seed. We are happy to talk to the people of this big office.'

On the interaction with the public service extension agent, a woman replied:

> 'Before, we hardly met a block supervisor in the village (. . .) if we met him/her our main inquiry was usually about agronomic practice, crop variety, protection, (. . .) now the block supervisor comes to us and discusses problems and solutions about seed production and post-harvest.'

This indicates that video-mediated learning created interest and motivation not only among the initial target group, but also among other knowledge and information intermediaries in the community.

Women were also asked to indicate the gender of the sources with whom they discussed and consulted about local rice seed production and post-harvest innovations. Discussion means general information sharing whereas consultation means specific need-based information sharing. Women discussed (81%) and consulted (78%) the sources almost equally (Table 2). However, women (41%) had more general discussions with men than need-based consultation (35%). It was almost equal in the case of discussion and consultation with women. Women exchanged information equally with members of the community irrespective of gender through a heterogenous (women to men or women to women) network.

What is the Contribution of Farmer-to-Farmer Video to the Rice Production and Self-sufficiency Status of the Rural Household?

After the video-mediated learning, farmers reduced almost by half their seed rate (Table 3). In *Aman* season, the average yield increased significantly by 14% from 3.7 t/ha to 4.3 t/ha, whereas the average yield increased by 15% from 5.4 t/ha to 6.2 t/ha in *Boro* season. No significant changes were observed in the control villages.

TABLE 2 Communication Pattern with Other Seed Information Sources by Gender in Video Villages

Gender based interaction	Discussion (%)	Consultation (%)
Female – male	40.7	35.0
Female – female	21.4	24.3
Female – male/ female	18.6	18.6
None	19.3	22.1

TABLE 3 Households Rice Production Statistics in Study Sites in Northwest Bangladesh in 2005 (Before Videos Were Introduced) and 2008 (After Videos Were Introduced)

Production characteristics[1]	Video villages			Control villages		
	Before	After	*t*-value	Before	After	*t*-value
Average seed rate (kg/ha)	58.1 ± 9.7	30.7 ± 7.5	47.2***	55.7 ± 9.5	54.8 ± 9.8	2.7
Average yield (kg/ha) in Aman	3770.9 ± 346.4	4323.1 ± 361.7	−24.2***	3701.2 ± 267.7	3709.5 ± 255.3	−0.83
Average yield (kg/ha) in Boro	5414.8 ± 506.4	6206 ± 601.7	−32.9***	5632 ± 497.9	5645.9 ± 491	−1.6

***$p < 0.001$

[1]Respondents were asked about the amount of seed(s) used and yield of paddy per bigha (local unit) of land. Yield and seed data were converted to per hectare. Seed rate means amount of rice seeds required per unit (hectare) of land.

Women can produce quality seeds by applying what they learnt from the videos. The seeds they produced were bright, had less deformity, and resulted in higher demand and price in the local market compared to before watching the videos. By applying the simple technologies presented in the videos farmers were able to produce and store quality seeds, which in turn contributed to yield increases in both seasons. About 69% of the households used their own farm seeds compared to 42% before the video intervention. The average RSSI value increased significantly by 27% for the households that were exposed to videos (Table 4). In control villages there was no significant change in the RSSI.

Marginal households decreased by 5% (Table 5), whereas rice subsistence households decreased by 19% after video exposure. Rice surplus households increased by 24% after the video was introduced. So while rice self-sufficiency of rural households significantly increased, subsistence households performed better in achieving rice self-sufficiency than marginal households. This is due to differences in rural institutions (land size, land tenure status, labor etc), which will be discussed later in the paper.

The households produced on average 2754 ± 1053 kg paddy in 2005 and 3157 ± 1208 kg in 2008 (based on double cropping). The average annual rice production significantly increased by 402 kg in video villages,

TABLE 4 Rice Self-sufficiency Index (RSSI) of Households in the Study Sites in Northwest Bangladesh in 2005 (Before Videos Were Introduced) and 2008 (After Videos Were Introduced)

Rice self sufficiency index	Video villages			Control villages		
	Before	After	*t*-value	Before	After	*t*-value
Average (%)	185.8 ± 72	213 ± 82.4	−23**	138.5 ± 55.5	138.9 ± 55.8	−1.4

