MICRO-IRRIGATION AS A MEANS TO SUPPORT POVERTY ALLEVIATION: NEPAL'S EXPERIENCES

Uttam Raj Timilsina[1] and Suman Sijapati[2]

Abstract

Nepal adopted poverty alleviation as the national priority from its Tenth National Development Plan. This resulted in a reorientation in the country's irrigation sector. Irrigation was already recognized as the key input for farming that enhanced farm productivity, household income and food security. However, targeted intervention approach for the poor shifted the drive from the previous focus of expanding the irrigated area through construction of large irrigation schemes to the aim of enhancing irrigation efficiencies, delivering year round irrigation and conserving land and water.

The land holding pattern in Nepal is highly fragmented with average landholding of 0.66 ha and 57% households owning less than 0.5 ha. A substantial portion of the rural poor have small plots which are insufficient to provide full employment or income and the agricultural outputs are hardly adequate to support the family economy. In this context, Nepal's shift towards shallow tubewell and water lifting technologies in *terai* plain areas and micro irrigation technologies in hilly areas has been found to offer a positive impact for poverty alleviation and conservation of land and water.

This country paper begins with a general overview of the socio-economic context and landholding pattern of Nepal and then describes the introduction of micro-irrigation program in the country. Then, using two case studies representing efforts from the public and the private sector, it presents an assessment of the endeavor. Finally, it enumerates the experiences and lessons learned which are also expected to be helpful for other small land holding farming circumstances.

Estival et Conclusion

Le Népal a adopté la réduction de la pauvreté comme la priorité nationale de son dixième plan national de développement. Il en est résulté une réorientation dans le secteur de l'irrigation du pays. L'irrigation a été déjà reconnu comme l'élément clé de l'agriculture. Toutefois, l'approche des interventions ciblées pour les pauvres a déplacé la voiture de la mise au point précédent d'étendre la superficie irriguée par la construction de grands projets d'irrigation à l'objectif de renforcer l'efficacité d'irrigation, l'irrigation livrer toute l'année et la conservation des terres et l'eau.

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[1] Mr. Timilsina is the Deputy Director General, Irrigation Management Division, Department of Irrigation, Jawalakhel, Lalitpur, Nepal. He is also the Member Secretary of Nepal National Committee for ICID (NENCID). Telephone No: +977 9841684994. Email: Uttam-timilsina@live.com.

[2] Mr. Sijapati is a Senior Divisional Engineer and a member of NENCID. Address: P. O. Box 8975, EPC 1115, Dhobighat, Lalitpur, Nepal. Tel No. +977 1 5532800. Email: suman@sijapati.wlink.com.np.

La tendance foncière au Népal devient très fragmenté, avec une moyenne de 0,66 ha et 57% des ménages possédant moins de 0,5 ha. Une partie importante des pauvres en milieu rural ont de petites parcelles qui sont insuffisantes pour assurer le plein emploi ou des revenus et la production agricole ne sont guère en mesure de soutenir l'économie familiale. Dans ce contexte, le changement Népal en vue de puits tubulaires peu profonds et de l'eau de levage technologies de *Terai* zones de plaine, où la recharge des eaux souterraines est suffisante et l'application des technologies de micro-irrigation dans les zones montagneuses, où la tête de naturel pour les systèmes d'irrigation sous pression est facilement disponible, il a été constaté à offrir un impact positif pour la réduction de la pauvreté et la conservation des terres et l'utilisation appropriée de l'eau.

