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In Search of an Alternative Agricultural Extension Strategy: An Action Research on Off-season Vegetable Production in Nepal

Murari Suvedi
Ramjee P Ghimire
Michigan State University

Abstract

Agricultural extension services in Nepal are in serious need of revival. An extension approach that brings agricultural stakeholders together and fosters co-learning among them is paramount for agricultural development. This study, conducted in 2013 in Hamsapur, Nepal, aims to assess the current agricultural extension services and search for an alternative extension strategy for speedy agricultural development. Specifically, the study seeks to examine the current agricultural production patterns; assess farmers' perceptions of the participatory action research (PAR) approach; and identify barriers for adoption of new agricultural technologies by farmers. Personal interviews and observations were employed for collecting qualitative and quantitative data. Ninety-two farmers participated in the study. Farmers, including women and youths, found off-season tomato production beneficial to them. Marketing of vegetables and lack of irrigation, education and knowledge are problems facing farmers. Farmers are optimistic about increasing farm productivity by adopting new and improved technologies. The PAR approach appears to be effective in helping smallholders when non-governmental organizations, farmers and educational institutions work together. Agricultural programs would likely succeed if there were provision of input such as seeds, fertilizers and farmer-to-farmer extension, and if technologies were market-driven and compatible with target communities.

Keywords: off-season vegetable production, participatory action research, agricultural extension services, Nepal

Introduction

Agricultural extension services in Nepal are in need of revival. In a traditional extension system, extension agents are in control and command of extension services, farmers and other stakeholders have little to say, and technology transfer dominates the mandates. Research, education, farmers and extension rarely connect to one another. This type of extension service cannot adequately address the dynamism of the agricultural system, including emerging challenges, and therefore cannot cash in on the opportunities for and sustain agricultural growth. Scholars suggest the need for dynamic extension services and strong linkages and complementarities between research, extension, education and farmers (Rivera, Blum, & Sulaiman, 2009), but little study has been done in this area, especially pertaining to smallholders.

Scholars advise reversal of the traditional extension approach in favor of pluralistic, participatory and demand-driven forms (Qamar, 2005; Swanson & Samy, 2002). Suvedi and Kaplowitz (2016) underscore that today extension services need extension workers who are competent in both technical areas of their field as well as in process skills. These new lines of thought about extension services posit that beneficiaries' participation in the extension process is paramount for needs-based, profitable and sustainable farming. Farmers have tremendous knowledge of their farming systems, so their participation in extension is crucial. When researchers, educators and extensionists work together with farmers, this brings synergy to their work. McTaggart (1997) argued that the development process will be effective and sustaining when researchers and clients engage in joint planning, implementation, systematic observation, reflection and co-learning. This is called participatory action research (PAR). PAR offers necessary information to address societal problems. This study employs PAR to identify an alternative approach for extension services in rural Nepal.

Nepal remains one of the poorest countries globally, with the gross national income (GNI) per capita estimated to be $730 (World Bank, 2016). About 80% of the population in Nepal resides in rural areas and practices subsistence agriculture, and poverty and hunger are rampant (IFAD, 2013). Addressing needs of the rural farmers is essential to address poverty and household food insecurity. Anecdotal evidence shows that few farmers who have tried off-season vegetable production have found it to be helpful in earning additional income and price of off-season tomatoes was four times the seasonal price. The question therefore is why are off-season vegetable production technologies not adopted by farmers, and why is this technology not scaled up in Nepal?

Scholars who studied Nepal's extension services have argued that the traditional and top-down approach of the extension process is hindering the diffusion of innovations among farmers (Suvedi & McNamara, 2012). Weak coordination and linkage between research, extension, education and farmers have been an issue for a long time. Extension professionals are not informed of research findings, and researchers are not aware of field researchable problems (Suvedi & McNamara, 2012). This prevents researchers from addressing real and/or important researchable problems facing farmers and limits interactions and information and knowledge sharing between stakeholders.