**$p < 0.01$.

TABLE 5 Status of Household Categories in Video Villages in Northwest Bangladesh in 2005 (Before Videos Were Introduced) and 2008 (After Videos Were Introduced)

Categories*	Before video (%)	After video (%)	Change of household categories (%)**
Marginal (RSSI<=100)	12.9	7.9	(−) 5
Subsistence (RSSI >100–200)	53.6	34.3	(−) 19.3
Rice Surplus (RSSI >200)	33.6	57.9	(+) 24.3

*Based on household categorization principle as suggested by Page *et al.* (2009) for northwestern Bangladesh

**(−) indicates decrease and (+) indicates increase

TABLE 6 Women's Perception about the Contribution of Rice Seed Innovations to Obtain Additional Income

Perception about additional income	% Respondents
Selling additional paddy	7.9
Selling additional rice seed and seedlings	20.7
Selling both seed and paddy	10.7
Sufficient paddy for the family saved cost to buy rice from the market	15.0
Production cost reduced due to use of own seed	13.6
No income	32.1

whereas no changes were observed in control villages. At an arbitrary price of 6 US$ for 38 kg (1 maund) paddy the increased production contributed to an annual increase of income of 63 US$ per household.

Two-thirds of the respondents said that the local rice seed innovations contributed to their ability to obtain additional income. They mentioned that selling additional paddy, rice seed and seedlings were major ways that contributed to getting additional income directly (Table 6). Some others saw input cost reduction and home consumption of additional paddy as an indirect contribution to improved household income.

How Does Farmer-to-Farmer Video Contribute to Gender Equity and Women's Empowerment in Decision-making about Rice Farming Related Issues?

Our hypothesis was that if rice seed innovations contributed to getting additional income, women would get more access to that income and subsequently it would influence decision-making patterns in the households. The majority of the respondents (62%) who obtained additional income indicated that the income was kept jointly by the wife and husband. Only 29% mentioned that they kept the income and 8% mentioned that the husband kept the income.

Figures 3 and 4 show changes in intra-household decision making in video and control villages, respectively. In all aspects, there was a substantial reduction in decisions being made by men alone, and a corresponding increase in decisions made jointly by both men and women in the video villages. In contrast, there was no substantial change in the control village.

> 'My husband used to quarrel with me when I was not able to preserve good quality seeds. After learning from the video I could retain quality seeds which increased our rice production (. . .) We could also sell and exchange the seeds with our neighbors (. . .) My husband started consulting me more in matters of rice variety, selling seed and paddy'.

Above statements of a woman in a video village indicate how their role in decision-making about selling of rice seed and paddy significantly increased. Similarly, they were consulted more about how to spend this additional income. Informal interviews and group discussions with women indicate