Le travail dans la micro-irrigation au Népal a d'abord été lancé dans le début des années 1990. Toutefois, le lecteur vers l'expansion de la micro-irrigation s'est accélérée davantage lorsque le gouvernement a également joint des mains avec le secteur privé. Grâce à l'utilisation de technologies efficaces, comme les gouttes et les asperge de précision l'agriculture a été rendue possible et que les agriculteurs ont reçu des rendements plus élevés. Ils ont été en mesure d'obtenir un rendement rapide de la culture des légumes et des femmes ont été trouvés à bénéficier encore plus. Quatre principales dimensions liées à l'eau de bien-être des moyens de subsistance: la liberté des corvées, de la santé, la production alimentaire et les revenus ont été observées ont été produites si le programme.

des expériences à petite échelle avec le Népal par exemple, technologies d'irrigation efficaces à la fois par le public ainsi que le secteur privé ont donné des résultats positifs. Ces expériences peuvent être utiles pour l'apprentissage d'autres irriguées, la détention de petites terres agricoles circonstances. Les conclusions suivantes peuvent être tirées sur la base des expériences de mise en œuvre du programme de micro-irrigation au Népal:

- technologies micro-irrigation dans les zones montagneuses, où la tête de naturel pour les systèmes d'irrigation sous pression est facilement disponible, il a été constaté à offrir un impact positif pour la réduction de la pauvreté grâce à une meilleure utilisation des sources d'eau dispersées et la conservation des terres peu soignée.
- Ciblage des pauvres et des défavorisés des groupes le plus, c'est possible grâce à la GTC vulnérables. Pour ce faire, d'abord une analyse socio-économique-cadre doit être élaboré, qui permettra d'identifier différentes réalités socio-économiques des communautés ciblées.
- l'irrigation des projets de développement-Micro offrir la possibilité d'élaborer des prestataires de services dans de nouvelles poches commerciales, les petites industries de la fabrication d'accessoires de système d'irrigation micro offrant des emplois et des services intégrés et de relier les fournisseurs de services de techniciens de la vulgarisation.
- Commercialisation assisté par le développement de micro-irrigation complète les initiatives de sécurité alimentaire. Il permet aux petits producteurs pour acheter des intrants pour améliorer la productivité et acheter de la nourriture. Il permet également l'expansion de réseaux de fournisseurs d'entrée.
- Lier les activités de santé et la nutrition aux activités de développement de l'agriculture a de grands avantages de la sécurité alimentaire.

1. Introduction

1.1 Socio-economic Context and Landholding

Nepal is a landlocked South Asian country located between India and China. Its population is about 28.5 million and growing at 1.7 % per year. Agriculture provides livelihood for three-fourths of the population and accounts for about 33% of gross domestic product (GDP). Over 30% live below poverty line of US$12/person/month. Figure 1 shows the trend of increasing population and dependency on agriculture.