Various scholars have explained PAR and found it to be effective in empowering farmers because it is a "for people and by people" approach. Borrowing the defintion from Lewin (1946), who first coined the phrase "action research," Srikandarajah and Fisher (1992) argue that action research combines investigation and action (cited in Fisher & Jackson, 1998). Findings from investigation inform action, thus the actions taken are pragmatic and sustainable. The PAR involves researchers, extensionists and beneficiaries in the extension and learning process and encourages systematic research by participants to generate new knowledge. Referencing Reason and Bradbury (2008), Baldwin (2012) argued that PAR has three purposes: conducting applied research that can lead to concrete action, involving beneficiaries in the process that brings change and nurturing ownership among participants. Because the process is based on a constructivist approach of researching, PAR is more progressive than a positivist approach (Figure 1). PAR helps bridge the gaps between extension workers, researchers, educators and farmers. In PAR, researchers visit farmers and collaborate with farmers in key activities including technology selection, dissemination and evaluation (Caister, Green, & Worth, 2012). Thus, PAR breaks the traditional one-way relationship between actors--farmers and researchers and extension workers---and fosters shared visions and actions among partners.

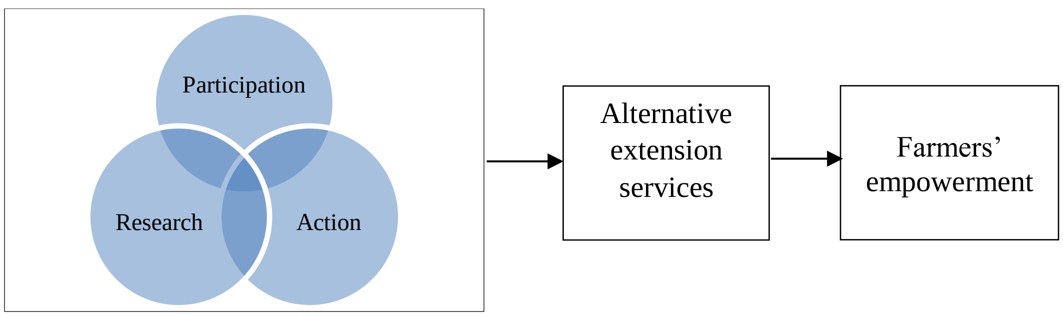

Figure 1. Participatory action research (PAR) approach to development.

Participatory Action Research (PAR) is popular in learning and development. Aziz, Shams and Khan (2011) contend that PAR provides spaces for participants to engage in critical reflection and action. McTaggart (1991) argues that PAR envisions flexibility and collective actions in planning, implementation, observation, evaluation, reflection and co-learning. Technologies are evolving fast. Societal needs are also changing. Problems and opportunities perceived to be important today may not be important in the future. PAR encourages agricultural partners to keep an eye on changes and remodel their programs to suit their changing contexts.

The project on which this paper is based followed a demand-driven, pluralistic and participatory extension model to plan and deliver technological innovations for socioeconomic change in the rural areas. Michigan State University (MSU) initiated an action research project in Hamsapur, Nepal, in 2011 with 18 farmers. The project's goals included enhancing food and nutritional security by increasing farm productivity with a focus on off-season vegetable crops. Building on the success of the MSU-initiated off-season vegetable production project, this project aimed to scale up the off-season vegetable production and develop leader farmers as entrepreneur-cum-extension workers at the grass roots. Most farmers in the village practice subsistence farming. There were no concerted efforts to scale up off-season vegetable production programs in Hamsapur in the past. Little is known about whether and how action research works in rural settings like Hamsapur. Aziz, Shams and Khan (2011) used PAR in a community empowerment program in Pakistan and found PAR to be effective in deciphering social contexts and finding solutions to societal problems. Fisher and Jackson (1998) used PAR in management of protected areas in Nepal and found it to be effective there, too.