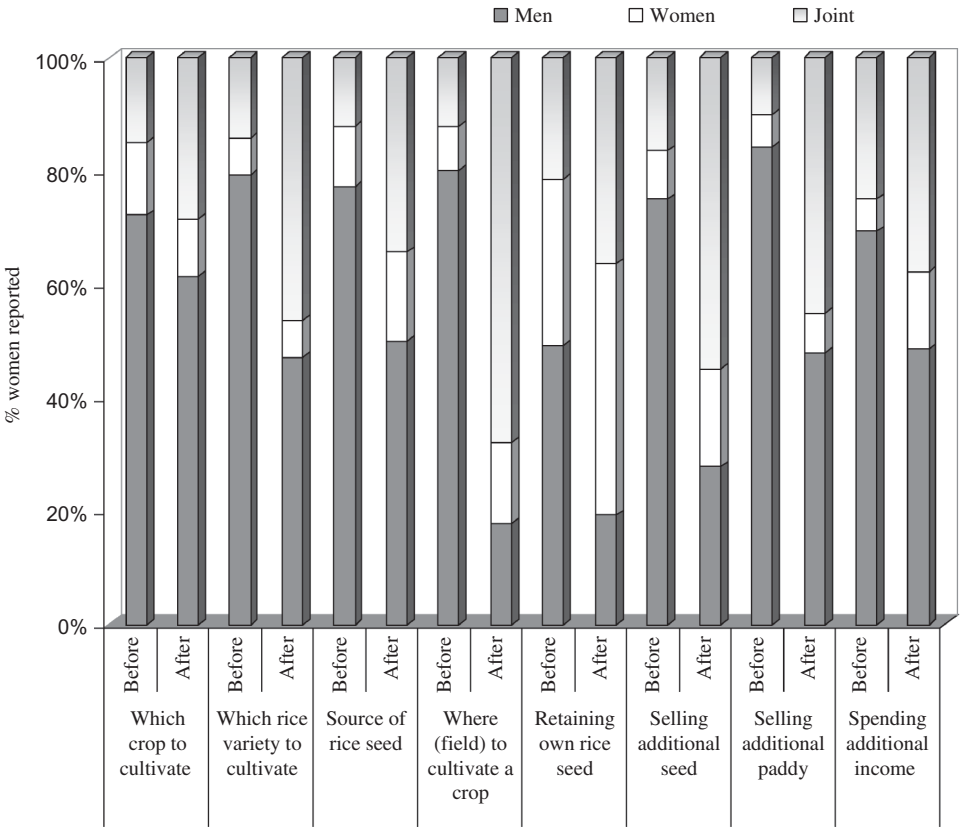

FIGURE 3 Household decision-making pattern in video villages in northwest Bangladesh in 2005 (before videos were introduced) and 2008 (after videos were introduced).

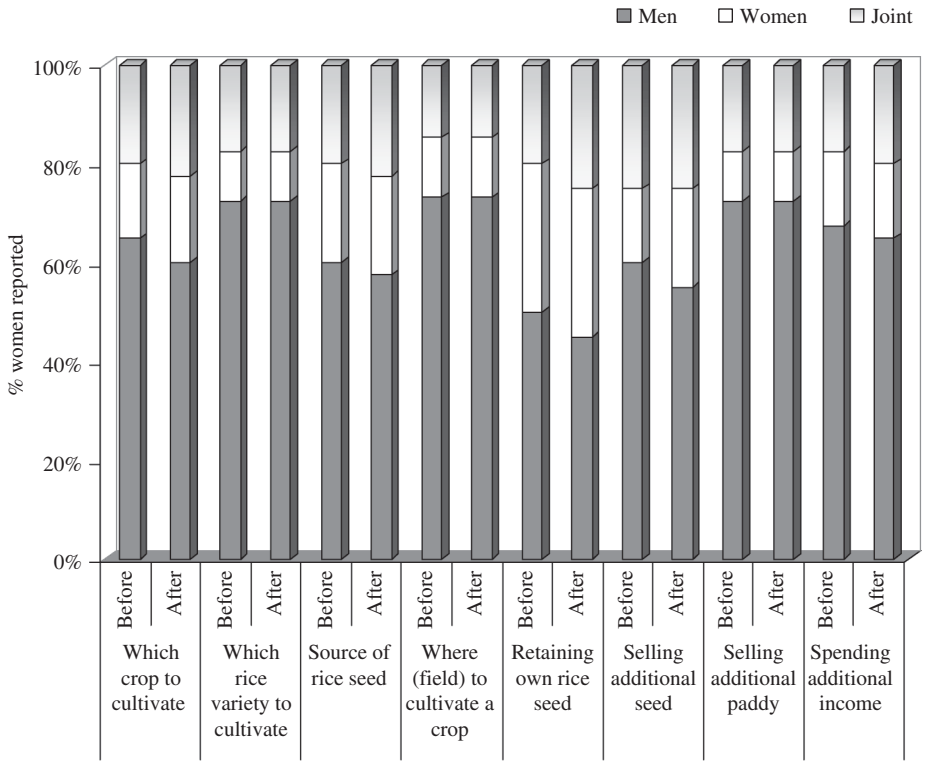

FIGURE 4 Household decision-making pattern in control villages in northwest Bangladesh in 2005 (before videos were introduced) and 2008 (after videos were introduced).

that they were not only consulted for rice and seed production related issues but also for spending additional income for other household expenditures, e.g., nursery, poultry, gift, household furniture, purchasing inputs and education of the children. The improvement of gender equity in video villages is illustrated by an increased joint decision-making and women's participation in decisions on how to spend additional income for other household expenditure.

What are the Factors Influencing Additional Income Creation from Applying Rice Seed Innovations?

