

Effects of small irrigation schemes in farm resource production and climate change adaptation practices in Nepal

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ABSTRACT

This paper is an attempt to evaluate the socio-economic as well as environmental impacts of small irrigation schemes in different parts of Nepal so as to help in formulating future policies on small irrigation schemes and subsidy programs. The paper has clearly pointed out the operation and management structure in each of the selected schemes have been playing significant role to increase the farm resource productivity, reduce poverty level, improve farmer participation and to manage available environmental resources in sustainable way. Furthermore, the functions and effectiveness of the Irrigation Management Committees (IMCs) and Water Users Groups (WUGs), farmers groups (FG) and cooperatives have been actively participated in the overall activities of small scale irrigation schemes to implement effectively.

Keywords: Schemes, subsidy, user groups, sustainability, accountability.

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INTRODUCTION

There has been a growing interest in how agricultural and natural resources related programs can be made more effective in reducing poverty, increasing social inclusion, and influencing policy and institutional change in favor of sustainable development (Elliott, 1994). This interest is expressed through learning and change, new action of research works and policy review to investigate, develop and test new approaches and methods. These are happening from actors who have been effective in existing political, economic and cultural environments in bringing about positive/ negative change. Thus, impact assessment, monitoring and evaluation are now established parts of development to know what is new inside the development action for moving a focus on proving impact to improving practice in order to increase the downward accountability of development processes and contribute to empowerment and civil society development (Mayoux and Chambers, 2005; Mosse, 2005; Rhoades, 2005). These benefits cannot be taken for granted but much depend on how they are used and by whom and the levels of political will to hear, listen and take action for the voices of voiceless people (Biggs,

2005). The role of infrastructure in alleviating poverty is an area of study that is currently receiving much attention. It has been argued that most of the poor are concentrated in rural areas and depend heavily on agriculture. Therefore rural infrastructure development, and irrigation development, in particular, is believed to increase returns from agriculture, thereby reducing poverty. As an established part of development planning impact assessment task focuses on innovation process that have relevance to contemporary political economic contexts in order to approve, adjust or reject the development projects by selecting criteria for assessing success or make positive change in location specific socio-economic situations. Since the last decade Government of Nepal has taken initiation for implementing various software as well as hardware programs for containment and protection of settlements and arable land from climate change induced natural hazards such as floods, landslides, river bank erosion, droughts and sedimentation in all ecological regions. Trainings and advocacy skill development programs at community level have also been executing by different

types of governmental and non-governmental organizations with huge amount of resources. But the achievement of the targeted programs and projects are not so impressive due to the political instability and less interest of politicians on such serious issues on the one side and low participation of locals on outsiders' launching programs. It is due to lack of transparency and accountability of executive organization and involved manpower. Another drawback is in policy frame to encourage different stakeholders for their active participation in prevention, protection and preservation of natural as well as cultural resources from the adverse effects of climate change and natural hazards. Weak national policy and institutional negligence many common property resources including farm lands are badly affected by the ongoing climate change, weather uncertainty and destructive natural events every year and the trend goes up. Evidences show that unfavorable political and bureaucratic situations create the additional confusion and gap in between beneficiaries and implementing agencies. Thus, development history of Nepal is being the matter of suspecting and doubt in terms of real achievement of the run program at community level due to high corruption and commission culture of politicians, bureaucrats and donor too. In such situation how the beneficiaries are benefited and what extent impact of smallholders irrigation schemes in overall productivity of farm activities have to be studied at village or community level. Such impact assessment of small scale irrigation schemes lunched by government and non-governmental organizations was increasing at rising rate up to 1980 and thereafter the impact of other policy and infrastructural factors on agriculture productivity has started to increase more than the HYV adoption in the rural areas of Nepal. The impact of small irrigation on farm production level is major factor that plays significant role to improve the agricultural production.

A number of studies have claimed that earlier irrigation schemes, established by government missionaries performed well in terms of agricultural performance, financial and economic viability. In African case, Roder (1965) indicated that irrigation projects have been successful in enabling farmers to obtain a certain amount of wealth, substantially more than dry land farmers, probably more than employees of white farmers, and comparable to levels enjoyed by urban workers. He suggests that farmers in irrigation schemes as long back as the 1930s were earning higher incomes than dry land farmers. The schemes helped in reducing the rural to urban migration by offering the rural population an alternative source of employment and income. Meinzen-Dick et al. (1993) reported that the greatest food deficits in developing countries appear to occur in dry land areas. They further noted that fewer irrigation schemes ran out of food during the year than dry land areas. The same study mentions that the majority (72%) of farmers with

between 0.25 and 0.5 ha of irrigated land reported that irrigated land was their only source of livelihood. FAO (1997a) reported that farmer incomes from irrigated agriculture are significantly higher than incomes of dry land farmers. The levels of inputs in terms of quantity are higher in irrigation schemes than in dry land areas, suggesting that there is more intensive crop production in irrigation schemes than in dry land agriculture. In the same report it is further pointed out that smallholder schemes can be even more viable if aspects such as reduction in drought relief handouts, employment creation and reduction of rural to urban migration are considered in the economic analysis of these schemes. With a more integrated approach smallholder irrigation can be the basis for rural development and improved standards of living among the rural communities. FAO (1997c) also gave some principal recommendations that can improve the management of smallholder irrigation schemes and enhance the benefits to farmers. Some of the recommendations are there is need to provide irrigators with security of land tenure, while it is important to give farmers autonomy in managing irrigation schemes, there is need to devise some mechanisms of assisting farmers to ensure minimum acceptable levels of production by each individual farmer to adequately justify the investments, and there is need to have a clear and well defined policy on the handing-over of irrigation schemes to farmers, which should be specific on timing of hand-over. A study made by International Food Policy Research Institute (IFPRI, 1999) shows that government spending on productivity enhancing investments, such as irrigation, research and development in agriculture, rural infrastructure (including roads and electricity), and rural development and welfare programs which target the rural poor directly have all contributed to reductions in rural poverty. Most of these investments have also contributed to growth in agricultural productivity, but their impacts on poverty and productivity show large variations.

