INTEGRATED SOIL AND WATER IMPROVEMENT PROJECT, EGYPT: SOIL IMPROVEMENT PROGRAM*

by

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Abstract. The Canadian International Development Agency in co-operation with the Government of Egypt is conducting a five-year multi-million dollar land improvement project on 30,000 ha on the Nile Delta. Soils throughout most of the project area, and in a substantial portion of the Nile Delta, have high water tables and extensive salinity and sodicity problems; hence, the need for land reclamation on a large scale. To improve the soils this project is employing an integrated approach consisting of several key components: basic data collection, irrigation system improvements, drainage improvement, soil improvement, extension services, social development, training, and project management. This presentation concentrates on the soils and agricultural conditions and planned reclamation activities, emphasizing the need for integration among project components.

Additional Key Words: Nile Delta, Agricultural development.

Introduction

The Integrated Soil and Water Improvement Project (ISAWIP) is a major undertaking to improve agricultural lands and increase agricultural productivity in three Markaz (Dikirnis, Minyet El Nasr and El Manzala) of the Daqahliya Governorate in Egypt.

The Canadian International Development Agency and the Government of Egypt are jointly financing the planning and the implementation of the project. The Ministry of Irrigation, the Ministry of Agriculture and the Governorate of Daqahliya will share the responsibilities for the planning and implementation of the project. For an excellent description see the ISAWIP Project Outline by Shady (1987).

Planning for this project commenced in 1982; Phase I of ISAWIP - the Basic Data Collection began in 1984; and work on main activities of Phase II, the current project, started in mid-1987 and is scheduled to be completed by 1992.

The main goal of the project is: to increase the agricultural output of the project area so that it contributes significantly and economically to national food security and agricultural production objectives. This requires reversing the deterioration in soil conditions, improving water management and facilitating the adoption by farmers of improved agricultural practices that will enable them to benefit to the fullest from the improvements in physical conditions.

The main goal is further sub-divided into three sub-objectives:

a) To improve soil conditions for agriculture by installing sub-surface drainage and carrying out soil improvement measures including sub-soiling, gypsum application and precision land levelling.

b) To improve water management for irrigation by introducing a balanced system of on-farm water management and securing the water supply during the critical demand period.

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c) To improve the ability of the farm population, including women, to take full advantage of better soil and water conditions through strengthened institutional linkages and integration of all project activities.

The government of Egypt is ambitiously striving to overcome a growing food deficit caused by population growth exceeding production increases. Major efforts are underway to increase agricultural production through irrigation development, installation of subsurface drains, crop improvement, soil improvement and so forth. These improvements are controlled by various government agencies working largely independently. It follows that the improvements are seldom integrated at the farm level thereby making it impossible for farmers to take advantage of their synergistic effects on yields and potential for increased income. The strategy underlying this project, therefore, was to bring together the various agencies and to make necessary improvements to overcome constraints that limit productivity — in one place at one time. The baseline conditions, improvements, and responses would all be carefully monitored. The government agencies involved would directly participate and interact in the development, and experience the predicted very positive agricultural production responses. They could then enact similar integrated improvements in other areas, having the knowledge and confidence gained at ISAWIP as a driving force.

This paper focuses on the soils and agricultural aspects of the project and stresses the need for a much more integrated approach than has been occurring to date.

The Project Area

The ISAWIP area is in the eastern Nile delta about 150 km north of Cairo and 50 km from the Mediterranean Sea. It covers a total of 33,600 ha of which some 26,300 ha is cultivated intensively. Principal winter crops are wheat, barley, beans, clover, flax and vegetables. Summer crops include cotton, rice, corn, soybeans, vegetables and potatoes.

Topography is generally flat and grades from about 4 metres above sea level in the southwest to less than 1 metre above sea level in the northeast. The area is irrigated by gravity and presently drained by a surface drainage network.

Soils are predominantly clay textured vertisols formed on deltaic deposits. Salinity affects two-thirds of the lower delta soils and is spreading. Shallow water tables (<1 m) are extensive and groundwaters are characterized by high salinity (>20,000 ppm salts). Chemical and physical characteristics of soils at the ISAWIP drainage test plots are summarized in Tables 1 and 2, respectively. The range of chemical and physical properties is considered to be representative of a large part of the project area. Exceptions include sandy areas towards the northeastern end of the project area.

