Farmer Managed Irrigation Systems Inventory: Experiences and Lessons from Nepal

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INTRODUCTION

This paper reviews Nepal's attempts at conducting inventories of FMIS and extracts lessons applicable elsewhere. During the past decade several institutions within Nepal have undertaken irrigation resource inventories. While one such inventory by the Water and Energy Commission (WECS) has been a nation-wide inventory, others have focused on a single river basin (WECS-IIMI), a valley (IAAS-IIMI), administrative district (Dhading District Development Project/GTZ), or thematic concern like common property arrangement (Indiana University). The experiences gained and lessons learned from such inventories are definitely applicable to many other agrarian societies.

The WECS inventory has been conducted so far in 59 districts indicate that around 3,172,000 ha area is under cultivation, out of which 947,610 ha of land is irrigated (mostly seasonal) and the rest is rainfed. Out of the irrigated land, 688,740 ha is irrigated by farmer managed systems and 258,870 ha of land by government managed irrigation systems. The number of farmer managed systems as identified by the inventory are 10,019. The numbers of government assisted farmer systems and government managed systems together total 411. It is to be noted that in the Terai plain area (covering 20 districts) systems with less than 25 ha and in mountain areas systems with less than 5 ha or 2 ha, depending upon topography have not been included in the inventory.

A river basin irrigation resource inventory was undertaken by WECS with assistance from the Ford Foundation and the International Irrigation Management Institute. An inventory activity was undertaken in the Upper Indrawati River Basin in Sindhu Palchok District to determine relative needs for assistance among systems and to establish criteria for selecting systems to assist. For such selection criteria to be established, it was necessary to identify all the systems in the basin and collect minimal information about each of them. The inventory also relied on farmers' knowledge for the variations of discharge in the stream at the diversion in each season, area irrigated for each crop, extent and nature of unirrigated land that could be served by each canal and also the reasons why it was not presently receiving water. The inventory identified 119 irrigation systems with canals longer than 0.5 km. in the 200 sq. km. area irrigating about 2,100 ha owned by more than 5,000 households. An important accomplishment of the inventory was a description of the potential for either intensifying the cropping pattern or expanding the area irrigated by each system. For example, out of the 119 irrigation systems, it was found that only 23 separate irrigation systems had both land and water resources with potential for expansion of the irrigated area.

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Drawing upon these and other inventories undertaken in Nepal, the paper presents i) the rationale or need for inventories, ii) the different types of inventories and their comparative advantages and utilities, iii) methodological issues in use of inventories, iv) the need to incorporate institutional and sociological variables or indicators into inventories (e.g., water and land rights, irrigation organizational capacities, availability of local resources and support services, etc.), and v) the relevance of the Nepal experience to FMIS inventory in general.

This paper concentrates on the inventorying experiences of WECS and DDDPGTZ, which we consider to be the most innovative and experiences. The Nepal nation-wide water use inventory study has to date been undertaken by WECS for 59 districts out of 75. The river basin irrigation water use inventory was undertaken by WECS with assistance from the Ford Foundation and IIMI-Nepal. This inventory activity was undertaken in the Upper Indrawati River Basin in Sindhu Palchowk District to determine relative needs among systems and establish criteria for selecting systems to assist. The other inventory described here is the one undertaken by DDDP/GTZ in the administrative district of Dhading.

Drawing upon these inventories undertaken in Nepal, the paper shall present i) the rationale or need for inventories, ii) the different types of inventories and their comparative advantages, iii) the methodological issues in inventories, iv) the need to incorporate institutional and sociological indicators for the inventories, and v) the possible relevance of the Nepal experience to FMIS inventory in other parts of Asia.

This paper will first describe the three types of inventories undertaken, namely: nation-wide, river-basin and administrative district and presents lessons learned from these inventories. The latter part of the paper will focus on certain issues pertaining to irrigation inventory and its possible relevance elsewhere.

CONTEXT OF IRRIGATION INVENTORY IN NEPAL

Water plays a very important role in Nepal's economy which is predominantly agricultural. The history of systematic introduction of government irrigation systems in Nepal is recent but farmers of this country have been using water for irrigation since time immemorial. More than 90 percent of the small and medium scale irrigation systems or about 75 percent of the irrigated area in Nepal were created, managed and operated by farmers themselves. But, unfortunately, proper records of such systems have not been kept. Without the proper knowledge and information about the existing situation in irrigated areas and uses of the water sources, it has become difficult for development planners in Nepal to make well-informed and sound decisions on whether to emphasize construction of new irrigation systems, to rehabilitate, to improve or to extend existing systems. The rapid population growth both in rural and urban areas has increased the demand and competition for water resources. This scenario could be a source of conflict not only for local communities wanting to use the same source of water but also among the *"co-riparian"* countries. Thus, it was realized that proper record keeping of water uses location-wise and time-wise was of utmost importance.