A Southern African Development Community (SADC) report in 1992 reported that most new smallholder irrigation schemes in the Southern Africa region not cover the cost of development and operation and are therefore uneconomic. The report further suggested that these schemes have a negligible impact on the national and household food security. FAO (1997c) further identified the following constraints to be affecting the capacity of farmers to invest and manage irrigation projects such as poor resource base of farmers, fragmented and small size of land holdings, unsecured or lack of land titles, high interest rates, and poor transportation and marketing facilities. In India, Sing and Misra (1960) compared the Sarda Canal irrigation and non-irrigating villages and noted that Gross farm output per acre is on the whole 8.6% higher in the canal-irrigated villages than outside. Similarly, the crop produce as distinct from the total farm output is 5.5% more with canal irrigation than without, mainly due to the cropping pattern under irrigation

incorporating cash crops. The value of crop produce sold per acre is 48% higher in the canal-irrigated area than outside. This was again attributed to the superior cropping pattern incorporating cash crops. Total inputs per acre are 3.7% higher in terms of quantity in the canal-irrigated area than outside, indicating more intensive farming under irrigation and payment to outside labor, including casual and permanent farm servants, is about 21% more in irrigated areas than outside. The foregoing literature review indicates varying and sometimes contradicting views on the economic viability and socio-economic impact of small irrigation development schemes. Some literatures have pointed out that the small irrigation schemes are agriculturally, financially and economically viable while other literatures argued such projects are not viable. However, none of the literature reviewed has gone a step further to explore and identify the factors which make good irrigation schemes perform well and those factors which make bad schemes non-viable. This assessment has made an attempt to do this by examining small-irrigation and cooperative based irrigation schemes in Nepal, for contributing to a better understanding of this small irrigation scheme.

METHODOLOGY

This impact study has focused on the agriculture performances of small-irrigation scheme, cooperative based small irrigation program and subsidy program in different parts of the country. Each selected district has represented both ecological and development regions for analyzing the impacts and effectiveness of the implemented programs on overall agricultural production and productivity, household income level and living standard of farm based households. All the selected districts have selected purposively to cover the all implemented components from each development regions and ecological or geographical regions. The sample size (75 schemes selected from each ecological and development regions) has been determined based on the number of small-irrigation schemes, cooperative based small irrigation and the beneficiaries of subsidy program. Farmer groups, irrigation management committees, water users groups, cooperatives were concerned as the prime focus of the study whereas the sampling unit was household. Randomly selected farmers groups and irrigation management committees and households were selected proportionally from rural and urban or road accessible areas. This helped to cover relevant information from accessible and inaccessible areas and study made more comprehensive in term of societal strata.

Both primary and secondary sources of data have been used to analyze, examine and evaluate the impact and effectiveness of implemented four components for overall enhancement of agricultural performance in terms of production and income level. Relevant policy, acts, plans and programs were reviewed in detail as the secondary sources of data and related research reports available inside the country as well as outside the country have been analyzed in depth in order to frame the study at standard level. Some descriptive as well as inferential statistic tools have been applied for generalization of the study findings. Primary data were collected by consulting the district level stakeholders through personal interview, focus group discussion and key informant interview. Focus group discussions was conducted with the representative members of cooperatives, farmers groups, water

users groups, irrigation management committee members, and beneficiaries at large in the sample districts, areas and location settlements. Key informant interviews were organized with district level stakeholders, lead farmers, and executive members of farmer groups (FG), irrigation management committee (IMC), water user groups (WUG), and community organization (CO) government officials, NGO representatives and those people who are knowledgeable on mentioned components. Household survey was made in limited size to trace out the impression of beneficiaries on the programs. Case studies for the impressive and remarkable case were made to generalize the significant changes and impacts of the programs. Therefore, the impact study has adopted both qualitative and quantitative methods. Participatory Rural Appraisal (PRA) techniques were used in collecting data from the schemes. Descriptive statistics was used to identify factors, which lead to conclusions on scheme viability or non-viability. Farm and scheme level data were generated to study the financial and economic viability of each scheme. Informal interviews have been carried out with some key informants in order to get enough background information on what are the main issues on each individual irrigation scheme, so as to focus on these during PRA. A checklist of questions was also used. Data analysis was made by adopting the standard format and framework that has elucidated all the aspects and components of small scale irrigation schemes rationally in order to advocate it necessarily to enhance the production capacity of Nepalese farmers along with sustainable livelihood improvement of the farm communities by their own initiation. Detail description of the data analysis plans has been presented in Figure 1.

RESULTS AND DISCUSSION

Small irrigation schemes and cooperative based irrigation schemes has been supported and promoted since 2001 as a means of ensuring food security as well as improving the standard of living of the rural people. Significant amount of budget has been spent for the contribution of agricultural production and productivity. It is therefore essential to make impact assessment of such agricultural inputs schemes to know the impact and effectiveness of the programs and overall achievements at implementation level. Often questions are raised at national level about the viability of such smallholder irrigation schemes: are small irrigation schemes financially viable? Are the schemes sustainable? Are these schemes not inducing a financial burden on the government as far as operation and maintenance is concerned? Are smallholder irrigation schemes the best way of investing the limited financial resources at the government's disposal? And, are the farmers able to manage these projects? All these inquiries are acquiring the fact of achievement as cost-benefit analysis and seeking the sustainability of the development works that actually improve the life standard of targeted people and rational use of invested resources. This is due to the food and climate crises fear created by political and economic elites as opportunities, to entrench corporate control of world agriculture and the ecological commons. It is noticeable fact that at the time of chronic hunger dispossession of food providers and workers. Commodity and land speculation, and global warming have increasingly