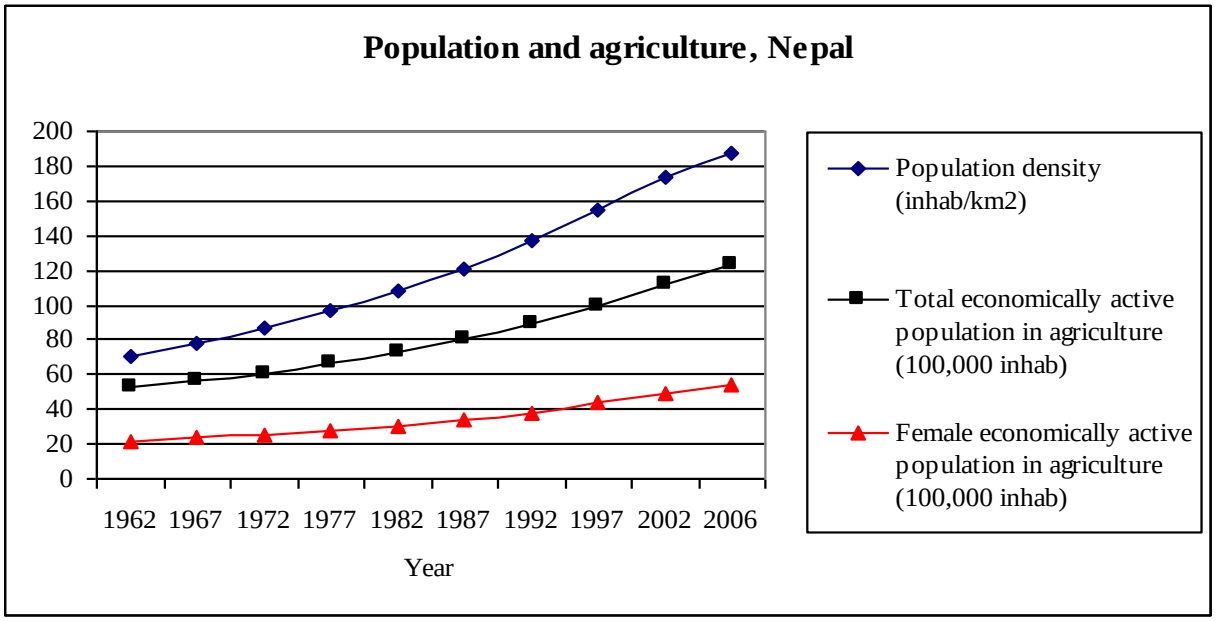

Figure 1: Population and Agriculture, Nepal (Source: FAO Database, 2008)

This population growth has been putting pressure on the already scarce land and water resources of the country. Landholding size has decreased in the past 40 years by 28% due to the partitioning of land to new families in each generation. Consequently, the landholding pattern is highly fragmented with an average of 0.66 ha and 57% households owning less than 0.5 ha. A substantial portion of the rural poor possess smaller plots which are insufficient to provide full employment or income and the agricultural outputs are unable to support the family economy.

The terrain consists of 'Terai' (plain land) in the south, central hilly region and rugged Himalayas in the north. Total arable land is about 2.64 million ha (16% of the country's area).

Land in Nepal is traditionally classified into three types depending on the crops grown. Since rice is the primary crop for the Nepalese, the most important land is *khet*, which is land suitable for growing rice and is commonly the only land that is irrigated. Flatlands in the *terai* and terraced lands with bunds in the middle hills come under this category. *Bari* is sloping land that is sometimes terraced to reduce the slope and generally is not irrigated but is used to grow rain-fed crops. Use of *bari* and *khet* is based on location in relationship to the homestead. *Bari* close to the homestead is generally used for vegetable farming that require protection from

predators and pilferage while *khet* close to the homestead during dry season is used for potatoes or other vegetables requiring more labor than traditional cereal crops.

In the rural parts of Nepal, since the economy is mainly agriculture based, the household economic status has direct correlation with the landholding size and the quality of land (*khet*, *bari* or *kharbari* and their soil fertility). Relatively well to do people generally own more and better quality land and vice versa. Landholding size generally increases with the decrease in land quality. Thus the 'poor' who cannot afford good quality land try to compensate by owning larger size of 'kharbari' or 'bari' and contributing more in terms of their labor.

Food insecurity is a real problem for many households in Nepal and child malnutrition still ranks among the highest globally. Historically the agrarian Nepali society used to emphasize that a farmer should grow all the food necessary for his household consumption. Therefore, diets largely (about 80%) consisted of cereals and tubers. Vegetable consumption only comprised a few scattered near the homestead, mainly cauliflower, radish, cabbage, green vegetables or mustard. Expenditures on vegetables and fruit have generally been low (in total less than 15%). However, this scenario is gradually changing. Vegetable consumption in Nepal rose by 34.7% from 1994 to 2003. Although 97 % of vegetable production is domestic, imports are increasing, with a good quantity of the vegetables traded at local markets coming from Indian traders. These factors suggest two opportunities for Nepalese farmers: capturing the market supplied by Indian vendors and servicing the expanding new vegetable markets of Nepal.

Even though 10% reduction in overall poverty incidence occurred in Nepal in the past decade, most significant reduction occurred in urban areas (22% to 9%) than in rural areas (43% to 35%). Prevalence of poverty among rural households with less than one ha of land still remains high (40%). Urbanization also factored into poverty reduction, accounting for roughly one-fifth of the overall decrease. However, as families migrated and shifted to working abroad, the gap between the rich and poor has widened and this problem is more extreme in rural areas.