Study Goal and Objectives

The overarching goal of this study is to document the lessons learned from the participatory action research on off-season vegetable production and recommend an alternative extension strategy that farmers deem appropriate to them. Specifically, the study aims to identify the sociodemographic characteristics of farmers, determine current agricultural production patterns, assess farmers' perceptions of the PAR approach, and identify barriers and/or constraints for adoption of new agricultural technologies and practices.

Methodology

The PAR employs various methods to collect data, such as in-depth interviews, case studies and observations. For this study, personal interviews and observations conducted in June 2013 collected qualitative and quantitative data. Ninety-two project beneficiaries volunteered for the interviews.

The survey instrument consisted of eight questions. Questions 1-4 sought information about production and marketing of vegetable crops, fruit trees, cereal crops and livestock. Question five contained nine statements about barriers to adoption of new and/or improved farming practices and technologies. Respondents were asked to indicate the importance of these barriers on a 1-5 scale with 1 being "not all important," 3 being "neutral," and 5 being "very important." Questions 6 and 7 were open-ended questions asking respondents to indicate educational and informational needs of farmers and suggestions on how the government can help farmers to increase agricultural production and productivity. Question eight was about participants' demographics. Graduate research assistants at Michigan State University designed the instrument. The instrument was reviewed by extension experts for content and face validity and revised incorporating their input. The farmers were interviewed in their native Nepali language, and answers were simultaneously recorded in English.

A Michigan State University (MSU) student spent two weeks in the village interviewing farmers, observing their farm activities and gathering ethnographic data. She visited 14 farmers, interviewed them and visited their vegetable fields. A local person helped translate the data. Informal discussions were held with the leadership of a local non-governmental organization—the Ingragufa Community Foundation (ICDF)—who shared the history and activities of the off-season vegetable production programs running in the study area. Crosschecking of information (triangulation) boosts study's credibility (Creswell, 2007). Trustworthiness of data were established through crosschecking with key informants, i.e., local farmers and NGO staff and participant observation.

Descriptive statistics (mean, standard deviation) and inferential statistics (independent sample *t*-test and one-way ANOVA) were calculated while analyzing the data. Open-ended answers were reviewed and coded, and key themes were drawn. Key verbatim responses are included in this paper.

This was an ex post facto study. Some respondents could not recall production and yield data; others did not want to share information on the sale of vegetables. This resulted in higher numbers of missing data for production, sale and income from vegetable sales than one would ordinarily find in this kind of research.

The off-season vegetable production program started in Hamsapur in 2008, when a few farmers indicated the need and interest to grow vegetables as a means of supporting their livelihood because cereal crops, which dominated their farming, were not of much help to them. A select number of farmers received training on off-season vegetable production, and one farmer actually started growing tomatoes under a plastic tunnel. The result of the tomato harvest was promising. More farmers requested support on vegetable production. In 2011 and 2012, 18 farmers each year got support from MSU and ICDF and started tomato production.

Farmers continued with the tomato production, but marketing of tomatoes was a problem. Farmers explored the markets, and ICDF guided them to link to markets. Upon request from ICDF, the extension experts in the District Agricultural Development Office (DADO) provided vegetable production training to the farmers. Lead farmers and ICDF staff members met with farmers to seek their input. Farmers would also approach the latter and share their experiences. The researcher and extension expert at MSU were also in regular touch with ICDF and lead farmers. Every year, the three partners—farmers, ICDF and MSU—would review the project and share the lessons learned and revise as necessary the next year's program.

In 2013, 93 farmers received technical assistance and training in off-season tomato production. Technical assistance included partial support to cover the cost of building a plastic tunnel house (hoop house). Farmers who participated in the program were required to contribute Rs. 1200 (approximately $12) to join the producer group. This contribution went into a revolving loan fund for the farmers.

Farmers were selected from households with little or no knowledge about the new technology and farmers who showed interest and motivation to participate in off-season tomato production for income generation. Farmers who had already grown tomatoes together with those who were committed to building tunnel houses were included in the program. Some farmers were selected to serve as lead farmers. They worked as resource persons for other farmers who were new to tomato production in plastic tunnels.