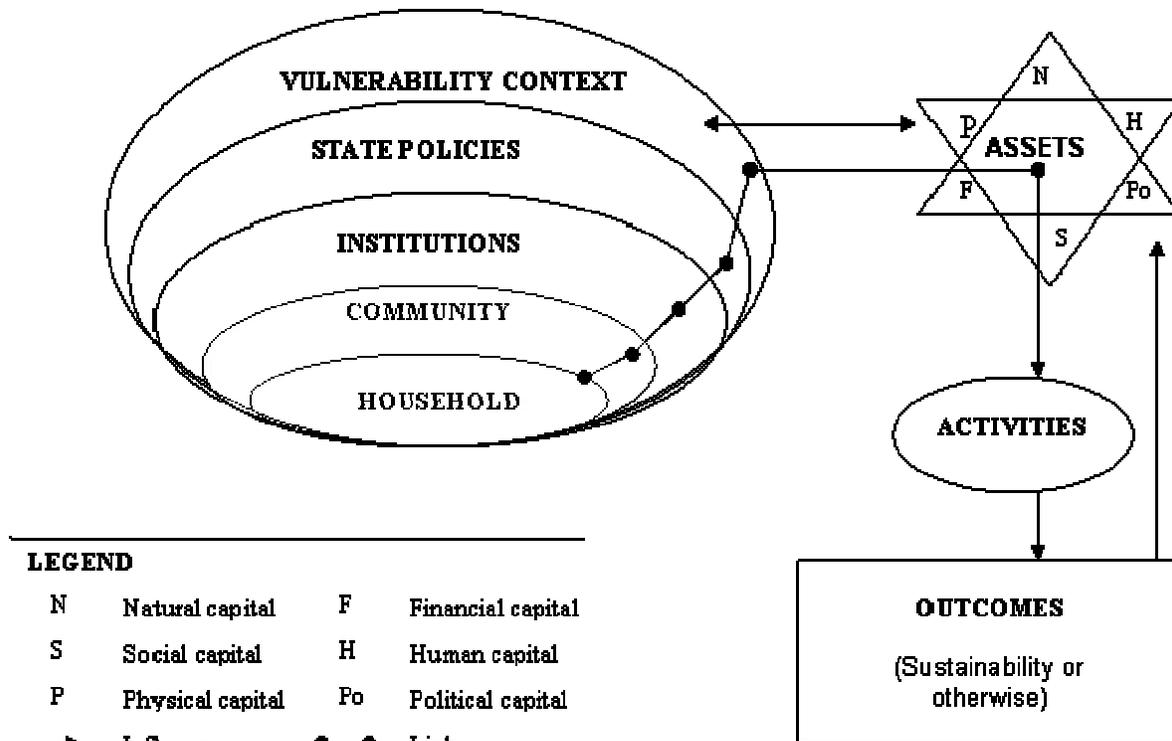


Figure 1. Frame for the data analysis. Source: SADC, 1992.

been the serious threats and acute crisis. This miserable situation of developing countries further rises by profit motive governments, multilateral agencies and world level financial institutions. Action taken by some governments and top UN leadership at high level, assault the ecological commons and continuity of traditional ecosystem services. As a result, food crisis and ecological assault are both the more dangerous versions of policies that originally triggered the worsened situation. Political and economic elites fragmented existing institutions roles thereby disempowering peoples and civil society including local government to respond with knowledge and practices appropriate to local context. World Bank-IMF designed structural adjustment programs laid the conditions for recurring food crisis through liberalization policies that undermined local and national capacity for self-sufficiency and appropriate policies (PANAP, 2008). Similarly, the rapidly emerging and cumulative climate crisis is being exploited by agribusiness companies, local and global elites through market transaction such as carbon trading and emission offsets, and profitable techno-fixes such as agro-fuels and patented technologies including synthetic biology. As it stands now, these elites will further increase the crisis of food and climate through most powerful actors from private finance, technology and business sectors to extract profits in the name of crisis management. In this regard, the wisdom of sustainable small-scale movement against chemically-dependent agribusiness is essential

by promoting small scale enterprises, ecological farming systems and small scale input like small scale irrigation which strengthen our capacities, in food production, protection of our ecologies, and reclaim our communities, societies and economies. This rejects the corporate industrial and energy-intensive agribusiness production model and shifts the paradigm of people's right of food.

Thus, impact assessment has tried to answer all of these inquiries that are raised by the local, national and global level stakeholders of the development schemes. Because recent years have witnessed major changes in the technology, economics, and institutions that have a significant bearing on the ownership, allocation, and management of water in irrigated agriculture by the right holders of the development projects. From the economy point of view, two major issues that impact on the effective and efficient allocation of water among multiple uses and users have emerged to the forefront of the policy debate. First, a growing body of evidence indicates that water conservation acquired through traditional cost-share conservation programs such as those implemented by national government whose participants are small farms, will likely be insufficient to meet the needs of growing non-agricultural water demands, particularly for environmental purposes. In this connection, nearly 81% of irrigated farms are small farms, while large farms apply 66% of agricultural water in Nepal. It shows that farm-size characteristics, economics, and institutions are central to the design of more effective water conservation policy.

While traditional cost-share conservation policy likely contributes significantly to small farm policy goals, integrated conservation/institutional policy may have an even larger conservation/reallocation impact and provide for a more effective balance between small farm and environmental policy goals. Secondly, the historic method of reducing agricultural production risks through subsidy provided by the government does not cover water shortfalls in irrigated agriculture. While on the institutional front, there is widespread dissatisfaction with respect to the efficacy and effectiveness of the prevailing water allocation laws, institutions, and procedures to efficiently, equitably, and sustainably allocate water among the newly emerging water uses and users in the country. An alternative institutional arrangement has to need to account for the changing inter-sector values of water, while also satisfying public equity requirements. The technological, economic, and institutional issues have to be addressed in a comprehensive and systematic fashion, and in conjunction on irrigated agriculture. It is well established that there are many complex interactions among technological, economic and institutional factors, which have a decisive impact on inter-sector water mobilization. Therefore, a careful scrutiny of these issues becomes compelling. This impact study is an attempt to examine, analyze and evaluate the key issues related to developing effective and efficient policy for small irrigation schemes and subsidy providing in agricultural sector. The main objective of this impact study is to evaluate the socio-economic as well as environmental impacts of small irrigation schemes and cooperative based small irrigation programs in different districts of Nepal so as to help in formulating future policies on ecological farming practice, crop diversification and state of commercialization, as well as change in cropping pattern and cropping intensity.