1.2 Significance of Irrigation

Irrigation has since long been contributing as a key input for farm production, household income and food security in Nepal. Since time immemorial the farmers of Nepal have constructed and managed traditional canal systems, many of which are still functional. However, these Farmer Managed Irrigation Systems (FMIS), about 17000 in hills and 2000 in *terai*, cover about a quarter of the total arable land and serve mainly to supplement irrigation during wet season. Most irrigation is done by diverting small rain-fed streams that have high discharge variability and no water during dry season. Moreover, these systems are built by using local materials and indigenous knowledge and require a lot of manual labor input which is increasingly being scarcer. Water use efficiency and reliability of most FMISs is very poor.

The Government of Nepal (GON) has also fully recognized the need and importance of irrigation. It has been making continuous efforts for the development of the irrigation sector of the country over the past five decades. However, irrigation facility expansion through conventional methods is severely limited by topographical constraints. Snow melt is largely inaccessible because rivers draining it have deep cuts and are usable only with very long canals

or by pumping, which is often prohibitively expensive. Moreover, the challenge is mounting as relatively easy and economically more viable projects have already been taken up.

Access to irrigation has also been observed to be a major factor for rural poverty. Land productivity of non-poor households is nearly two times higher than that of poor households, mainly because of access to irrigation and better situated farms. According to the latest "Nepal Living Standards Survey", the risk of poverty is more pronounced among farm households that do not have access to irrigation. As access to irrigation and the share of irrigated area increases, the poverty gap between farm households with and without irrigation grows.

Despite large investments in the sector, only 50% of arable land presently has irrigation facilities. Furthermore, only 30% of the area having irrigation facilities gets year round irrigation while the remaining 70% receives only seasonal irrigation. Agricultural practices are still highly dependent on rainfall due to inadequate irrigation infrastructure or facilities. This dependency on rainfall not only affects yields but also significantly influences the sowing and harvesting time.

1.3 Introduction of Micro-irrigation in Nepal

The focus of GON in the irrigation sector slightly changed after the promulgation of the Tenth National Development Plan (2002 -2007) which stated poverty alleviation as the main national priority. This shifted the priority from expanding the irrigated area through construction of large irrigation schemes to the aim of enhancing irrigation efficiencies, delivering year round irrigation and conserving land and water.

The present emphasis of the government is on expanding Shallow Tube Well (STW) and water lifting technology in the terai (southern flat plains) where sufficient groundwater recharge is available, and applying rainwater harvesting and micro-irrigation technology in the middle hills where natural head for pressurized irrigation systems is easily available. It has been recognized that *Bari*s in the middle hills of Nepal have great potential for increasing crop growth with micro-irrigation because the technology can be used on sloping land without danger of erosion. For this reason, the productive portion of the currently implemented micro-irrigation programs focuses on vegetables in *bari* land close to the homestead.

Work in micro-irrigation in Nepal was first initiated in the early 1990s by an INGO called International Development Enterprises (IDE). Since then IDE has been not only developing more cost effective micro-irrigation technology suitable for the country but it has also been working towards developing enabling market opportunities based on the comparative advantage of smallholders.

The drive toward expansion of micro-irrigation gathered further momentum when the government also joined hands with the private sector. The first initiative from the public sector in the direction began in 2003 with the establishment of Non-conventional Irrigation Technology Project (NITP) under the Department of Irrigation (DOI) of the GON. This program came as a response of the irrigation sector to align itself to the national goal of poverty alleviation.

2. Case Studies

Two cases have been studied in greater detail: one of a micro-irrigation program conducted by the public sector, viz. Non-conventional Irrigation Technology Program (NITP) and the other, viz. Smallholder Irrigation Market Initiative (SIMI), by the private sector. These cases are expected to give a better insight as to how these projects and programs are being implemented and what has been their outcome.

2.1 Case 1: Non-Conventional Irrigation Technology Program (NITP)

NITP was initiated by DOI in 2003. Its construction works started from 2005. The main objective of the program is to address the backward and marginalized community in areas where conventional forms of irrigation have not been able to serve. It aims to do so through different activities including water source conservation, construction of water collection ponds and implementation of water efficient irrigation systems like drips and sprinkles.