Table 1. Soil chemical properties at El Genina and at El Sirw (from Wahdan et al. 1987).

		El Genina		El Sirw	
Property	Depth cm	Mean	Range	Mean	Range
EC(dS/m)	0- 30	4.1	0.9-13.5	4.9	1.2-11.3
	30- 90	4.3	1.3-10.7	5.1	1.1-11.5
	90-150	4.8	1.3- 9.4	8.6	1.1-22.0
SAR	0- 30	8.4	1.0-21.2	9.1	2.8-24.1
	30- 90	15.3	5.7-77.7	13.3	2.6-23.3
	90-150	13.6	6.4-23.2	22.0	2.7-43.5
ESP	0- 30	38.3	28.7-47.3	14.2	6.1-35.7
	30- 90	41.5	27.9-49.4	22.8	9.8-36.5
	90-150	45.6	30.0-52.8	30.9	13.7-42.6

The soils are generally fine textured and well structured. Wide deep cracks develop as the soils dry forming huge soil columns 30 cm across. Topsoils are granular while subsoils are subangular blocky grading to angular blocky at depth, with slickensides also at depth. The planar surfaces retain their identity even after prolonged flooding with rice.

Table 2. Soil physical properties at El Genina and at El Sirw (from Wahdan et al. 1987).

Property	Depth cm	El Genina Mean	El Genina Range	El Sirw Mean	El Sirw Range
Cse sand%	0- 30	1.6	0.3- 1.4	0.9	0.1- 2.6
	30- 90	0.8	0.1- 1.9	0.4	0.1- 1.6
	90-150	0.7	0.2- 2.9	0.6	0.1- 1.3
Fine sand%	0- 30	24	13-32	26	10-41
	30- 90	22	12-39	23	9-35
	90-150	19	7-28	23	12-34
Silt%	0- 30	30	17-46	33	17-50
	30- 90	34	14-48	36	23-50
	90-150	33	19-48	32	19-45
Clay%	0- 30	44	38-53	39	26-51
	30- 90	43	40-45	40	31-56
	90-150	45	38-52	44	31-61
PAW* Vol%	0- 30	25	20-31	21	17-23
	30- 90	25	19-31	22	20-26
	90-150	26	18-29	22	19-26
db* Mg/m3	0- 30	1.20	1.12-1.40	1.05	1.02-1.18
	30- 90	1.26	1.12-1.34	1.15	1.12-1.22
	90-150	1.32	1.21-1.44	1.23	1.18-1.26
DPV*%	0- 30	17	11-21	16	12-21
	30- 90	15	13-20	14	9-20
	90-150	15	11-22	15	11-18
Ks* m/d	0- 30	0.1	0.0- 0.3	0.5	0.0- 0.9

* - Plant available water (30 - 1500 kPa suction)
- Soil bulk density
- Drainable pore volume
- Saturated hydraulic conductivity

Project Components

The project consists of an integrated package of eight work components all directed towards the achievement of the project objectives. The components and estimated budgets for each are outlined in Table 3. The key elements of each component are outlined in Figure 1, the Work Breakdown Structure. To date, the proposed workplan has been revised and rewritten three times largely to reflect changing needs and schedules and the Agricultural Extension Component has been externally reviewed, in recognition of the need to expand the program. While there have been several delays in meeting targets set-out in the initial workplans, there have been many successes thus far, in terms of specialists within each component working towards their specific objectives within their respective disciplines. For example, the drainage pipe plant is built; a major purchase of computing equipment was made, operators trained and the system is operational and busy; lab equipment is being purchased to up-grade the laboratory for soil and water analysis; a number of extension or demonstration plots have been established; and so forth. Much effort has gone into collecting and analyzing data pertaining to drainage design, to improving irrigation works, to soil improvement, and to developing an agricultural extension centre, etc. There have been major questions raised and resolved, although not necessarily to everyone's satisfaction. Examples include: selection of conventional rather than modified drainage design (the latter consisting of shut-off values on drain pipe outlets to permit control of drain discharge); is there a need for subsoiling; and what are suitable criteria for gypsum application. However, integration is woefully lacking yet it remains vital to meeting the project goal of increasing agricultural productivity.

Table 3. Project components and estimated budgets.