Assessment of the effects of schemes

The use of water from river flow, reservoir storage, surface water and deep motorized boreholes, has used for irrigation purposes by constructing small irrigation projects, rehabilitating farmers managed *kulos* as well as cooperative based irrigation schemes. Government record shows that 16408, small irrigation projects, 778 cooperative based smallholder schemes, covering an area of about 15100 ha cultivated land. A further 200 ha has been developed on small-scale purchase land. This gives a total of 15300 ha of land under smallholder irrigation in various parts of Nepal (MOI, 2012). In order to increase and improve the available but under-utilized water resources for irrigation purposes Government of Nepal has been providing budgetary support to user groups and cooperatives for further irrigation development, based on the available potential water resources. In terms of management, there are three

broad types of smallholder schemes: government managed, farmer managed, and jointly managed schemes. In the new schemes, there tends to be a shift away from this practice towards farmer managed projects. Farmer managed schemes are developed by the government but owned and managed by the farmers' Irrigation Management Committees (IMCs) with minimal government interventions in terms of management. For jointly managed schemes, the farmers and the government share the financial responsibility for the operation and maintenance. For such schemes the government is usually responsible for the head works, while farmers take responsibility for the infield infrastructure. In terms of scheme numbers, 50% of the smallholder schemes are farmer managed, 32% are cooperative based. However, in terms of area, the government is still managing a larger hectare, as most of the farmer-managed schemes tend to be small. The high cost of available appropriate irrigation technology is still a problem. The private sector has also traditionally involved with limited know how on planning, design, construction and provision of services to the smallholders. The government of Nepal has been providing financial and technical support to smallholders' irrigation under food security program to support poverty reduction by increasing additional agricultural production and to give relief to the farmers from the effect of climate change and it induces natural hazards. Ministry of Finance (2012) shows that about 1,500 ha of land have been destroyed by inundation, river bank erosion, and siltation in the fiscal year 2011-2012. Paddy could not be planted in about 25,000 ha of land due to plotting for housing plans and less precipitation. Similarly, 656 ha of maize production land have been destroyed by gales and storms, 31 ha by landslides and sand burials. The impact of cold wave in various parts of Tarai has been increasing since last decades and damage of winter crops caused by cold wave has increasingly being great challenge to farm communities (MOAC, 2012). Program impacts and changes are presented in Table 1 based on qualitative information.

Socio-economic impact

All the schemes studied had some positive impacts on the farmers, the surrounding areas and the economy in general. However, some schemes had more impact than others and generally farmer managed schemes seemed to have more effective than government managed schemes. The impact of the schemes has been examined in the following areas:

Agricultural production and income

Farmer managed schemes, have resulted in higher crop

Table 1. Impact and changes.

Program themes	Impacts	Before 2001	After 20012	Changes
Small Irrigation	Crop production and productivity, crop intensity, cropping pattern, crop diversification, level of household income, employment, food security, poverty reduction, and commercialization.	Crop production was low, productivity and crop intensity both were at insignificant level, food crop dominance and monoculture practice, low level of household income, food insecurity and high level of poverty existed.	Crop production per unit of land as well as per labor increased by 30 to 60%, crop intensity and productivity both are increased by 200 percent, crop rotation and cash crop production are practiced, income of household level increased by 100 percent, and poverty level reduced significantly with somehow commercial farming practice at community level.	Crop production, farming methods, productivity, crop intensity, farming system from substance to commercial, poverty reduction, and overall community livelihood improvement are significantly seen as the positive change of small scale irrigation schemes in all parts of the country.
Cooperative based small irrigation	Group mobilization in terms of social inclusion, group formation and self-help concept, gender balance and working modality with regarding sustainability of the schemes.	No water user groups, depend on government managed irrigation system, no participatory and right holder engaged irrigation modality and ownership feeling of local farmers.	All small-scale farmers are organized into water user groups in social inclusive methods, they managed their irrigation system themselves adopting innovative modality where need and social justice as well as responsibilities are properly managed, and regular meetings, discussions, documentation and active participation of each member of group are seen.	Significant changes have been noticeable in management, water distribution and active participation of group member in planning, decision making and implementation of minutes, and proving innovative modality of social inclusion and sustainable livelihood improvement of community people.
Subsidy for chemical fertilizer and seeds	Time quantity and quality, price factors, effects in overall performance, type and varieties, and demand factors.	There was on any accessible to agricultural inputs that provided by the government. All of the subsidy supports were misused by the government officials and farmer communities had not any access.	Now, farmers are organized and they do all the works in organized form. Subsidy supports like chemical fertilizers, seeds and other are properly used by local but organized farmers due to easy accessible for them. Subsidy supports help to increase farm productivity and decrease the unnecessary cost and burdens of the local farmers.	Farmers are able to utilize the government provided subsidy supports themselves without any linkage and misused by government officials, private sectors and other middle men who misused subsidy in huge amount in past.
Institutional management capacity	Group formation, group mobilization, group function, resolution of dispute and conflicts, number of FGs, WUAs, IMCs, group fund and its sustainability.	No institutional process to manage and utilize the water resource for irrigation and other purposes, no any system to distribute water and conflict was common, elites were captured the water and no social justice to water distribution even in farmer managed irrigation .	Groups formed, group mobilization, group function, resolution of dispute and conflicts are properly managed, number of FGs, WUAs, IMCs, are worked, group fund and its sustainability is secured, and institutional strengthening is in proper way.	All the farmers are organized into their respective groups and all the groups, management committees manage all activities of irrigation themselves without any disputes and conflicts. Livelihood of the organized farmers is gradually improving.

Source: Field Study, 2012.

Table 2. Monthly average income from irrigated average (0.5 ha) plot and percentage of household heads.

Monthly average income from plot per farmer (Rs)	Household heads (%)
9000	11
5000	30
3000	45
2000	20
1000	30
500	80

Source: Personal computation, 2012.

yields than the yields found under rained agriculture. Irrigation has permitted the growing of crops that would not be grown under dry seasons and conditions. The production of high value crops by some of these schemes, both for local and export markets means that they are now effectively participating in the mainstream economy. The government managed schemes have not produced high value crops on a large scale and their yields have also been low and not very different from past yields production trends. High incomes have been reported for farmer managed schemes in tarai, hills and inner tarai. Average annual incomes of Rs 90 000 per farmer for tarai, Rs 60 000 for inner tarai, Rs 25 000 for hills and Rs 20 000 for mountain are substantially higher than the annual minimum wage of Rs 16 800 paid to an unskilled worker in nonagricultural sector in Nepal (Table 2).