A logistic binomial regression analysis was conducted to determine the factors influencing likelihood of getting additional income from applying the rice seed innovations. There were six significant factors (Table 7), namely, number of times video watched ($p < 0.01$), communication exposure with local seed sources ($p < 0.01$), land tenure status ($p < 0.001$), involvement of family labor ($p < 0.01$), applying rice seed innovation ($p < 0.01$) and getting additional organizational support ($p < 0.01$).

TABLE 7 Factors Influencing Additional Income Due to Rice Seed Production and Post-Harvest Practices in Video Villages in Northwest Bangladesh

Factors	Level	Coefficients (B)	SE	Exp (B)
Age	Continuous (years)	0.008	0.039	1.00
Number of times video watched	Continuous (number)	0.606**	0.206	1.83
Place of video watch	0 = Only in TV 1 = Video show	1.164	0.688	3.20
Communication exposure with local seed sources	Continuous (score)	0.467**	0.187	1.59
Family size	Continuous	0.174	0.250	1.19
Education	Score	0.019	0.125	1.01
Land tenure status of households	0 = Dependent on sharecropping 1 = Have some own rice land	3.228**	0.819	25.23
Labor support from family member	0 = No 1 = Some support from family member	2.965**	0.971	19.39
Applying rice seed innovation in other crop seeds	0 = Don't apply for other crop 1 = Apply for other crop	2.059**	0.727	7.83
Getting additional organizational support (packaging, credit, market linkage)	0 = No 1 = Yes	1.609**	0.673	4.99
Household head is female	0 = No 1 = Yes	1.706	1.715	5.51
Cultivable land	Hectare	0.241	1.811	1.19
Constant		−14.351		
Model Chi-square		103.62**		

**$p < 0.01$.

Land ownership is the most important factor to consider when aiming for rice seed production as a rural economic enterprise. The odds ratio of 25.2 indicates households having own rice land were 25.2 times more likely to get additional income than households that sharecropped. Sharecropping is increasing day by day. An agricultural census in 2008 revealed that in Bangladesh almost one-third (29.4%) of the households were tenants, of which 34.5% were located in the northwestern region of the country (BBS, 2008), which is in our study area. Women mentioned that when they cultivated the land of others, producing rice seeds and applying the innovations depended on the landlord's intention and choice. In most cases, landlords wanted immediate return, either as share of paddy or currency. In that case it was impossible for them to opt for seed production and sales. In those cases where landlords were flexible in method and time to get their shares, women could decide for rice seed retention. It allowed households to pay the shares in currency and earn some additional income by selling seeds or seedlings, and paddy.

Family labor availability was the second most important factor. The odds ratio of 19.3 indicates that households which had labor support from family members were 19.3 times more likely to get additional income than those which had no support. Local techniques on manual seed sorting, seed flotation, threshing and storage required casual labor. Techniques on manual seed sorting and threshing are comparatively more labor consuming. When family members helped in these activities it resulted in additional income. Hired labor to perform these activities is not economically viable. According to the women interviewed, when their son, daughter and husband or other elderly members gave a helping hand they could easily apply the innovations resulting in quality seeds and subsequent increase in yield and income.

The application of innovations to other crop seeds is the third most important factor predicting additional income. Women who applied to other crop seeds what they had learnt from the rice videos had 7.8 times more chance of obtaining a higher income than women who did not. Smallholders in Bangladesh usually cultivate a variety of crops, in addition to rice as a staple crop, and retain small seed quantities of these crops. Inspired by the videos, women discovered that the rice seed innovations could also be applied to produce quality seed of vegetables and other cereals. These in turn contributed to additional production and income.

The fourth important factor was additional organizational support. Women who received additional support had 4.9 times more chance of getting additional income than women who did not. Some women received support for packaging and credit which helped them to sell quality seeds in the market. Some women also explored market linkages during the follow-up visits by TMSS and RDA field staff. Others interacted with local extension agents and seed dealers which helped them to get contacts for selling additional seed and paddy.

Women who had watched the video multiple times were 1.8 times more likely to get additional income than women who watched them less. When women watched the rice videos repeatedly, they more easily understood the principles and value of the innovations. It increased their confidence to produce quality rice seeds and to think about selling additional seeds and/or paddy. Women reported that when they watched the video once, they understood the innovations. When they watched the videos numerous times, it made them further reflect on the benefits of the innovations, namely increased production and income.