Component	Can $ Millions	Egypt L.E. Millions
	(rounded figures)	
1. Basic data and investigations	2.1	1.3
2. Irrigation system improvement	2.1	4.5
3. Drainage improvement program	33.9	8.5
This includes:		
(Subsurface drain installation)	(20.1)	(0.8)
(Tubing plant)	(7.1)	(2.3)
4. Soil improvement	2.4	5.2
5. Agricultural extension services program	4.9	4.4
6. Social development	1.6	1.5
7. Training	1.5	0.4
8. Project management	1.7	1.5
Project Total	50.2	27.3

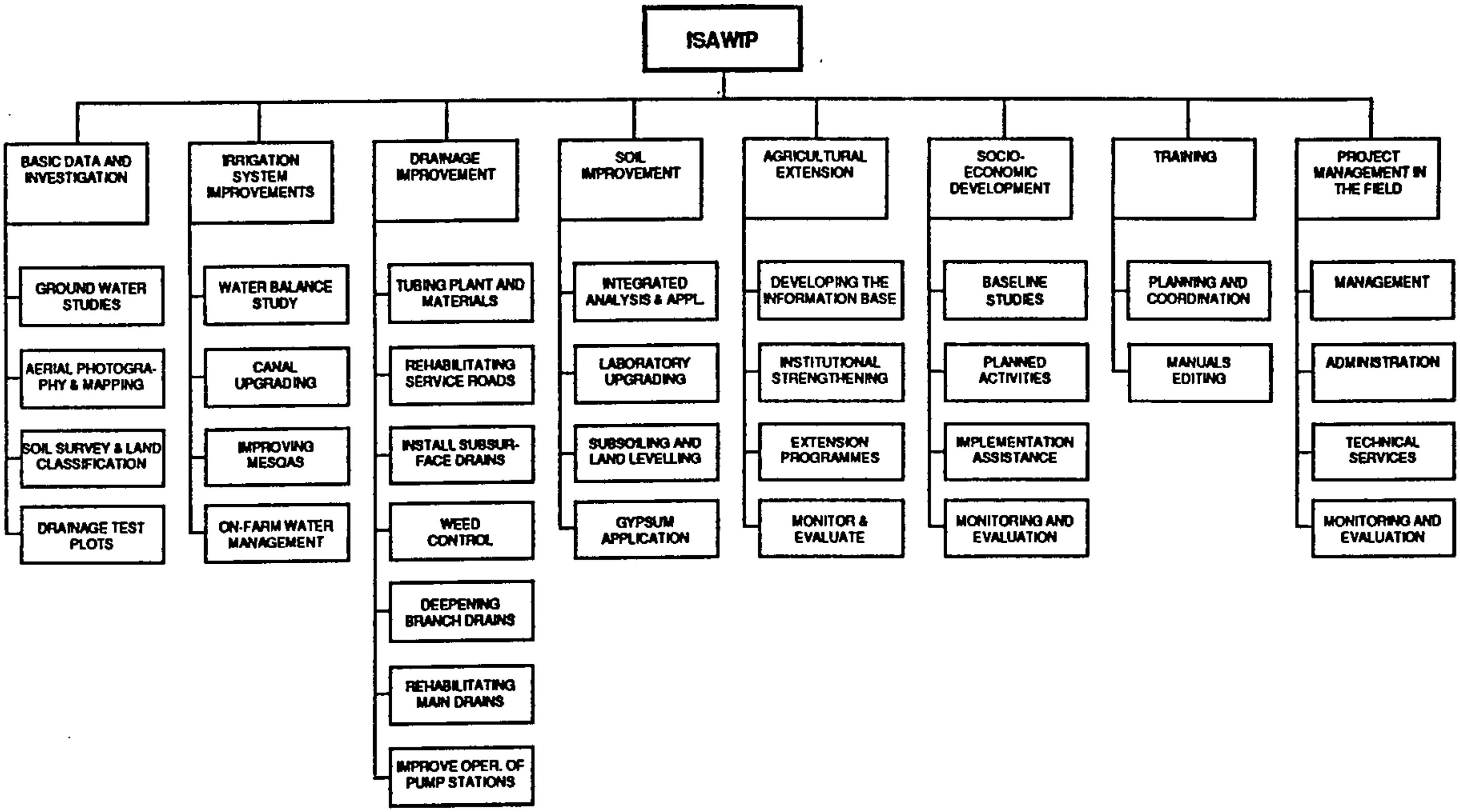

Figure 1. Work breakdown structure.