In view of the Nepali context where the major use of water is in the irrigation sector, studies that brought about the collection, compilation and systematic management of information for water use were first focused on the irrigation sub-sector. The Water and Energy Commission Secretariat (WECS), an advisory commission of His Majesty's Government of Nepal, started a *"Water Use Inventory Study'* program in 1984. This inventory study was conducted district-wide with the objective of covering the whole country. This program is still continuing and, as mentioned above, 59 districts have already been inventoried.

During the course of this nation-wide inventory, the need for an action-oriented research program to identify cost-effective ways and means for supporting farmers to improve their irrigation systems was also felt. Therefore, a priority listing of systems for improvements had to be made. This meant the preparation of an inventory of farmer irrigation systems and their characteristics. This was later carried out within a selected river basin. This inventory will be dealt examined below in this paper.

WECS carried out two different types of inventory studies with different purposes. The purpose of one inventory study was to create a comprehensive data base on existing irrigation systems on a nation-wide basis. The other purpose was to create a basis for selecting farmer managed systems along river basins on a priority basis. Another purpose was to develop and test methods, techniques, and technologies for assisting existing farmer-managed irrigation systems in a cost effective manner in the form of an action research program.

Similarly, DDDP/GTZ initiated Dhading District inventory study with an objective to generate information for assisting the central as well as the district level agencies to effectively plan and implement small-scale water resource development. This study focused on and intensive inventory of all rivers and streams along which irrigation systems and hydropower have been developed in only one district.

BRIEF DESCRIPTION OF THE NATION-WIDE INVENTORY OF IRRIGATION SYSTEMS

The objective of the nation-wide inventory were: i) to identify existing or planned uses of water with particular emphasis on irrigation use (including the identification and provision of preliminary information regarding the scope and nature of potential projects, ii) to acquire preliminary information on the technical, institutional and performance aspects of the irrigation systems, iii) to identify the sources of water with emphasis on river/stream water resources and iv) to assess approximately the quantity of the sources of water.

Collection of all relevant secondary materials, maps and aerial photographs of the study area were undertaken. Maps were studied for identifying the probable sources of water in the study area. Identification of the existing irrigation systems and the land use pattern in the study area were carried out with the help of aerial photographs and cadastral survey maps. The suitability of land for agricultural production was determined by the use of land capability maps.

An index map of the study area was prepared by incorporating all this information in which the irrigation systems identified by the aerial-photo interpretation were also located. In short, the secondary materials collected focused on information regarding the irrigation systems, hydrology and agriculture.

After assessing and arranging the necessary data for a particular district, the field survey work was carried out in order to verify information and up-date it or add missing information, including present cropping pattern. Identification of existing traditional irrigation systems, agency built and managed, or locally constructed and managed irrigation systems was done with the help of the index map prepared during the desk study stage.

Verification and checking of the systems was undertaken by the study team by visiting each system and making necessary corrections in the index map. Generally, more irrigation canals were found in the field than were identified by aerial photo interpretation and there was about 20 to 25% error in their interpretation. Measurement of discharge in the rivers and canals were done wherever possible.

After analysis and verification of information collected during the desk and field survey, a comprehensive district water use inventory report was prepared containing particularly the comparative study of available discharges of the rivers, existing water use by irrigation and water balance available for downstream use. During the study, an irrigation system network map also was prepared and annexed to the report.

PRESENT STATUS AND RESULTS OF WORKS ALREADY COMPLETED

Out of 75 districts of Nepal, 59 districts have already been inventoried by this study. The districts for which inventory reports are available are shown in Figure 1. The study in the remaining districts is continuing. After completion of district inventories, they will be arranged into a nation-wide inventory arranged by different basins.

The inventory study conducted so far in 59 districts indicated that around 3,172,000 ha is under cultivation. Out of the irrigated land 688,740 ha is irrigated by farmer managed systems, 258,870 ha is irrigated by government developed irrigation systems. The number of farmer managed systems, as identified by the inventory study, is 10,019. The number of government assisted farmer systems and government managed systems together total 411. In the Terai (covering 20 districts) systems with less than 25 ha and in mountain areas the systems with less than 5 ha or 2 ha (depending on topography) have not been included in the inventory.

From the point of view of agricultural production, the terai is considered the granary of the country. Out of 947,610 ha of irrigated land as identified by the inventory study, 760,226 ha are in the terai and 187,384 ha in the hills. Meanwhile 69% of the irrigated area in the terai and 87% in the hills is irrigated by FMIS (see Table 1).