To make the adoption of this new off-season vegetable technology sustainable, a three-stage process was followed. The first year, select farmers were provided with ready-to-plant tomato seedlings raised by a trained nursery grower. In the following season, farmers received seeds from ICDF and had to raise and plant their seedlings independently. The third time around, farmers were required to acquire and plant the seedlings on their own.

Results and Discussion

Participants' Demographics

Farmers (N = 92) were on average 44 years old. They had average family size of five, an average of eight years of education and farm size of 1.15 ha. Three out of four respondents were males. More than half (53.4%) of the farmers were of 31 to 50 years of age. Males, higher caste and younger farmers tended to be more educated than females and older farmers. The majority of households (74%) indicated males as their household heads, but nearly half (47%) of the respondents said farming-related decisions were made either by females or by both males and females. Among the 92 farmers interviewed, 50.5% were from high castes, followed by 33%

from ethnic groups and 16.5% of from lower caste or occupation-based caste.

Males had slightly higher levels of schooling (*M* = 8.41, *SD* = 3.42) than females (*M* = 5.87, *SD* = 4.07), and in a *t*-test this was found to be significantly different, t (19.709) = 2.216, $p < .05$. Seven percent of farmers had had no schooling; one-fifth and one-third had completed six to eight years, and nine to 10 years of schooling, respectively. The older farmers (age 61 years and higher) tended to have less education (*M* = 4.56 years) than younger ones. The ANOVA post-hoc test results show that there was a statistically significant difference in education of the oldest group and the younger (F (4) = 2.604, p = .044). Further, the youngest group of 30 years or younger had the highest level of education (*M* = 9.21, *SD* = 3.02).

As expected, farmers from high caste group had more education than the other groups. The majority (73%) of the high caste farmers had nine to 10 years or more education. Only 30% of farmers from ethnic groups and 18% of farmers from the occupation-based caste had achieved such high levels. About one-third of the respondents (27%) from the occupation-based caste did not have any school education, as compared with 4% and 3% from ethnic groups and higher caste, respectively.

Farmers' farm size was relatively small—i.e., 43% owned 0.5 to 1 hectare, and 19% owned farms of 0.4 ha or smaller. Only six respondents had more than 3 hectares of farmland. The majority (73.9%) of the households were headed by males. Several farmers interviewed were women who had assumed the role as the head of the household. Some women farmers had husbands working in the cities and foreign countries, which left them in charge of the farm. Younger farmers tended to share the responsibility as head of the household and for agricultural decision making more than older farmers. These findings reveal the changing demographics and social trends of farmers.

Agricultural Production

The overall agricultural outlook of the farmers in Hamsapur reflects those of typical subsistence farmers in the hills of Nepal.

Vegetable production. Overall, 19 types of vegetables were grown by farmers; the top eight are shown in Table 1.

Table 1.
Vegetable production

Vegetable	Farmers growing vegetable(s)	Area		Production		Income from sale	
		N	Average (sq. m.)	*N*	Average (kg)	*N*	Average (Rs)
Tomatoes	40	33	90.82	31	408.23	28	22,375.00
Cabbage	39	22	117.05	18	49.44	3	3,666.67
Cauliflower	37	19	25.75	16	27.31	4	950.00
Onion	27	13	7.87	11	14.09	x	x
Cucumber	26	12	154.77	12	173.33	7	4,857.14
Potato	20	14	183.57	13	129.62	2	6,500.00
Bitter gourd	20	5	8.80	6	25.83	2	950.00
Garlic	19	5	39.40	6	27.50	2	5,200.00

Note. "x"= No data reported.

Tomatoes are the most commonly grown vegetable and generate the most income for the farmers. Farmer 1 has been participating in off-season tomato production for three seasons now, and this past season he earned Rs. 30,000 from tomatoes alone. This is no paltry amount for a subsistence farmer in rural Nepal. This is even after he distributed tomatoes to his immediate and extended family. Farmer 1 explained that he had been using the extra money to expand his farm; for example, most recently he purchased chickens.