The schemes are providing gainful employment for the participants. It shows that schemes have a lot of household heads working in farms. This can be attributed to the low incomes the families derive from the schemes which are not enough to sustain their daily living. All farmers managed schemes give high incomes to the farmers. These high incomes are mainly due to the cropping patterns being practiced which incorporate high value crops. Government managed schemes generate very little income for their farmers.

Labor

Farmer managed schemes have family member labor whereas government schemes have hired labor to assist in land preparation, weeding and harvesting. Schemes that grow high value horticultural crops generate much more labor than schemes that concentrate on grain crops. This means that farmer managed schemes which produce cash crops requires more labor than government managed schemes.

Food security

The schemes were found to act as sources of food security for the participants and the surrounding communities. Schemes with high production levels

provide more food security than the low producing schemes. Some of the schemes like hilly area are located in harsh climatic regions and act as important sources of food for the farmers and surrounding communities. The farmers in these schemes never run out of food as compared to their dry land counterparts. The payment of labor in kind by most schemes also ensures food security and better nutrition.

Drought relief savings

All the schemes that are performing well do not get drought relief from the government. Some schemes have created an annual drought relief saving of Rs 20000. The figure is based on the current drought relief monthly ratio of 100 kg per person, the then current Grain Banking Board (GBB) maize price of Rs 1400 per ton, an average family size of six persons and a six month drought relief provision per year. This figure excludes the transport and administrative costs. If these were added, the above costs would be higher. Those schemes that are performing badly run out of food during the year and get drought relief from the government. It is notable that if a scheme is performing well, it can result in substantial savings for the government in terms of drought relief costs.

Conservation of natural resources

All the schemes contribute towards the conservation of natural resources. While highland farmers adjacent to these schemes engage in gold panning to earn a living, irrigators do not. By working in the irrigation schemes, farmers are distracted from engaging in environment destructive activities like watershed management panning. In addition, watershed management is very risky and as such most non-irrigators prefer to work in the irrigation schemes for cash rather than to go for it.

Assets

All schemes that are doing well in terms of crop production

and income generation have had their participants acquiring various assets. Mountain farmers have started grassland management and medicinal plant cultivation in their upland where food grain cannot be produced. They have all managed to buy farm implements, cattle and they are all literate now. Some farmers have managed to buy lighter vehicles in tarai and inner tarai. On those schemes that are performing badly, most farmers have not managed to acquire any assets.

Gender aspects and technology

Surface systems are more labor intensive than tube well or localized systems. Women on the surface schemes much labor on the schemes. It is the women who on these schemes that tend to provide the bulk of the labor required during irrigation.

Entrepreneurial skills

Most of the schemes have had their participants acquiring entrepreneurial skills. This is evidenced by the ability of the farmers to do their own budgeting, keep record books and manage their own affairs. These skills are most evident in farmer managed schemes. Farmers have to search for marketing information, organize cropping programs which fit the markets, and organize transport to such markets. They are also capable of negotiating contracts, although they still need assistance in this aspect. The increased demand for inputs from the local dealers, necessitated by the growing of crops in most schemes, is an example of the backward linkages offered by the irrigation schemes. All the schemes studied provide some degree of demand for inputs in their areas. Transport is hired for marketing by schemes. Most dealers interviewed accepted that they are benefiting from the schemes. The fact that most schemes go for more than 200% cropping intensity means that most dealers are in business all year around. This is different from dealers who service other farmers and who experience local business only in summer. The demand for scheme produce by some vegetable growers and food grain wholesalers in three ecological regions is an example of the forward linkages offered by irrigation schemes. By offering such produce, the schemes create businesses environment for what they supply. In overall, government spending on agricultural research and extension has had the largest impact on agricultural productivity growth, and it has also led to large benefits for the rural poor. Additional investments in irrigation had the third largest impact on growth in agricultural productivity, but a smaller impact on rural poverty (it should be noted here that the impact is determined based on marginal returns of each additional unit of investment, over and above the past investment in irrigation

development), while the study acknowledges that irrigation development played a large role in production growth during the project period.

Economic development

The fact that some irrigation schemes result in the increase in incomes for the farmers means that the schemes are promoting economic development of the nation, which is measured by the well-being of the people. The changes which occur to the people such as improved houses for farmers, better nutrition, self-independence, improved assets and so on are part of economic development. The high economic rates of return obtained in all regions show that small irrigation schemes can significantly contribute towards increasing national income.

Reasons for success of the irrigation schemes

The study showed that the performance of the schemes depend on a number of factors. The most important factors revealed by the study are:

Planning and group cohesion

Those schemes which were planned and implemented with full farmer participation are performing well as illustrated by the all-in-hill schemes. The opposite is true for the schemes which were planned without involving the farmers. Schemes which were planned by consultants without Participatory Rural Appraisal (PRA) experience are also performing badly as shown by the tarai schemes. Projects whose farmers cooperate among them are doing well, while the schemes in which the farmers do not work together are failing. Cooperative action is important in activities such as marketing, transport hiring and operation and management (O&M) work. This type of management came to be very important in the performance of the schemes. All farmer managed schemes are doing well. However, all government managed schemes are performing an average. The reason for this is that farmers in farmer managed schemes feel that the schemes belong to them and as such they invest heavily in them. In the government run schemes, farmers have no sense of ownership and they are not worried about efficient utilization of resources. The type of irrigation technology, whether tube well or surface, affects the labor inputs and leisure time for the farmers. It appeared that tube well schemes require less labor, while surface systems are relatively more labor intensive. Farmers on the surface irrigation schemes complained of the high labor demands of the irrigation leaving very little time for other important

Table 3. Reasons for irrigation schemes successes or failure by regions.