Figure 1. Location map of the area covered by inventory

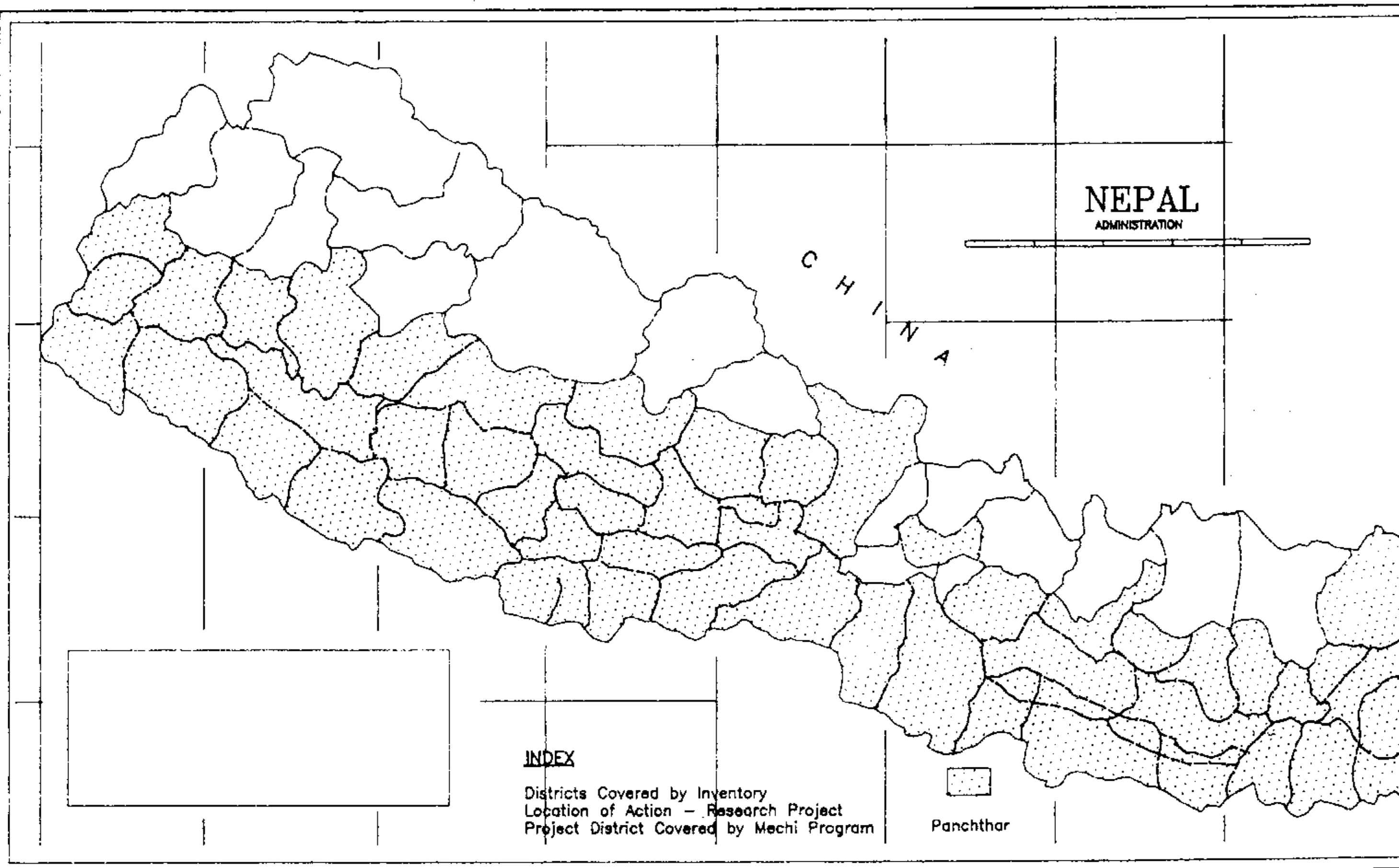


Table 1. Summary of nation-wide inventory

Numbers of Districts Completed	59
Total Cultivated Land (59 Districts)	3,172,800 ha.
Total Irrigated Land (59 Districts)	*947,610 ha.*
FMIS irrigated land	688,740 ha.
Government Managed System	258,870 ha.
Total Nos. of FMIS (59 Districts)	10,019
Total Nos. of Government Managed System	411
Total Irrigated Land in the Terai Region (20 Districts)	760,226 ha.
Total Irrigated Land in the hills (39 Districts)	187,384 ha.
Percent of Irrigated Land Covered by FMIS:	
Terai	69%
Hills	87%