The next five most prevalent vegetables were cabbage, cauliflower, onion, cucumber and potato (Table 1). More land is devoted to growing potato (M = 184 sq. m.) than any other vegetable. Cucumber is next, with planted areas averaging 155 square meters. Farmers reported producing on average 408 kg of tomatoes, 173 kg of cucumbers and 130 kg of potatoes in the previous 12 months.

Although off-season vegetable production has excellent potential as an economic stimulant, marketing the produce remains a problem. A small number of farmers were selling their produce, but no single vegetable (excluding tomatoes) was being utilized for generating income. One farmer facing difficulty in marketing her/his produce commented, *"Although vegetables have quick turnover for production, it is difficult to access the market for vegetables…It ends up being harder to see results than you would expect."* The findings suggest that it is not only the production that the project and farmers have to focus on--they also have to think about the marketing of products.

Fruit production. Fruit production in Hamsapur is less common, with 10 fruits reported by farmers. Production of bananas, oranges and guava was reported most frequently. Fruits that farmers generated income from are bananas, oranges and coffee. This is consistent with the previous study in the research site by Aoki and Suvedi (2012), who found farmers receiving substantial earnings from the sale of coffee and banana. On average, farmers had 68 coffee plants, 15 pineapples and nine banana trees on their farms. All farmers that reported growing bananas and oranges raised local varieties. As for coffee, both local and improved varieties were indicated. On average, farmers produced 137 kg of banana, 96 kg of coffee and 220 kg of oranges the past year. Average production of guava and papaya ranged from 41 to 48 kg. Banana, orange and coffee were the major fruits that farmers sold in the market. Among 19 farmers growing oranges, one farmer had 500 trees and sales worth Rs. 48,000; others had an average of one to 30 trees and sales of Rs 400 to Rs 7,000.

Table 2
Crop production

Crop	Farmer grow-ing crop (*N*)	Farmers reporting tenure of land			Crop area	Native varieties							
						Total production		Farmers selling crops		Quantity sold		Amount earned from sale	
		Own	Rent/ Lease	Other	Mean (Ha)	*N*	Mean (kg)	Yes	No	*N*	Mean (kg)	*N*	Mean (Rs.)
Rice	81	72	-	5	0.67 (*N*=79)	62	1314.3	6	48	5	816	5	26,800
Maize	91	84	1	2	0.48 (*N*=90)	68	299.2	4	52	2	200	2	7000
Millet	86	77	3	2	0.39 (*N*=83)	66	208.0	13	46	9	200	-	x
Mustard	12	9	x	x	3.20 (*N*=7)	7	45.14	0	3	x	x	x	x

Note. “x” = No data reported (either no data or it is not applicable).

Crop production. Crop production in Hamsapur is dominated by maize, millet and irrigated rice (Table 2). All farmers except one grew maize. Nearly every farmer grew millet, and only 12 farmers grew mustard. Predominantly, crops that farmers grew were of native varieties.

Regarding land title, the majority of farmers reported that they owned the lands where they grew the above-mentioned crops. Only one maize grower and three millet growers said they rented the land on which they grew these crops. Among the four crops listed in Table 2, maize and millet were cultivated in areas of 0.48 and 0.39 ha, respectively; the average crop area for rice was 0.67 ha. Likewise, production and sale of rice in Hamsapur exceeded that of other crops.

Livestock production. The majority of respondents (89 of 92) reported the ownership of buffalo, and 72 said they raised goats. Poultry, cattle and pigs were also raised, but less frequently. On average, farmers possessed two buffalo, six goats, 16 poultry and two cattle. Most livestock in Hamsapur were of the local breeds; among pigs and poultry, some were improved breeds.