The project is being implemented by the Canadian Executing Agency which includes Canadian and Egyptian specialists working on a consulting basis, and Government of Egypt personnel working in their regular positions but concentrating on the project area. Consulting time allocated to each discipline is summarized in Table 4. Most of the manpower is professional and the majority of the time allocated is to be spent in Egypt.

Table 4. Executing agency manpower allocation.

	Canada		Egypt	
Discipline	Initial Terms of Reference	Contract Terms	Initial Terms of Reference	Contract Terms
	person months			
Irrigation	102	92	192	135
Drainage	156	152	252	161
Soil Improvement	54	26*	60	62
Agricultural Extension	54	43*	60	66
Training	24	26	45	18
Other				
Short Term Advisors	17	included above	109	included above
Technical Support	30	22	1042	820
Procurement	18	13	132	150
Management & Admin.	91	87	60	98
TOTAL	600	477	2000	1558

* Deficiencies in these areas now recognized and extensions are under consideration.

The Integrated Approach

The initial project design and schedule provided an excellent basis for integration. Some examples of integrated activities that were or should have been done are briefly discussed next.

Basic Data Collection: The soil survey of the Phase I ISAWIP program was to provide the physical land inventory needed for planning drainage, subsoiling and gypsum application, and as a basis for agricultural extension. But, the final maps and report have not been completed to date and preliminary draft information was not made available to the project for almost one year after project start-up. In the meantime, it was necessary, for drainage design purposes, to conduct an auger hole permeability survey of the entire project area. Clearly this resulted in considerable duplication of effort. Furthermore, it cancelled an opportunity for integration between the soils and drainage components. This would not be too serious except that there are places where the findings of the preliminary soil survey maps do not match the findings of the permeability survey. One map shows deep clays while the other indicates presence of sand lenses below the surface. Why do they differ? Is it a problem of mapping intensity, or if one is incorrect how can the problem be corrected and avoided next time? These questions should be addressed. On one hand, it is not fruitful for one component to find fault with another and in an effort to encourage co-operation it is best to downplay such differences. But what happens two years later when drains are installed based on findings of one map and recommended water management for reclamation is based on another?

As a second example, early in the study it was recognized that three different agencies each produced their own maps showing cropping patterns and all were slightly and understandably different. Drainage, irrigation and agriculture each require these maps for their planning needs. The project chose to use one mapping base. This was a small but very positive first step towards integration. The second step should have been to follow through and ensure everyone involved understood why the maps differed, what the implications were to the respective agencies and what steps could be taken to improve, as necessary, mapping accuracy and efficiency in the future.

Drainage: Drainage test plots at El Genina and El Sirw were established as part of ISAWIP Phase I to test different drain depths and spacings prior to drainage design for ISAWIP Phase II.

Drains were installed, baseline soil and salinity surveys were conducted and plans were prepared for monitoring. Some five years later, it is evident that full scale monitoring did not continue. Drain discharge and water quality data were collected but irrigation inputs were never monitored. Crop yields were monitored only occasionally but other agronomic inputs such as seed quality, fertilization practice, etc. were not. Recent salinity surveys indicate that highly saline areas remain, that some drains are not functioning, that water levels at drainage outlets were often submerged, and that conclusions about optimum drain depth and spacing could not be reached. To date these test plots have been a failure in drainage. An attempt to resurrect these plots in an integrated manner in 1988 also failed. If time is taken to examine and understand why these failed so that similar problems do not arise in the large scale project then this investment might be justified. Is it safe to assume that everyone involved will do their utmost to avoid similar problems on the large scale that Phase II is implementing?