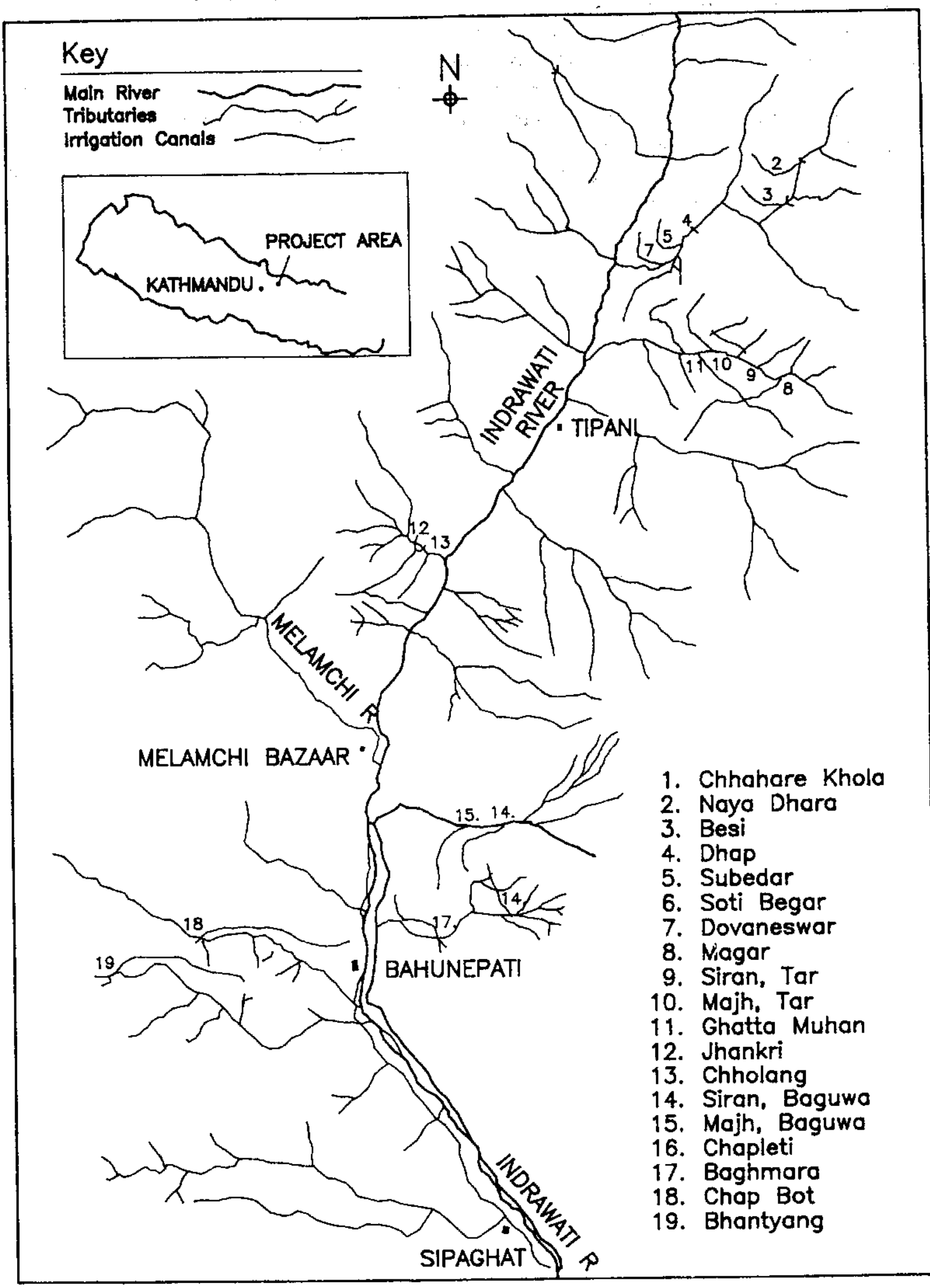
The above figures show the importance of farmers' contribution in the development of irrigation in Nepal. As a matter of fact, most of the command areas covered by the government managed systems also include the areas already irrigated by farmer systems. Planners and decision makers have to think whether new projects are to be undertaken on a priority basis or concentrate on assisting the already existing farmer systems to strengthen their management and expand the command area through augmentation of the water flow. In this regard, the inventory study has been considered as the basic source of information for use in selection of the projects to be improved, rehabilitated, strengthened and/or expanded.

AN ACTION-RESEARCH PROJECT

Keeping in view how assistance could beprovided to existing farmer irrigation systems that it would have the maximum impact on agricultural production at least cost, WECS with the assistance from the Ford Foundation and the International Irrigation Management Institute (IIMI) undertook an inventory of irrigation systems in the upper Indrawati River Basin aimed at selecting appropriate systems for an action-oriented research project (Figure 2).

One objective of the action-research project was to establish low-cost procedures for identifying the relative needs of all systems in a particular area, allowing selection of systems for assistance where greatest impact on food production could be made (WECS/IIMI, 1990). Another objective was to develop and test methods for providing assistance that enhance farmer management capability for operation and maintenance without eroding *"farmer management"*, especially if physical infrastructures were being improved.

Figure 2. Location map of improved FMIS under action research project



Source: WECS/IIMI. 1990

The work was divided into two phases. In the first phase, a field-based reconnaisance to produce an inventory of all existing systems was carried out. The inventory included important information about the problems each systems faced and particularly the extent to which the land and water resources were being utilized. This information was collected by visiting each canal from the diversion to the command area with a group of water users. An assessment of available discharge in the stream throughout the year was also made by using farmer informants to describe the variation of discharge in each season compared to that being observed. As a result of the inventory study, 119 irrigation systems were identified with canals longer than 0.5 km in the 200 sq. km. project area. These systems irrigated about 2,100 ha and land was owned by more than 5,000 households. A major accomplishment of the inventory was a description of the potential for either intensifying the cropping pattern or expanding the area irrigated by each system. Out of 119 irrigation systems identified, only 23 separate irrigation systems were identified as having both land and water resources with potential for expansion and improvement of irrigation area.