Ecological/development regions	Overall performance rating	Reasons for success or failure
Eastern Tarai	Very good	<p>Good planning. Farmers were involved at the planning stages and so they have a sense of ownership</p> <p>Strong IMC</p> <p>Security of tenure</p> <p>Group cohesion</p> <p>Irrigation is valued</p> <p>Training was provided to farmers</p>
Central Mountain	Poor	<p>Poor planning. Farmers were not involved at the planning stage and hence they have no sense of ownership</p> <p>Poor maintenance of the system</p> <p>Poor designs</p> <p>Poor construction, as hydrants are not in position</p> <p>Low levels of inputs</p>
Western Hill	Good	<p>Good planning. Farmers were involved at the planning stages and so they have a sense of ownership</p> <p>Group cohesion</p> <p>Security tenure</p>
Mid-Western Inner tarai	Good	<p>Good planning</p> <p>Farmers were involved at the planning stages and so they have a sense of ownership</p> <p>Irrigation is valued</p> <p>Security of tenure</p>
Far-WesternMid Hill	Average	<p>Secure water supply</p> <p>Strong IMC</p> <p>Group cohesion</p> <p>However the above strengths are negatively affected by :</p> <ol style="list-style-type: none"> i. Some farmers who are not capable of meeting their O & M obligations ii. Poor selection of farmers iii. Interference by government officials, on allocation of vacant plots iv. Insecurity of tenure

Source: Field Study, 2012; Office records of the Schemes, 2012.

activities like weeding, spraying and organizing marketing of produce (Table 3).

The broader context

The current population in Nepal is 26,494,504 with an annual growth rate of 1.35% (CBS, 2012). The annual growth in agricultural output is 4.93% with 35.68% of Gross Domestic Product (GDP) in current fiscal year 2011/12 (MOF, 2012). It shows that agriculture sector plays a critical role in the Nepalese economy as this

sector still contributes one third GDP and more than 80% population directly depend on it for their employment and livelihood. However, agricultural sector has severe fluctuations on its contribution, production and even productivity due to the lack of easy access to irrigation facility on agricultural lands, improved seeds and seedlings, agricultural loans, advanced technology and farmers' access to technology and knowledge. Several issues and constraints are ahead to ensure food security by increasing farm productivity. Irrigation facility is one of the challenging issues for this sector. Out of the total arable land (2,641,000 ha), irrigation command area is

1,766,000 ha. Whereas total irrigated land has been recorded only 102,247 in the current fiscal year. Efforts have been made since last few years to enhance agricultural production by bringing more and more land under irrigation providing organized irrigation facility through development of surface and underground irrigation systems on irrigable lands. But, only 38.75% of irrigable land has irrigation even though it is not available throughout the entire twelve months. Besides this, no targeted achievements have been met out in tune with policy to increase production and productivity through irrigation (NPC, 2010). The major challenges in irrigation sector are the lack of collaborated efforts of private and public sector to carry out the integrated program of agriculture in coordination with irrigation, multipurpose use of water resource and water induced disaster prevention control and climate change risk reduction capacity development and adaptation. Therefore, time knock us to develop the system for providing irrigation throughout the year with operation of multipurpose water resource development schemes on watershed or in inter basin approach in order to produce enough food to feed the nation and enjoys surpluses for export, in years of drought the reverse is the case. Additionally, even in good years many households are not able to grow enough food for home consumption largely because of poverty and inadequate access to land. Moreover, the little land they occupy is poor land in general. Irrigation can be the answer to the above problems and can permit the farmers to operate on commercial lines. The high yields obtained at tarai and inner tarai schemes for example strongly substantiate this point. Most of the farmers have adopted some stringent farm management practices, such as record keeping, which helps to keep track and continuously assess their profits. The high levels of inputs used in most irrigation schemes also indicate that the farmers have developed a commercial mentality. The development of small-scale irrigation schemes can result in substantially high incomes for the smallholder farmers. Irrigation affords farmers a means to be gainfully employed away from urban centers. The earnings from the irrigation schemes far exceed the industrial minimum wage for unskilled labor per worker per month, thus giving every reason for the government to channel more resources to smallholder irrigation development.

Nepal's food situation is characterized by food insecurity at both micro and macro levels. The major area of concern is the availability of food at household level. The country is able to produce most of its cereal requirements and in normal years few surpluses. However, this national level of security is not translated to household level. There is need to address the issue of distribution and effective demand. Poverty and the lack of an effective distribution system cause household food insecurity. National target is to achieve food security both at national and household levels. To achieve this, specific

programs are needed to address the two sides of the food security equation: availability of food through increased production and storage, and access to food through family production, purchasing on the market and through effective food transfer program. Smallholder irrigation can lead to availability of food at household level through increased productivity, stable production and increased incomes as shown by the analysis of the irrigation schemes. It appeared that all the schemes offer some form of food security for the participants and the surrounding communities. The Government of Nepal has spent large amounts of money since the last decades on drought and flood relief. Irrigation development can contribute towards flood/drought savings. The importance of irrigation in drought relief savings can be illustrated by a comparative analysis of the cost of a drought relief program and the investment required in irrigation to obtain a similar relief.

The economic situation, which prevails in Nepal now, is that the formal sector (which is the dynamic part of the economy) contributes a greater part of the Gross Domestic Product (GDP). This sector however only employs about 20% of the labor force while the remaining 80% of the labor force is employed in the informal sector. The development of the informal and rural sectors is therefore important as a way to reduce unemployment. It will also help reducing the rural to urban migration, which has reached critical levels. According to the 2011 national population and housing census, the major urban centers in tarai and Kathmandu exhibited the highest in-migration rates at 61 and 53% (CBS, 2012). The influx of people into these two and other centers exerts phenomenal pressure on the urban municipalities in their attempt to provide adequate services such as housing, water, sewerage, education and health. The need therefore to curb high rates of rural to urban movement is a challenge to the Government. Agriculture, which is viewed as the most important potential employer of rural people, is not achieving its objectives because of constraints posed by weather. Without irrigation, rural people are not assured of any meaningful incomes, so they tend to move into cities. It is therefore important to give rural people water to improve their incomes and subsequent standards of living. The reduction in rural to urban migration can also be a saving for the urban municipalities as they will no longer need to provide services for the migratory. Cash crops grown under irrigation can directly create employment in the field, through forward and backward linkages, and indirectly through multiplier effects. In the field cash crops require more labor input per unit land than non-cash crops and hired labor input tends to be higher for cash than non-cash crops. For example, 1 ha of irrigated tomato (or any other vegetable) requires soon after restoration of democracy, the government of Nepal adopted a policy of growth with equity and transformation and this policy has been carried over into the Millennium Development Goals (MDGs) and its successor, the

program for economic and social inclusion.