This program is implemented mainly through the Sub-division and Division Offices of DOI. However, "Sample Projects" are constructed by the Coordinator's Office which not only coordinates and monitors all the activities of the project but also formulates policy directives.

In this program, consorted efforts are made to make sure that the activities are as "pro-poor" as possible. Specific criteria have been developed for site selection in order to target the poor and the most disadvantaged groups. First of all, potential Village Development Committees (VDCs) are identified using available secondary information including Poverty Mapping data. Then suitable sites are selected that meet both the social and technical criteria. Farmer households having landholding ranging from 0.05 ha to 0.5 ha are generally included as the target beneficiary. Pocket areas with high concentration of marginalized groups are given priority. Projects are also thoroughly checked for technical viability. Sites having at least 100 lt per day water at the source are considered for the operation of drip system and suitable hydrogeology with shallow aquifer is considered essential for the installation of treadle pump.

This program is still ongoing. Table 1 presents the summary of its accomplishments so far in terms of additional irrigated area in the different development regions:

Table 1: Physical Accomplishments of the NITP as of July, 2009

S. N.	Development Region	Districts	Completed Projects	Area (ha)
1	Eastern Development Region	8	14	198
2	Central Development Region	8	31	779
3	Western Development Region	5	15	580
4	Mid-western Development Region	7	16	242
5	Far Western Development Region	5	8	129
6	Sample Projects by NITP Coordinator Office	6	12	138
	Total	35	96	2066

Not only has NITP completed more than 96 sub-projects scattered throughout Nepal but it has also adopted a Integrated Crop and Water Management Programme (ICWMP) with large

number of training materials and manuals and carried out numerous trainings and study tours for the farmers in the field of ICWMP as well as micro-irrigation and rainwater harvesting. The target farmers have earned significant quick return from vegetable cultivation. It has also helped in commercializing agriculture and contributed towards making women economically more independent. The program has only contributed to water saving and efficient use of water consequently made possible multiple use of water. However, collaboration and coordination with NGOs in terms of institutional strengthening of farmer groups for linkage building with services and market could not be achieved to the extent envisioned during program formulation.

2.2 Case 2: Smallholder Irrigation Market Initiative (SIMI)

SIMI was a project implemented jointly by Winrock International (WI), International Development Enterprises (IDE) along with Nepal's non-government and government agencies from 2003 to 2009. It was a value-chain approach project for high value commodities implemented in 20 districts out of Nepal's 75 districts. The main goal of the project was to alleviate poverty and to reduce causes of instability. It aimed to facilitate over 70,000 hhs to adopt improved technology and increase annual income by 50%. The project focused in micro irrigation technology (MIT) though development of supply chains for equipment and inputs.

Project intervention began with the development of a Socio-economic Analysis Framework which helped in identifying different socio-economic realities of the targeted communities. Constraints and opportunities faced by disadvantaged groups and women in agriculture / MIT / market activities were identified and appropriate measures to address these gaps were noted and integrated in the detailed program implementation plan. The list of potential VDCs on the basis of site selection criteria and available secondary information and field experience were proposed. Duplications in the proposals were avoided with other existing programs of similar nature.

Then social mobilization works were conducted for the different clusters of target beneficiaries. Groups comprising of 10 to 25 farmers were formed and social mobilization trainings were conducted. These trainings included group formation and strengthening, management of funds, repair and maintenance of MIT, leadership building, linkage building with service providers and the market, and keeping records of investments and profits. Members attending trainings and representing different committees were asked to impart the knowledge they receive back into their group. For this, each group was asked to prepare their own strategy. Following the meeting the NGO team made field assessment and prepared a brief report on the finding of the field as per the VDC/pockets selection criteria.

Group members were motivated to meet at least once a month and to save in a group and retrieve loan installments from MIT back into the group. One literate member from the group was asked to handle the bookkeeping and manage the group fund. Women and members from disadvantaged group were encouraged to become members of the group management committee. These members were also given priority for technical and capacity building training.