An additional rapid appraisal of the selected systems was carried out to identify the specific problems of each canal and to begin the process of identifying the type of assistance the beneficiaries felt useful. A complete profile of the existing agricultural and irrigation practices, water rights, sociological variables and the mechanism for operation and maintenance activities of the canals was developed. Finally 19 systems out of 23 were selected for assistance.

The second phase of the project implemented the *"improvement works"* of the selected canal systems. The rapid appraisal report identified more work to be done than the available project money. Hence, the improvement work was divided into three categories: (i) first priority work that was essential for expansion but difficult for farmers to do without assistance, (ii) second priority included work desirable for improved operation and maintenance, and (iii) third priority work as identified as improvements farmers could accomplish with their own resources. The details of this implementation process with continuous dialogues negotiations and bargaining are described in WECS-IIMI, 1990. Tables 2 and 3 portray some of the achievements of the assistance program that could only be designed after the inventory.

Table 2. Irrigable area and cost of improvements to 19 farmer-managed systems

System Name	Existing Command Area (Ha)	Command Area Expansion (Ha)	Total Irrigable Area (Ha)	Project Grant (NRs.)	Cost per Irrigable Area (NRs/ha)
Chhahare Khola	126	37	163	126,615	777
Soti Bagar	19	11	30	150,699	5,023
Dovaneswar	2	10	12	74,807	6,234
Magar	100	43	143	160,805	1,125
Siran, Tar	18	6	24	136,789	5,700
Majh, Tar	71	16	87	114,321	1,314
Ghatta Muhan	23	10	33	124,321	3,767
Jhankri	18	13	31	91,707	2,958
Chholang	23	14	37	116,066	3,137
Siran, Baguwa	18	19	37	57,488	1,554
Majh, Baguwa	13	20	33	113,541	3,441
Chapleti	8	15	23	78,065	3,394
Baghmara	3	6	9	44,433	4,937
Chap Bot	12	5	17	71,630	4,214
Bhanjyang	21	14	35	65,178	1,862
Dhap & Subedar	30	35	65	85,000	1,308
Naya Dhara	55	55	110	139,720	1,270
Besi	65	20	85	119,839	1,410
Total	625	349	974	1,871,024	

(*Source: WECS/ IIMI, 1990*)

Average cost per irrigable hectare	NRs. 1921
Average cost of supervision tools and farmer training per irrigable ha.	NRs. 1365
Total cost of improvement per irrigable hectare	NRs. 3286

**The cost in Nepali Rupees (NRs) is based on 1985 exchange rate: 1 US$ = NRs. 22.

Table 3. Savings in cost of improvements due to farmer participation
(Prices are based on 1985 exchange rate of US$ 1 = NRs. 22)

System Name	(a)	(b)	(c)	(d)	(e)	(f)
	First Priority Work					
	Grant (NRs. '000)	Actual Expenditure (NRs. '000)	Saving (a-b)a (%)	Farmers Contribution (NRs. '000)	Work Completed (NRs. '000)	Effective Increase (%)
Chhahare Khola	127	62	51	3	168	132
Soti Bagar	151	83	45	1	167	111
Dovaneswar	75	68	9	1	89	119
Magar	161	133	17	1	192	119
Siran, Tar	137	40	71	1	214	156
Majh, Tar	114	96	16	1	143	125
Ghatta Muhan	124	82	34	0	170	137
Jhankri	92	28	70	1	108	117
Chholang	116	41	65	1	136	117
Siran, Baguwa	57	42	26	25	81	142
Majh, Baguwa	114	85	25	42	170	149
Chapleti	78	60	5	19	109	140
Baghmara	44	30	32	12	73	166
Chap Bot	72	60	17	16	86	119
Bhanjyang	65	50	23	15	102	157
Dhap & Subedar	85	35	59	4	154	181
Naya Dhara	140	105	25	21	245	175
Besi	120	95	21	10	221	184
TOTAL	1872	1195	36	174	2628	140

(*Source:* WECS/ IIMI, 1990)

(a) Grant amount allocated to the systems to complete most first priority work as estimated using national norms.

(b) Grant money expenditure for completing first priority work. Money saved, (a-b) was used for second and third priority work.

(c) Savings in comparison to the grant allocated.

(d) Unpaid labor (calculated as the number of person-days of labor multiplied by the district wage rate) plus the difference between the district rate and a lower labor rate as agreed to by farmers in some systems to reduce cost.

(e) Value of work completed as computed using national norms. This is higher than (a+d) because: 1) estimates computed by norms are generally high, and 2) work efficiency due to farmer participation was very high.

(f) Effectiveness of farmer participation in accomplishing more than estimated by the national norms.