Soil Improvement: Is subsoiling or gypsum needed? Some studies in Egypt have shown a positive response to each, others have not. Soil bulk densities as indicated in Table 2 are considered normal and subsoiling to reduce compaction would not be recommended on that basis. Why the response to subsoiling elsewhere? Is it due to better drainage, better aeration, better moisture penetration, better moisture storage, different soil conditions, increases in other agronomic inputs (manure or fertilizer) due to expected improved soil conditions, or to some combination of these? The ISAWIP plan was to establish a series of test plots on different soils and under different crops to monitor the response to subsoiling and to gypsum with and without subsurface drainage. Included in the monitoring would be agronomic inputs; irrigation amounts and timing; groundwater levels; soil salinity; crop performance and yields; and soil physical conditions. While current plans are to proceed with subsoiling and gypsum application on a widespread basis using interim guidelines, the results from these test plots would enable preparation of specifications for future use. Establishment of these test plots provides an opportunity especially for the soils, agronomy and extension specialists to work together, and there is to be interaction with irrigation and drainage specialists also. Much of the field work is to be done by extension agents and as such provides an excellent opportunity for training.

Agricultural extension: Perhaps more than any other component agriculture depends on integrated technical input and in turn forwards integrated output. Extension officers need sound technical recommendations to pass on to farmers. These cover many aspects of farming including water management, soil fertility maintenance, cropping practices, credit, livestock, etc. Farming activities encompass all project components — farmers are integrators and to help increase productivity they need good "integrated" information. To reclaim saline soils and to realize the benefits of drainage, farmers need good water management advice and they must implement it; hopefully they will be motivated to do so. Drains without accompanying proper water management are of questionable value; over irrigation can lead to excessive leaching and soil degradation while under irrigating will not remove salts that reduce yields. In both scenarios precious water is not efficiently utilized, yields are not optimized and net returns are not maximized. To capitalize on the synergistic effects of improved soils and better agronomic practices (i.e. irrigation, fertilization, seeding, proper tillage, weed control), the farmers need good advice on water, soil and crop management.

To accomplish the main goal of increasing agricultural production it is our professional responsibility to ensure that the team of Canadian and Egyptian consultants along with the many Government personnel provides the full package — water management, soil and crop husbandry, farm management and so forth. A skilled and highly motivated team of extension officers is needed to market this information. Farmers need to see the potential benefits to them to enhance adoption. Note that by world standards, Egyptian farmers produce yields well above average and there is great potential to do much better.

Why The Lack of Integration

To date there has been relatively little integration of activities among components. Some important reasons, in my opinion, include:

The reductions in manpower in the agricultural and social sectors between the proposal and the contract stage created an unbalanced team and sent out a clear signal: "This is a drainage project!" No doubt there are potential benefits to installing subsurface drains. Groundwaters are high and saline, soils are saline — drainage will help. But installation of drains, at best, contributes only partially to potential for increased yields.

Much baseline data that was to be provided by Phase I of ISAWIP was either late in arriving, inadequate or incomplete. This necessitated an immediate change in priorities such that data were to be gathered, interpreted, etc. with no immediate changes in budgets or responsibilities. Not surprisingly everyone in their respective components concentrated on their main activities. A case of first we get our work done then we'll have time to integrate. Once this direction is established it is very difficult to change course. For example, initial plans called for each component to have computer mapping facilities to prepare maps that could be integrated, etc. Due to the unforeseen need for gathering baseline data, to delays in purchase and arrival of equipment, training needs, etc. it followed that the computer equipment and operators would first do the drainage design work, then shift their attention to other areas. Again, an excellent opportunity for integration lost. Another message— "the first priority is subsurface drainage!"

There have been numerous start-up problems and delays that might be considered normal for projects of this scale. In addition there have been several changes in key personnel. This contributed to delays in scheduling and changes in work plans which put more pressure on specialists and again they focused on their components, with integration being set aside. At this point there has been virtually no Canadian manpower input in the social and economics areas; agriculture is behind schedule; and the irrigation specialists will be soon completing their assignments and leaving. There is little opportunity left for integration unless there is a major funding increase or re-allocation accompanied by a serious effort at integration. Whether this might best be accomplished under the present or under a separate contract should be carefully evaluated.

Integration has not been a high priority. It has been discussed many times and its importance recognized but there has been little progress in implementation. The inability to resurrect the drainage test plots is a good example. Much effort went into preparing a new work plan that, if implemented, would provide key information essential to the agricultural, drainage, irrigation, soils and socio-economic components. It could have been a focal point for starting true integration.