An impact assessment was carried out in April 2010 of SIMI project. The assessment revealed that SIMI was able to achieve almost all of its targets. More than 70,000 households adopted micro-irrigation. The project covered 55% women, 15% *dalit* and 40% indigenous race.

Annual income of the target population increased in the project area by over US$ 200. The income level increased by over 50% and strengthened agricultural value-chains.

SIMI created over 230,000 full time equivalent jobs with the cost per job of $45. The impact assessment also showed that SIMI farmers received 20% higher prices for their vegetables from the farmers in the control group. It revealed that SIMI hhs not only increased production and productivity of food crops but also consumption of vegetables. SIMI hhs increased expenditures on food by US $12 per month and consumed more nutritious foods. Impacts from SIMI have been summarized in Table 2.

Table 2: Major Impacts observed from SIMI Project and their Indicators

S. N.	Development Region	Indicators
1	Strong employment generation effects	Employment increases by 136,000 persons, with 39,000 direct SIMI target farmers and 87,000 indirect. Also considering 43,000 from enterprises and 61,000 from multiplier the total job equivalent was estimated to be 230,000 persons.
2	High benefit cost ratio	BC Ratio computed to be 15 while considering all benefit and 5 while considering only direct benefits.
3	Strong scaling up prospects	Market for vegetables are large and can still have a strong domestic market for an expansion of up to 300,000 with reasonable cost of $150-175/households.
4	Positive impact on food security	Subsistence cereal production also increased. Higher income may have been used for better seeds and fertilizer for cereal production and collection centers to operate small storage facilities.
5	Positive impact on poverty	The total number of persons out of poverty due to the project was computed to be 345,000.
6	Demonstration impact of the project	In *terai* the indirect households had an increase of agriculture cash income of 108% and in the hills of 75%.

3. Overall Achievements of Micro-irrigation Developments in Nepal

Micro irrigation technologies have been found to offer an overall positive impact for poverty alleviation and conservation of land and water in Nepal. Through the use of efficient technologies like drips and sprinkles precision agriculture has been made possible and the farmers have received higher yields. They have been able to quick returns from vegetable cultivation. Women have benefited more and they have been made economically more independent. All this has helped in commercializing agriculture.

Efficient use of water through micro-irrigation technologies has also contributed towards conservation of water and soil fertility. It was observe that this water saving has been put to multiple uses of agriculture-based livelihoods including drinking, sanitation, cooking, personal hygiene, laundry and general cleaning. It is has also been observed to be utilized for many small-scale or domestic enterprises including livestock watering, horticulture, crop irrigation, tree growing, fisheries and for ceremonial purposes. Four main water-related dimensions of livelihood wellbeing: freedom from drudgery, health, food production, and income were observed to have been produced though the program.

4. Lessons Learned from Micro-Irrigation in Nepal

Nepal's experiences have confirmed that small scale, water efficient irrigation is an effective tool for poverty alleviation in small landholding farming circumstances. It has proved that targeted, homestead-scale support through micro-irrigation technology using scattered small water sources is the appropriate way of achieving a more integrated set of poverty impacts than conventional water services. Some of the pertinent lessons learned by Nepal from micro-irrigation programs are as follows:

- Suitable selection criteria have to be in place in order to target the desired beneficiary group, i.e. the poor and marginalized communities.
- Well defined mechanisms are needed especially for the public agencies to collaboration with private agencies for developing linkages with services and markets.
- At the community level there may be other projects and programs trying to support the same target group, hence, sufficient effort has to be made from the very beginning to ensure that there is no duplication.
- Social mobilization training to marginal farmers is very effective but it should also include group formation and strengthening, management of funds, repair and maintenance of MIT, leadership building, linkage building with service providers and the market, and keeping records of investments and profits from vegetable farming, seedling production of vegetable as well as fruits like banana, apple and orange etc.
- Development and strengthening of rural collection centers within pockets is the key to involving smallholders and providing services.

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