The ultimate objective of this inventory study was to provide information necessary for the selection of the systems where further study and possibly development activities were warranted. Based on the experience of the action-research project, the most important information to be included in the inventory study was the information about the potential for expanding or intensifying irrigation from each particular system. The essential characteristics to examine are:-

The Land Resource: Is there land in the command area that is not irrigated or irrigated in only part of the year or is there area that can be extended if the system is improved?

The Water Resource: Is the water discharge in the source sufficient for expanding irrigation or are there other sources that could be tapped?

The Water Rights: Are there several systems competing for the water in the source? Is there possibility of tapping more water?

The Water Allocation: How are the rights to use water within a system allocated and are the present beneficiaries or owners of the system open to adding new members?

The Physical System: What are the major difficulties faced in acquiring and delivering water in the present system?

The Management System: How well are the present beneficiaries or owners of the system organized to operate and maintain the system?

The Agricultural System: Information on cropping pattern in the head and tail of the irrigation area, frequency of irrigation, inputs other than the irrigation, support services such as JTA, loans. Are crops mainly marketed or consumed by farmers?

DESCRIPTION OF DHADING DISTRICT INVENTORY

The Dhading Development Project (a district development project) funded by GTZ felt the need for a comprehensive inventory of the existing and potential water uses by the people of Dhading. This water resource utilization inventory was undertaken with the hope that the study would generate information that will assist central as well as the district level agencies to effectively plan and implement small scale water resource development. A Nepali consulting firm was commissioned to undertake the inventory study. The inventory included i) the existing and proposed forms of water resources and their utilization for existing and proposed irrigation systems as well as hydro-power units, ii) a quantitative assessment of available water resources for irrigation, and iii) identification of the potential for future development of available water resources for irrigation (Silt Consults, 1991).

The study concentrated on inventorying all rivers and streams from which irrigation systems and hydropower have been developed. The study also undertook an inventory of all water sources from which future irrigation systems or hydropower could be developed. Even irrigation systems with command areas less than .25 ha were included in the inventory.

The activities for the inventory were carried out in four stages. Both secondary and primary data were collected. The first stage involved the collection and analysis of secondary data and the preparation of a report based on it. The second stage included field work and reporting it. The third stage consisted of the comparative study of the report based on secondary materials and the report based on actual field work. The final stage was the preparation of the final report.

The following section describes various activities undertaken during the four stages and lessons learned during those stages. The first phase concentrated on maps and photographs (e.g., topographical maps, land utilization maps, cadastral survey maps, village maps, aerial photographs, etc.) and data pertaining to i) village profiles, ii) hydrological data on rivers and streams, iii) information on agency managed or financed systems, iv) information on locally developed irrigation, v) information on irrigation projects approved by the local district development administration, vi) land survey registration data, vii) land utilization and land capability data, and viii) information on all hydro power units located in the study area.

The abovementioned information were collected and analyzed for specific purposes. The village profiles helped ascertain the present status of the uses of existing water sources within each village administration. The irrigation department's various reports helped in the preparation of the salient features of the projects within the study area. The various cadastral, land use and capability maps helped in presenting the overall agricultural situation of the study area and also identify where irrigation systems may be located. Topographical maps and aerial photos were helpful in supplementing information from other sources and in the preparation of the base map for the inventory study. This new base map was prepared for the purposes of the inventory to indicate in the map itself the location of the various water uses.

The final report of the inventory work (Silt, 1991) however note that clearly the only direct basis for the inventory would be the actual field survey. It was necessary for the field team to actually visit each irrigation system and conduct "walk-throughs" to identify the details of existing water use. The report recognizes that "for potential water use systems local people and their political representatives needed to be contacted and interviewed before such systems could be built or expanded to increase their capacity.

During the second stage, the field survey was prepared, field work undertaken and the data analyzed for the preparation of the final report. The field team typically consisted of an engineer, an overseer and a number of assistants. They had with them aerial photos, topographical and various other maps and equipment like magnifying glass, abney levels, altimeters, measuring tapes, etc. During the team's field visit, the various members met with local villagers, walked through the irrigation systems and observed water use. The inventory study team prepared a data compilation form which was filled at the site (See Annex 1 as a sample). The form included the various indicators thought to be important for assessing existing and potential irrigation schemes.

Field teams had continuing discussions and orientation meetings among themselves and with the Dhading Development Project advisors. Even in the field itself, the teams discussed the inventory work and issues involved. The field work was discussed and the data gathering process improved through successive meetings and discussions.

A typical field visit consisted of the following steps.

1) Upon arrival, the team, with the help of the local people and authorities, verified the list of all water use schemes currently in use and those proposed;
2) Those schemes not entered or missed for the village area were noted;
3) The data compilation form for existing and new potential water use schemes was completed during interviews with the users and local authorities; and
4) Information provided during interviews was verified by actual measurement and assessment. Data verification and assessment was carried out by the team by actual observations of the hydro-units and walk throughs of the irrigation systems. This information included in the reference maps. The final compilation of information was again discussed with farmers and local people for further verification and cross-checking.

The various lessons learned and problems encountered during the field work stage are as follows.