The inability to integrate appears to be primarily a problem of "control". This is by no means unique to Egypt; rather, it seems to be a universal quality of bureaucracies. It seems that any one specialized agency is ready and willing to conduct studies, allocate resources, and attain success in its field, provided it is in "control". Also there is a willingness to participate in other fields provided required inputs are minimal. However it seems impossible to obtain major but more-or-less equal inputs towards an integrated "project" from say four or five agencies. It is not surprising then, that at ISAWIP where a major portion of the funding is allocated to subsurface drainage that drainage takes "control". Now the need for much more effort in agricultural extension is gaining acceptance. More funding is needed to establish a proposed Agricultural Communication Centre. However, with a limit on funding the debate is on as to whether money is allocated to the "drainage" budget or the "agricultural extension" budget. This does not bode well for integration. Whichever group is successful it will no doubt, follow through with satisfactory implementation of its "project". So what is wrong with that? The returns to investments, or yield responses to inputs will not be as great as if an integrated approach is used. This becomes even more pronounced as higher value and more productive food crops (e.g. vegetables) replace conventional crops (rice, wheat, etc.).

Recommendations

This project represents a major Canadian undertaking in Egypt. We take pride in the project's successes and good rapport we have been enjoying with our Egyptian colleagues. We have experienced some difficulties, made mistakes and neglected certain critical areas and hopefully we have learned and will improve as a result. The following points indicate areas that I believe need to be carefully examined. While this project in Egypt has been the focal point, these recommendations are intended for agricultural development elsewhere too.

A definite commitment to integration should be specified in contracts, both between countries and with executing agencies. Resources (especially money and time) should be specifically allocated to integration, for example, 20 to 30% of professional time is chargeable only to integrated activities— workshops, field projects, etc. Performance evaluations should note the integrative efforts.

The executing agencies of agricultural development projects should be required to have senior management input by Professional Agrologists. Professional Engineers, who are often in charge of such projects, do a great job on engineering aspects of the projects but they are not so successful in the agricultural areas. Senior management input from both professions would improve the balance of power and certainly increase the chances of successful integration. In this context, if Canada is serious about providing foreign aid in agriculture, we must privatize agricultural research and extension so that we could greatly increase our expertise in this area. We could reap the resultant benefits internationally and domestically. Agrologists can contribute substantially more to increasing agricultural production and also to global environmental reclamation by going beyond the bureaucratic and academic domains, into the business world. The accomplishments in land reclamation by industry as expressed in other papers at this conference clearly demonstrate this potential.

Time frames for agricultural development studies should be redefined and perhaps phases for various activities should be reconsidered. Two to five year studies are appropriate for physical or mechanical works but when human resources become an integral part of the project it is likely that more time is needed to establish contacts, develop trust, understand the subtle cultural differences and the implications to development, and so forth. Rather than trying to follow predetermined schedules work should be advanced in stages, a second phase commencing after the first is completed. There must be better documentation of baseline conditions and monitoring of performance in order to evaluate and quantify responses. For example in ISAWIP Phase II, it was estimated at the outset that the benefit/cost ratio to drainage was about 3 to 1 and to agricultural extension it was about 3.8 to 1. The cost of drainage was around $25M while the cost of agricultural extension was $5M. These benefits to improved agricultural extension are obtainable without drainage, so why not have a good extension service in place first then when drainage is installed, the synergistic effects of both could bring greater and quicker returns to the high cost investment in drainage? If drainage is installed first, and the agricultural extension is not immediately effective, then chances of successful land reclamation are reduced, indeed expected benefits to drainage may never be realized. Perhaps this is a matter of visibility. Politically and in the short term the impact of large construction equipment plowing through farm fields is certainly greater than the nudgings of extension officers, and silent adoptions of better practices by farmers. The latter though, is the key to meeting the objective of increasing agricultural production in the longer term. The ISAWIP Phase II work plan is designed to gather information to allow a quantitative evaluation of responses to various inputs, separately and together. While there have been difficulties in establishing integration in some critical areas thus far, there is still time and resources to fill these gaps and to gather the data needed to make such evaluations. Is there the will to do this? Having such information on a project basis would obviously be extremely valuable for planning, implementing and optimizing returns on future investments.

Conclusion

This project is nearly half-way through. Clearly there have been important and major accomplishments, even though they have been within disciplines — a credit to all those involved. However, there has been insufficient integration and the consequences are yet to be measured. Perhaps this is best summed up by the following quotation:

> "There might be a seed but of what
> purpose to our tomorrows and our yester-
> years to not know of the flower within."
>
> Author Unknown

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