Women who communicated more with local sources had 1.5 times higher chance of getting additional income than women who had less communication. Women reported that they received moral support and suggestions from NGO staff, extension agents and local seed agents to produce seeds and/or seedlings. Discussion and consultation with these sources motivated them to explore rice seed as a rural enterprise.

DISCUSSION

The farmer-to-farmer videos on sustainable rice seed practices significantly contributed to the capital building of rural households in Bangladesh. Lee (2005) mentioned different categories of sustainable agricultural practices without mentioning on-farm rice seed management. The rice seed innovations featured in the Bangladeshi videos are sustainable since: (i) these incorporated local knowledge and skills, scientists were involved only to explain the principles or to improve the practices; (ii) the practices entirely employed locally available natural resources; (iii) and they promoted on-farm resources. Many authors (e.g., Pretty, 2006; Altieri, 2002a; Murdoch et al., 1994) consider these as key characteristics of sustainable agricultural practices.

Video proved to be a powerful tool to enhance social, human and financial capital and to cultivate farmer-to-farmer learning pathways. After watching the videos rural women's ability to apply and adapt the innovations in their context increased substantially. Women innovated with local resources based on their endogenous and newly acquired knowledge and skills. They did not only apply the innovations for rice seed production, but also started applying these to other crop seeds. The creativity and learning sparked additional human capital building e.g., women were motivated and confident to ask for information and bargain with intermediaries. This helped them to become rural entrepreneurs. The finding is in line with Zossou et al. (2009) who showed how video-mediated learning stimulated the creativity of rural women rice processors in Benin.

Video-mediated learning played a catalytic role in social capital building. It not only helped to expose rural women to new ideas and practices but also cultivated learning pathways within the households and community. When women watched the videos in their neighbor's or group leader's house or in the yard of a household, new learning avenues unfolded for both women and other intermediaries (men, women, extension and local seed agents). This indicates the power of farmer-to-farmer video to spark unsupervised learning, supporting similar observations made in Africa (Van Mele, 2010a). Interests of the intermediaries about women's rice seed production and post-harvest practices increased and their attitudes towards them changed. They started interacting more frequently with the women, which is a signal of transformative learning (Friis-Hansen & Duveskog, 2008; Percy, 2005) that might help change the frame of reference of the farmers and others within the local rice seed innovation systems. Van Mele (2006) also suggested that the attitudes of researchers and extensionists may change when involved in video-mediated learning.

Neighbors and knowledge intermediaries started to have more trust and confidence in women's capabilities, and opened up sharing of learning and innovations with others in the community. Building relations of

trust and reciprocity is one of the major challenges for sustainable agricultural projects and programmes to be successful. According to Westermann et al. (2005), norms of reciprocity and collective action in natural resource management were more evident in women's and mixed groups than in men's groups. Then what is the additional importance of targeting women for video-mediated group learning? Video contributes to visual literacy that empowers rural illiterate, mainly women, in Asia and Africa (White, 2003; Lie & Mandler 2009). Seeing other farmers and peers face similar problems, and being able to solve these problems by themselves, proved an additional source of motivation and interest for women and others in the local seed system. This would be missed out with verbal and written medium only. And as such video served as a media that stimulated learning and interaction both horizontally and vertically within the rural rice farming community in Bangladesh. According to Pretty & Ward (2001) social capital-based connections for the rural actors are key to sustainable agriculture.

The experiences of FFS on rice-based sustainable farming practices in Bangladesh suggest that, despite being successful, it faced challenges to create a learning environment for illiterate and women (Barzman & Desilles, 2008). The challenge was partly due to the change agents being inaccessible to the illiterate and women. In Kenya, NGOs succeeded in providing information on organic agriculture through different face-to-face extension methods (workshop, demonstration and on-farm visits) but without succeeding in enhancing farmers' ability to put new knowledge into practice (Goldberger, 2008). The bulk of standardized knowledge and information that were provided during a workshop obstructed farmers' creativity, the language created a barrier of communication, and subsequent supervision was not evident. As a result, these methods were unable to trigger learning and adaptive capacities of the organic farmers. In a study on cross-cultural learning, Van Mele et al. (2010b) reported that when he suggested to national partners to use the Bangladeshi rice videos (after translating them into local languages) in learning sessions with rural women in Africa, the intermediaries (research and extension staff) were skeptic about their suitability for the African context. They only became convinced after witnessing how the rural women in their respective countries responded positively to the videos. Farmer-to-farmer video can trigger learning, irrespective of culture and literacy levels.