Backward and forward linkages

Irrigated farming can create economic backward and forward linkages. Backward linkages will take the form of creating and enhancing business activities for those dealing in farm inputs. This is due to the fact that high value crops, which are grown under irrigation, rely heavily on improved purchased agricultural inputs. This has positive employment implications for agricultural input enterprises, which is particularly important in the seed production and preservation because most seed has to be produced locally. Such expenditures contribute to increased labor use in the marketing and distribution sectors. Forward linkages can occur if irrigation leads to cash cropping, which no doubt would be the case as the cost of setting up an irrigation system may have to be justified by producing cash crops for the market. This production of crops for sell will promote agro-business and will lead to increased employment opportunities and increased standards of living. As food insecurity at the household level is usually caused by lack of purchasing power, irrigation brings extra income to the farmers, thus enabling them to access food. These effects have been reflected in the analysis of the small scale irrigation schemes.

Constraints and challenges

The selected schemes studied indicated that smallholder schemes can be financially, economically, socially and technically viable. The most important factor that came out as affecting the viability of the irrigation schemes is the mode of planning. Projects that are planned with full farmer participation appear to be more viable than those that are imposed on farmers. By involving farmers in the planning they develop a sense of ownership, making them willing to participate in the operation and maintenance. The planning of schemes by PRA consultants and smallholder irrigation development experiences seems to create problems. These professionals normally lack participatory approaches that are very important as far as smallholder agricultural development is concerned. Such experts do not have the time to invest in doing the necessary social investigations in consultation with the farmers. For example, the failure of the experts to involve farmers during the identification phase of some schemes created a lot of problems. Farmers were only told when the land had already been identified. This was not welcomed by the farmers and up to now this is one of the factors negatively affecting the performance of the individual schemes. The technical designs made by consultants are not suited for smallholder management and no farmer input was

searched for during the design process. It also came out clearly that social aspects, such as land tenure and the social setting, should be considered in the planning of a scheme. Some of the problems are of a social nature and were not addressed at planning. The question of inheritance is an important determinant of the level of infield investment by the farmers. If farmers are able to inherit the plots, some element of security is felt and thus farmers can invest. For example, farmers who have no sense of security are reluctant to take part in any form of O&M for their scheme. The selection of people of different backgrounds may create problems on a scheme. Some participants were drawn from different places and from people with different backgrounds. This aspect was not captured at the planning stage and is now affecting the smooth running of the scheme. Therefore, social investigations involving sociologists or social anthropologist should be done prior to any irrigation development. The choice of technology was found to be important, especially for women. Surface systems were said to have higher labor demands than tube well systems. It is thus the future planning need to take this into account. High electricity bills are a problem for some pumped schemes and generally the energy costs seem to be rising every now and again. Systems that require less energy like low pressure and localized systems. The type of management was found to very important as it affects the level of O&M, the cropping pattern practiced, and the general viability of the schemes. Farmer managed schemes, if properly planned, have better O&M than government managed schemes. It was found that all farmer managed schemes having some technical problems, have efficient O&M. Government managed schemes have problems because of budgetary constraints. Frequent pump breakdowns and disconnection of electricity are common at government managed schemes. Good irrigation water management is a problem at schemes which do not pay for O&M costs. The farmers have nothing to lose since the government pays the electricity bills. So, some cost recovery measures should be instituted to make farmers much more responsible. Given that water is a scarce resource, allowing these farmers to continue wasting water is not acceptable. These schemes should be turned over into farmer managed schemes to make farmers more responsible.

Marketing, especially through contract farming, has proven to be a problem for smallholder farmers. Most of the contracts are verbal and farmers usually are cheated by unscrupulous dealers at the end. The terms are always in favor of the buyers and farmers lack the bargaining power. Training in contract marketing is as a means of safeguarding the farmers against some unscrupulous companies. A major constraint in irrigation development in the past was the top-down approach by the government, which viewed the target population primarily as beneficiaries rather than as customers or

stakeholders. In turn, beneficiaries perceived the government as a free delivery channel and consequently, no one would be willing to pay for O&M. There was also a tendency for technical experts and politicians to make decisions on behalf of the farmer. The experts pretended to know what was best for the poor uneducated farmer. The government is moving away from this approach and participatory planning is now being highly emphasized.

CONCLUSIONS AND RECOMMENDATIONS

Small scale irrigation has a role to play in agricultural and economic development of Nepal. The high yields obtained in irrigation, coupled with other benefits such as increased incomes, food security, employment creation, drought relief savings and environmental resources management, an indication that irrigation can be a vehicle for the long term agricultural and macro-economic development. With water being the scarcest resource especially in the smallholder sector, the need for irrigation development in this sector is quite apparent. The true fact is in future all smallholder irrigation development should take an integrated rural development approach covering irrigation infrastructure and associated communication and health facilities. This will result in schemes not being shunned by transporters because of poor roads, as is happening at present at scheme area. Improved communication facilities will ensure that farmers get marketing information timely through such means as telephone. Health facilities should also be near the scheme. Given the fact that irrigation development can be associated with diseases, the need for health facilities cannot be over-emphasized. The priority date system for water allocation, which is based on the first come first served principle, has proven to work against smallholder irrigation. This was illustrated by the scheme where a commercial farmer upstream fails to release water for the smallholder scheme downstream during times of shortages. This is because the commercial farmer has an earlier water right, which gets precedence over the other farmers' water right; this tends to affect the performance negatively during times of water shortages. The government is already in the process of replacing this biased Water Act by a better system that results in equitable distribution of water. This new system utilizes the concept of water permits, which are issued for a five-year period and renewable if need be. The permit system is managed by water users' groups, which are elected on a catchment basis to administer the allocation of water. The WUGs comprise representatives of all stakeholders including the small-scale farmers. The permits issued to farmers can be revised at any time at the discretion of the WUGs to ensure equitable distribution of water. During times of water shortages, the WUGs distribute water according to its availability and ensure that all users get an equal share. This means that for most smallholder

irrigation schemes of water allocation will soon be a thing of the past.