Benefits of Off-season Vegetable Production to Farmers

Besides helping farmers with income generation and livelihood improvement, the off-season tomato production program was found to be helping the Hamsapur community in sustainable development. Farmer 2, who went abroad to Kuwait to work for five years and returned and started tomato production, recalled his experiences: *“Why am I working so hard for another country, long hours, sending money home, when I could be just doing this in my own country?”* He was the first who started growing off-season vegetables using traditional methods and later used tunnel houses. He explained that people were skeptical about tomato farming when he started it, but he did it, he benefitted from it, other farmers saw it, and they are following Farmer 2’s footsteps now.

The contribution of vegetable production to community development and farmers’ empowerment is also shown by the fact that a forerunner in the tomato project and currently the vice president of a local tourism committee, Farmer 2, stepped up as a model farmer. Another lead farmer, Farmer 3, who is participating in and benefitting from the tomato project, recounted the time that he spent in Saudi Arabia: *"When I was 37, I went to Saudi Arabia for work. There I spent twenty hours a day, doing very hard labor, as a carpenter."* He was in Saudi Arabia for 25 months before he returned to Hamsapur and began farming again, but upon returning he no longer was satisfied with typical subsistence farming. Instead, he began participating in the tomato project and proved that, with dedication and hard work, farmers could become highly successful using hoop houses for off-season production. He stated, *"Abroad I earned no money, but here, I earned four lakhs [four hundred thousand rupees]. When I was abroad, I only earned one lakh!"* Vegetable production like that discussed here, besides preparing farmers for leadership, could eventually lead to other development projects -- thus the sustainability.

Barriers to Adopting Improved Agricultural Technologies

To the question about whether they saw any possibility for increasing their farm productivity by adopting new and improved farming practices and technologies, out of 86 respondents, a high percentage (90%) said yes, they can. To the question "Are there barriers to fully adopting the improved agricultural technologies?" about eight respondents in every 10(77%) replied "Yes", 16% said "Unsure" and the remaining 7% said "No."

When asked how important the given nine barriers were in the adoption of new and/or improved technology, a high proportion (82.2%) indicated the lack of market information, and 80.8% indicated no access to irrigation as the most important barriers hindering their adoption of technologies for farm production and productivity. Other important barriers included lack of access to markets for their products (74.6%), lack of required education or skills (68.9%), and insufficient knowledge or details about the new technology (62.7%) (Table 3). Surprisingly, more than 50% of the respondents did not perceive unsuitable technologies and small farm size as important problems, which needs further inquiry. As expected, respondents perceived "not owning the land they farm" as unimportant.

Table 3
Barriers for adoption of technologies

Barriers	Not important	Neutral	Important	Total		
	% reporting			*N*	Mean	*SD*
I do not have sufficient knowledge or details about the new technology.	25.3	12.0	62.7	75	3.85	1.42
I do not have the education or skills to adopt the new technology.	20.3	10.8	68.9	74	3.84	1.26
The agricultural technology is not suitable to my farm.	52.7	17.6	29.7	74	2.39	1.51
I cannot get credit needed to adopt the new technology.	36.5	29.7	33.8	74	2.85	1.46
I do not own the land I farm.	66.2	18.3	15.5	71	1.87	1.26
My farm is too small.	72.2	2.8	25.0	72	2.00	1.44
My farm has no access to irrigation.	13.7	5.5	80.8	73	4.34	1.26
I do not have access to a market for my products.	2.8	22.5	74.6	71	4.01	0.85
I cannot get market information as needed.	4.1	13.7	82.2	73	4.10	0.78

Note. Scale: 1 = not at all important, 2 = a little important, 3 = neutral, 4 = somewhat important, 5 = very important.