1) The precise village administrative boundaries were either drawn wrong in the maps or were unknown to the local inhabitants and therefore it was difficult to carry out the inventory on the basis of the village administrative boundaries;
2) The cadastral and village maps seldom indicate all the irrigation systems within the village;
3) At times it was difficult to communicate with the local inhabitants because the field team did not understand the local language;
4) Several villages were very indifferent and negative towards the field inventory because they had experienced several teams undertaking surveys there but without any results or benefits for the village;
5) Where several field teams were mobilized, it was difficult to bring about a uniform approach;
6) Farmers were generally more enthusiastic about receiving grants than loans and were willing to contribute labor to developing the irrigation systems; and

7) The time taken for the inventory differed from one village to another. However, on the average, it took around 15 days for one village which had multiple irrigation systems.

The last two stages were devoted to writing the report incorporating the suggestions and comments made by DDP on the field findings. Information and data were analyzed and improved upon after successive meetings and discussions not only with the DDP advisors but also among the various field teams.

The specific indicators or information sought are outlined in the data compilation form (See Annex I).

CONCLUSIONS OF THE DHADING DISTRICT WATER USE INVENTORY

1. Interaction between the inventory team and DDP advisors was crucial for the refinement of the inventory approach. As the study was undertaken, the scope of work, data collection methods, and recording was constantly improved upon. Given this scenario, the flexibility provided by DDP to the inventory team was important for carrying out the new targets.

2. The inventory was able to list 1766 streams and 71 springs in Dhading district with an area of 1926 sg. km. The various water use units such as irrigation systems, traditional water mills (ghattas), water mills and mini hydro-electricity generation units have been inventoried. It was found out that there were 2961 existing irrigation systems, 359 traditional water mills, 69 water mills, and 9 improved water mills. Similarly, in the case of irrigation systems, the inventory identified 163 potential irrigation schemes which could be developed tapping 110 streams and one spring (Silt, 1991).

3. The inventory did include some non-technical information regarding the organization of the irrigation systems but more variables regarding the socio-institutional aspects of irrigation management could have been incorporated.

4. There was a lack of meteorological data for the district because there were only two hydro-meteorological stations in the whole district.

5. Though the district is rich in water resources, much of it cannot be used because the river beds are far below the potential arable land.

6. In terms of the distribution of the irrigation systems, it was found that systems less than 20 ha numbered 2891 with a total area of 8213.1 ha while those above 20 ha numbered only 70 systems covering 3626.25 ha.

7. For purposes of planning, the inventory proved to be useful because out of the 71 irrigation schemes proposed for survey by the district development administration, 68 were found by the inventory to have potential for further improvement. Thus, these systems deserve further investigation before investments are made on them.

8. In terms of irrigation technology, the report notes that the inventory did not take into account the possibility of small scale irrigation with pipes. The farmers living higher up in the mountains with upland fields could benefit through pipe irrigation on their orchards and vegetables.

CONCLUSIONS

Several agencies involved in the development of irrigation in Nepal have not only used the information from the IIMI/WECS inventories but also have started to adopt the methodology used in IIMI's preliminary strategic action-research with WECS for improvement of FMIS. Examples of projects that made use of information generated by the WECS inventories include, the Irrigation Master Plan Study, the Irrigation Sector Project, and the Mechi Hill Irrigation and Related Development Program. The Mechi Hill Irrigation and Related Development Program implemented under the assistance of the Netherlands Development Organization (SNV-Nepal) is spread over three districts- Taplejung, Panchthar and Ilam in the eastern border of the country in Mechi Zone. The master plan for irrigation development in Nepal prepared under financial support of UNDP/World Bank has extensively used the information from the reports of the district inventory. The Irrigation Sector Project under the Department of Irrigation has been using information from the district inventory reports for selecting irrigation systems and areas for irrigation development.

The nature of work of the Mechi Hill Program in the development of irrigation is similar to that of Action-Research Project implemented by WECS in Sindhupalchok District. The objective of this project is to rehabilitate, upgrade and construct approximately 50 farmer irrigation systems with participation from farmers and the District Irrigation Office. For this purpose, the program had to select systems having potential for improvement and expansion, for which the program used the district inventory reports prepared by WECS as basic documents, in addition to the information gathered by the program during survey and discussions with local people. For collection of in-depth information and selection of priority schemes, the program also used the methodology adopted in action-research in Sindhupalchok District. This procedure helped the program to select specific systems for improvement. The experience of the WECS action-research was utilized during implementation of the improvement works as well.

The three inventories discussed above showed the importance of both the use of secondary materials and the field inventory. The rationale of inventories also varied in that i) they were meant to provide basic information regarding the status and condition of *"what is out there"*, ii) use such information for planning water use within a watershed, basin or district, and iii) provide information in order to rationalize and prioritize assistance and support services to irrigation systems.