In the analysis of the schemes, it has become clear that at times, the government just stops its management obligations on irrigation schemes without properly handing over the O&M to the farmers. This creates problems at such schemes as farmers remain with the understanding that the government is still responsible. It is important that the government works out a clear, transparent and systematic system of handing over government managed schemes to the farmers. This will avoid some of the problems that exist in the Nepalese context. It is also important to be transparent and not to threaten people as a way of making them accept a project. The farmers claim that they were promised inputs by government at the beginning of the scheme, but this promise up till now has not been fulfilled. Some politicians also threatened them with eviction if they refused the project. This was all done in an attempt to make farmers accept the scheme and this did not go well with the farmers. Civil servants and other employed people should not get priority during plot allocation in irrigation schemes. Government officials should not unnecessarily interfere with the running of irrigation schemes. They now consider the project to belong to the government, despite the fact that they are responsible for the O&M costs (Figure 2).

In above background, some recommendations that have come out of the study of the schemes which are important for the implementation of viable and sustainable schemes are suggested:

- i) Farmers should participate throughout the schemes planning, implementation and evaluation phases.
- ii) A bottom-up approach is ideal for irrigation development, treating farmers as owners and not as beneficiaries of the programs.
- iii) Consultants with no PRA and small scale irrigation development experience should not be engaged to plan smallholder irrigation schemes.
- iv) It is sustainable to develop farmer managed irrigation schemes, as they reduce the financial burden on the government in terms of O&M.
- v) The government, given the budgetary constraints facing it, should come up with a clear, transparent and systematic policy and method of handing over government managed schemes to farmers.
- vi) Only schemes which are technically sound should be handed over to farmers.
- vii) Given that water is the most limiting factor in small-scale irrigation development in Nepal, efficient irrigation systems must be encouraged in this sector in order to save water.
- viii) Study tours for farmers and extension workers prior to irrigation should be organized for any new scheme.
- ix) Training in water management, marketing and general crop production is important for new and old irrigation

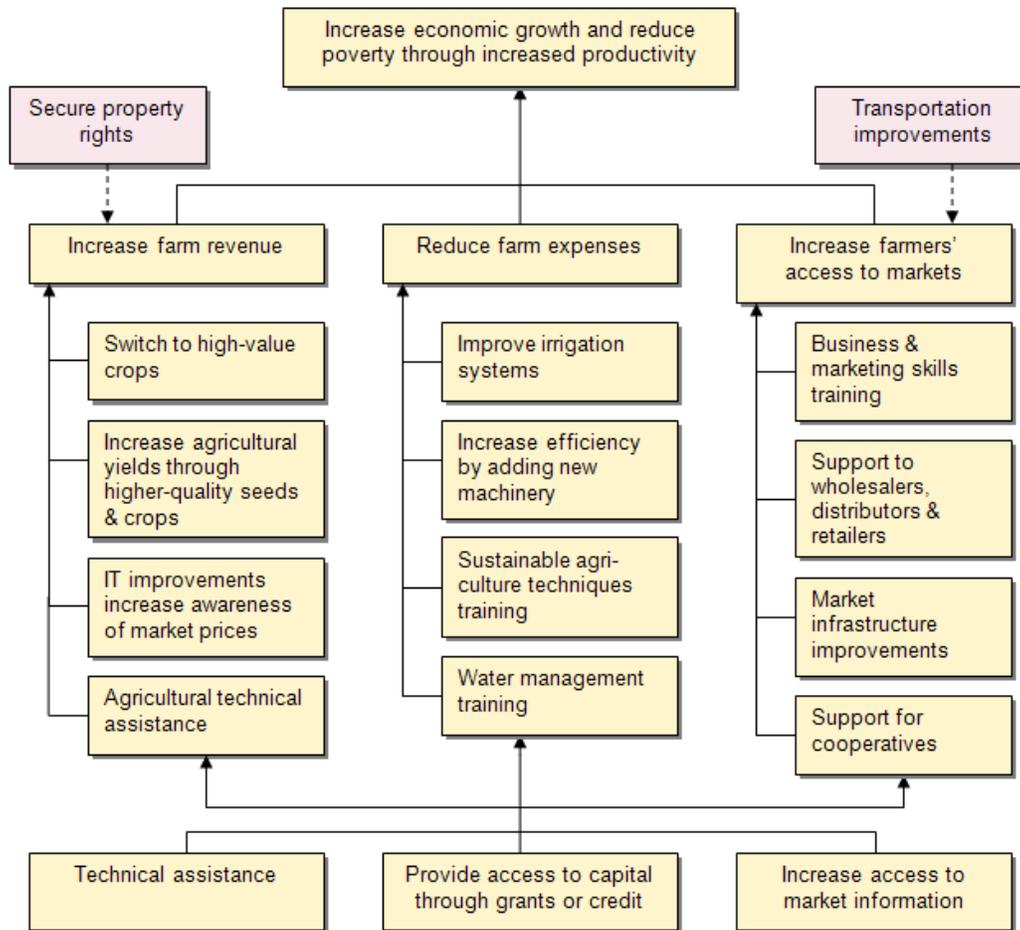


Figure 2. Suggested model for small-scale irrigation scheme development. Source: Adopted from Ministry of Irrigation, 2012 and Personal computation.

schemes.

x) It is important to help farmers with inputs for the first season, so that they can build a cash flow base.

xi) Institutional support should be enhanced in small-scale irrigation development.

x) Continuous monitoring and evaluation of irrigation schemes is necessary to provide feedback and information important for the future planning the management of new schemes.

xi) The issue of inheritance should be considered seriously in the planning and management of small scale irrigation schemes.

xii) Coordination of all relevant institutions involved in small-scale irrigation development is important during the planning and implementation of small scale irrigation schemes.

xiii) An integrated rural development approach should be followed in any agricultural development program.

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