Farmers' Perceptions of the PAR Approach

Farmers indicated that lack of markets and market information, a weak public extension program, and lack of education and knowledge were the barriers holding them back. Farmer 4 is a woman whose husband pursued employment abroad, leaving her in charge of managing the farm and the home. She said that she knew the market was important to understand, but it was far away and difficult to access because of lack of transportation. She often did not know what the prices for products were. Additionally, she said that she would benefit from training on how to improve her maize and millet production, but that the training is lacking: *"Agriculture office representatives come only one or two times a year, and they do not give me enough information on how to improve my crops."* With an education that extended only to grade three, she said every opportunity to gain new knowledge and training for her fields was vital. Another farmer expressed concerns on how training by governmental organization was conducted that *"The training by NGOs and government is too theoretical. It needs to be more practical. The training by government needs to be more focused and specific. Training is short and too widespread in topics."*

The interviews revealed an increased level of awareness of farmers about organic agricultural production. Farmer 5 offered his point of view on the topic of improvements that the government can make. *"It would be helpful if the government developed an official standard for organic production. If an organic market were managed, then farmers who use all natural methods would be able to obtain a higher price for vegetables."*

On the way forward to attain sustainability, farmers reiterated the need for education and training on vegetable production and the urgency for a contingency seed supply regime. One farmer said, *"Government training [is needed] on how to produce tomato seeds by ourselves so we don't [have to] rely on Pokhara. More money can be made. Five grams of tomato seed costs Rs. 600, and if [seed] runs out in Pokhara, we have no backup."*

Conclusions

Following are the conclusions and the summary of the study focusing on three areas of PAR—participation, research and action.

Participation. The off-season vegetable production program run in Hamsapur is a farmer-led program. Initial demand for the program came from farmers who were struggling to support their families and some of whom even worked abroad. A few farmers who dared to take the risk of piloting new technology—those who Rogers (2003) called early adopters or innovators—showed that tomatoes could be a successful enterprise in Hamsapur. It is a typical example of "learning by doing" and the multiplier effect of intervention. Other farmers followed the lead farmers, and every year more farmers demanded and joined the program. It showed how innovation can be diffused easily across farmers— "farmer-to-farmer"—when the perceived benefit of innovation is greater than perceived risks (Rogers, 2003). Furthermore, technologies that are appropriate and culturally compatible are adopted quickly. This is an example of pluralistic extension services as well where farmers, a local NGO—the ICDF—and MSU worked together.

The participation of women farmers and farmers from ethnic groups in vegetable production indicates the project's contribution to empowering disadvantaged groups. However, the majority of the tomato growers were high-caste males with middle school education. Males dominated as the household heads and made decisions in most HHs. There were more females as HH heads among the younger generation, and in HHs with younger HH heads, males and females tended to share agriculture-related decision making. Proportionate participation from the lower caste and ethnic groups is required to foster equality in the community and sustain the programs. Participation and support of local stakeholders is needed to address the problems that respondents highlighted, such as lack of irrigation and lack of access to markets and marketing information, and need for education and training and advisory services.

Research. Except for off-season tomatoes, which showed promise for commercialization, most other agricultural crops and produce were of native varieties and used for families' own consumption. It appears that more farmers pilot-tested tomatoes on their farms because the partner NGO trained them and provided them with inputs—seeds, seedlings and plastic sheets. Several other agricultural products that may have market demand have not yet been tested in Hamsapur; they need to be pilot tested as farmers did tomatoes. Farmers' expressed interest in organic vegetable production shows their awareness of environmentally friendly production and their interest in getting higher returns to improve their livelihoods. Given increasing awareness of and growing demand for organic products among Nepali urban consumers, this demand appears to have potential. This, however, needs to be carefully planned, executed and promoted via a piloting and/or field-based research project.

Action. Partners collectively worked to make the off-season vegetable production project a success. The local NGO helped with social mobilization and with getting plastic sheets and other inputs. MSU faculty provided advisory services. Lead farmers helped other farmers to address technical and marketing problems. They also worked to collect farmers' feedback and helped with distributing the agricultural input.

In summary, such a program is likely to be successful if technologies are market-driven and culturally compatible; there is provision of inputs (e.g., seed, fertilizer, credit, technical services) in the program; farmer-to-farmer extension is used to disseminate technology; and finally, when research, extension, education, and NGOs work together.

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