The type of information collected for each system differed between the inventories depending on the magnitude and scope of the inventory. Who to contact for such information also becomes crucial for successful results. Though physical and agricultural indicators are important, the socio-institutional variables are also equally important to be included in the types of information sought from each individual system. Such information are very useful for planning water use within a river basin as well as selecting systems for assistance.

The abovementioned information could have been collected from individual systems by including questions related to methods of water allocation, methods of resource mobilization, membership criteria and expansion, levels of organization and functionaries, types of records kept, types and frequency of meetings, rules and roles of the organizations, conflicts and their resolutions, sanctions, ethnic group distribution within the system and ownership of the system. The history of system creation and expansion, the interrelationships with other irrigation systems in terms of water sharing or resource mobilization, method of water allocation for the interconnected irrigation systems and water rights are some of the types of information necessary to be included in an FMIS inventory - if the objective is to select systems to assist on a priority basis or plan and manage the various uses of water along a river basin.

The various inventories in Nepal and elsewhere (for example, Lintau Buo Inventory conducted by Ambler (1989) in West Sumatra) show that the inventory is an iterative activity. It must undergo several revisions and verifications. Even then, *"an inventory is a rough overview and is not intended to provide detailed data on each irrigation system. For personnel in the field, it provides a basis for subsequent revisions. For planners at higher levels, it is intended to start to fill a gap where little or no data on macro, intersystem relationships previously existed (Ambler, 1989)"*. Nepal's experience in inventories (and their objectives) does have relevance in Southeast Asia and vice versa regarding the methodological and substantive issues of inventories. Ambler's (1989) experience in inventorying in West Sumatra dealt with similar issues that the Nepal inventory teams faced.

Usually inventories are "externally" driven, meaning that the types of information collected for specific objectives like planning water use within a watershed or being able to select systems on a priority basis are thought of in advance by the inventory team. An effective process for involving farmers in data collection tasks or letting irrigators themselves determine types of data and information to collect is still in need of development. A move towards a more participatory inventory needs to be developed rather than only involving farmers in "verification" of the data and information. Locally-originated inventories of irrigation systems and development potential sometimes occurs informally among villagers using indigenous knowledge and historical experience. Having agencies (government or non-government) facilitate development of farmer-developed inventories (to improve water rights and allocation systems, support services and marketing) is a strategy worthy of experimentation in the future - in order to meet information needs of farmers and to make support services more demand driven.

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Annex 1. Data Compilation Form (i) (Existing System)

1. System Number: T2-00-00-00/4(9)/32
2. Name of System: Mill Kulo
3. Ward No(s): 9
4. Name of v. Panchayat: Thakre
5. Persons Interviewed: Siddi Raj Pandey
6. Area served and accessibility: On the Prithivi Highway
7. Type of system: 1

   1. Existing farmer group 2. Gov't. managed

   3. Gov't. Planned construction 4. Individual of family managed
8. Name of basin/sub basins: Mahesh Khola
9. Type of source: 2

   1. Seasonal 2. Perennial 3. Part seasonal
10. Nature of source: branch stream B. of Trisuli

    1. Spring 2. Spring fed gully 3. Small stream 4. Main stream
    Branch stream of:
11. Hydrological data of source at point of abstraction

    Max: 117334 LPS Min:310 LPS Flow measured at (on): 758/07.03.46 LPS
12. Point of Abstraction (with local place name, ward No. etc).

    Dharke, 9/Thakre
13. Length and capacity of canal: 1100/30 Meters and LPS respectively.
14. Type of canal with main features:

    Simple unlined canal
15. Type of head work or diversion structure:

    Dry stone masonry
16. Land area served: 100 Ropani
17. What are the main irrigated cropped areas, crops and cropping season?

1. Summer	Rice/Maize	0
2. Winter	Wheat	0
3. Other		0

18. When was system built and who first built it: Traditional
19. Any external assistance utilized for building/improving, when and how much? No
20. Number of households having land in command area: 16 HH

    Smallest holding: 1 Ropani Largest Holding: 15 Ropani
21. a) When/how often is the system repaired and maintained:

    Every year by farmer
22. Can the system be enlarged/extended to increase capacity and how? Yes
23. What is the farmers need? Irrigation or other inputs:

    To construct a permanent intake structure
24. Comment on farmer's enthusiasm and willingness to raise local resources and utilize grant/loan received to increase/enlarge capacity: Y
25. What are the limitation? 3 1) Water source 2) Money 3) Land
26. Is there enough area (Yes/No)?: N
27. Is there enough water (if not, in which month)?: Yes
28. Who are the key persons/farmers of the system names and address:

    Kedar Pd. Pandit Organization structure: Informal
29. Effectiveness of organization (effective, ineffective): E
30. Consultant's comments and suggestion and recommendation as to whether the system has potential for further investigation and by whom

    (Recommended, not recommended): R by ADBN
31. Any other remarks/information: It serves a water mill of Mr. Kedar Pd. Pandit. He wants to enlarge its capacity by construction of a permanent side intake and increase the power of the mill and more area will be irrigated.

Source: Silt Consultants (P.) Ltd. 1990.