In Africa, video helped to strengthen the fragmented landscape of rural extension (Van Mele et al., 2010a). Video-mediated learning also created enthusiasm about the process and practices that yielded benefits beyond the original suite of improved practices. Studies in Benin (Zossou et al., 2010) reported how the approach contributed to mobilizing women rice processing groups, rice traders and financial institutions (credit), which

was far beyond the intended goal of the project, e.g., improving parboiling practices of rural women. In our study in Bangladesh video impacted on the community by stimulating network building with neighbors, traders, extension agencies beyond the intended goal of the project, i.e., improving rice seed quality. However, to gain a more comprehensive understanding of the process, characteristics and outcome of farmer-to-farmer video on network building more research will be needed in the future.

Kaaria et al. (2008) and Manzur & Onzere (2009) reported how women's local skills and knowledge affects intra-household decision-making. The new knowledge and skills on sustainable rice seed practices that Bangladeshi women learnt from the video likewise created a leverage point for them within their households. Women's status was transformed in that the new knowledge and skills helped households earn more, and that they could share and exchange these with men and women in their community. Considering the role video can play in creating human and social capital, to what extent could it contribute to food security?

Debates have mounted on whether the world can solve the problems of food security and poverty using sustainable agricultural practices. The world has observed the lowest cereal stock in three decades, and many developing countries, such as ten Asian rice growing countries including Bangladesh, have faced localized food crises. Market reliance and food imports are no key solutions towards food security, as made clear by the recent food crisis. This calls for an integration of an ecological and sustainable approach towards localized food production (Dobbs, 2008). Proponents of agroecology and sustainable agricultural systems (Altieri, 2002a, 2002b; Gliessman, 2005) believe that this system that relies on sustainable agricultural practices can increase yield and productivity of cereals between 50 to 100% if there is a continuous accumulation of social, human and natural capital assets. Our study showed that rice productivity increased by 15% after women and men applied rice seed innovations learnt from the videos. Although Lee (2005) mentioned that a key bottleneck to sustainable agriculture is the context-specificity of the practices and hence the near impossibility to scale them up, the farmer-to-farmer rice videos showed how this could be overcome and move beyond the pilot scale. Sharing knowledge and skills is more effective when farmers watch their peers explaining the '*why*' and '*how*' of a locally grounded technology. It cultivates reciprocal sharing and trust building that are influential factors for new ways of increasing localized food production.

Although video has a certain power to influence capital asset accumulation, existing institutional factors like land rights, involvement of casual and family labor were important determinants for households to get additional income. Likewise, organizational support for credit, packaging and establishing market linkages also helped resource-poor men and women to

transform their existing capital through market and consumption. These factors are very important when we talk about successful adoption, adaptation and utilization of sustainable agricultural practices in developing countries (Pretty, 1999; Lee, 2005).

Mere use of video *per se* is no guarantee to bring about change. In addition to the factors mentioned above, it also depends on how the potential of video is being harnessed, e.g., how women and poor people viz a viz other stakeholders are involved in the video development and subsequent viewings in other communities. Earlier studies (Van Mele, 2006; Zossou et al., 2009; Van Mele et al., 2009) on video and learning about sustainable agricultural practices highlighted the importance of: involving local people in video content development; mobilizing other intermediaries (research, extension and media) through context-specific networking; and local policy support for rural learning.

CONCLUSIONS

Farmer-to-farmer video has huge and untapped potential for building farmers' capacities at local and regional levels in the context of sustainable food production and self-sufficiency. While video-mediated group learning enhanced the capacities of rural women, who were the main target, it equally contributed to cultivate an environment of reciprocal sharing of the benefits of new knowledge and skills. Increased rice production and rice self-sufficiency were not only an outcome of individual women's abilities to try new things but also of accumulating human and social assets within the households and the community. Along with the potential of video to spark changes, existing capital, institutions and policy equally determine the transformation to sustainable agriculture. To maximize the contribution of video-mediated learning, we need to integrate it along with changes in policy and institutions supporting sustainable agriculture.

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