TECHNOLOGICAL MODERNIZATION IN IRRIGATED AGRICULTURE: FACTORS FOR SUSTAINABILITY IN DEVELOPING COUNTRIES

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ABSTRACT

Technology has much to offer to irrigated agriculture in developing countries. Many technological advances have been introduced into practice in these countries. National governments have often played an important role in this process by investing in modern equipment needed by their irrigation districts. Computers, meteorological monitoring stations, and GIS, to mention just a few examples, are used in transferred irrigation districts ranging from large to small, in different climatological and hydrological settings, and by users of varying degrees of education. At first glance, all this would appear to signal success, particularly at the end of a project. In some countries, such as Chile and Mexico, modernization efforts have helped the agricultural sector become more competitive in the global market. However, in other countries, modernization efforts and investments have failed to achieve their goals of improving agricultural production at a competitive level. Thus, there have been considerable successes, but there have also been gaps in this transfer of technology.

This paper examines this troubling situation from first-hand experience, and it looks at lessons learned from experience gained in introducing technology along with water users organization in developing countries. Factors that help ensure sustainability of technological modernization in irrigated agriculture in developing countries are discussed, and suggestions are given to make investments in this modernization process more effective in the long term.

INTRODUCTION

As the twenty-first century begins, technology is the buzzword; technology is what makes the world go ‘round. In business, implementation of new technology is often viewed as the way to make any enterprise more competitive. Similarly, technology transfer is often considered the answer to many problems in irrigated agriculture in developing countries. However, while many developing countries have made significant investments in irrigated agricultural technology, not all of these countries have experienced the same success. At the same time, with globalization and the lowering of trade barriers, the need has become urgent for

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developing countries to be ready to compete globally with their agricultural products (Yap-Salinas 2004).

In many developing countries, water users associations (WUAs) have become the heirs of irrigation system management. Because the irrigated agricultural sector contributes the largest percentage to a country's agricultural production in many of these countries, WUAs bear an increasing responsibility. Nevertheless, introducing technology to WUAs is a complex endeavor that is not always successful. How can WUAs in the irrigated agricultural sector become technologically savvy and use modern technology in an effective, sustainable way to become competitive in today's markets?

BUILDING COMPETITIVENESS IN WATER USERS ASSOCIATIONS

Ingredients in Successful Agricultural Enterprises

Some developing countries have become very competitive in international markets with their agricultural products, but others have been far less successful despite significant modernization efforts. A look at two common factors in the successful cases is warranted.

1. Private Sector Investment: In many countries where agricultural production has become successful in the global market, outside, or foreign, investment, with outside, or foreign, technological implementation, is responsible. Often, this investment takes place where there are good natural resources, good human resources, and security of property rights; and where a stable local economy and good governance provides security for the investor. Often this investment is by private investors; indeed, success tends to be more likely when investment is by the private sector than when investment is by the local government (USU 2001, Yap-Salinas 1994b). Thus a look at characteristics of the private sector may be helpful in determining how to help WUAs become successful and competitive.

2. Continuity: Another factor that often can be observed in these countries with successful agricultural competitiveness is a national government policy committed to success in the agricultural sector and supportive of private sector investment and exportation. This can even be seen in some parts of the irrigated agricultural sector in societies that do not always have a stable economy, because the government apparently recognizes that the success of a given agricultural enterprise benefits the country economically as a whole. Thus providing continuity, protection, and stability to WUAs may similarly help WUAs become successful and competitive (Yap-Salinas 1994b, USU 1997-2001).

Water Users Associations

These two observations in countries with successful agricultural exportation and global competitiveness can provide answers to making WUAs competitive. First of all, WUAs should be considered as analogous to private sectors. Into the collective enterprise of WUAs, water users invest of themselves through their own effort and time, as well as through their land and their financial resources; this last is accomplished by equitable water tariffs agreed upon through a collective, participatory process. Furthermore, if WUAs are organized well, they can act as legal cooperatives for water users in the marketplace, much as Ocean Spray does for cranberry producers in the U.S. To be effective, however, WUAs must incorporate some of the characteristics that make private sector investors effective, and they must have continuity, protection, and stability to flourish. Without these conditions, technological modernization programs will not have their maximum intended effect. Secondly, continuity and uninterrupted programs are essential for WUAs.

KEY STEPS IN PROMOTING EFFECTIVE TECHNOLOGICAL MODERNIZATION IN WUAS

At least six main steps are necessary to make technological modernization effective and sustainable in the irrigated agricultural subsector in developing countries. Once again, these efforts focus on strengthening WUAs so that they can absorb and use new technology effectively.

1. Develop Human Resources

The first key to making technological modernization effective in the irrigated agricultural subsector of developing countries is to develop the human resources of WUAs. Technology cannot just be "dumped" on water users. Water users must be prepared to receive it. Again, the characteristics that contribute to the success of private sector in business provide guidelines. Some such characteristics include:

- order and discipline
- entrepreneurial capabilities and experience
- decision-making capabilities
- responsibility
- financial resources

In lessons learned in transfer projects with WUA formation and building, the International Irrigation Center of Utah State University (IIC/USU) has found that institutional innovation provides the "red carpet" for technological modernization (USU 2001, Yap-Salinas 2003b). In other words, developing the managerial and entrepreneurial abilities of water users and providing training in representative self-governance and decision-making have been key

in making water users and their associations strong and sustainable. In USU projects it has been observed that as water users gain confidence in the representation and fair management of their WUAs, their commitment to the growth and strength of their WUAs grows, and they are more interested in learning new technologies that can save water and produce more agricultural yield (Yap-Salinas 1994b, USU 2001).

Thus, it is necessary to build strong WUAs with equitable, participatory self-governance in order for technological modernization to be effective and sustainable. In fact, USU's eight-year On-Farm Water Management Project (PROMAF) in the Dominican Republic, concluded in 1993, produced strong WUAs open to technological modernization (Yap-Salinas 1994a); these served as models for irrigation system management transfer throughout the country. Later, because of their orderly participatory self-governance, their understanding of their community water needs, and earlier experiences with technology in PROMAF, these WUAs were able to absorb more advanced technology such as GIS mapping and computer scheduling in follow-up projects.[2] This shows the clear advantages of training WUAs in self-governance and management and of using a stepwise approach to technological modernization. Similarly, projects and training in the Dominican Republic, El Salvador, and Ecuador have focused on building water user capabilities in managing their own WUAs effectively as part of the prerequisite for sustainable modernization (Yap-Salinas 1996, 2003a, 2003b).

However, one size does not fit all. In developing the skills and capabilities of water users, the characteristics and culture of water users in each individual WUA must be respected and considered. In any given developing country there exists a great range of water users: some educated, some with minimal education, some illiterate; some already with extensive entrepreneurial experience, others with minimal or none; some with experience in irrigation, others with little or none; some with traditional indigenous agricultural and societal customs, others with more national customs; and some with already functioning, representative WUAs, others just beginning. The amount and type of training in the various areas of institutional innovation and managerial skills accordingly varies with the characteristics of water users in each WUA. The IIC's Technical Assistance Project in Ecuador involved seven different WUAs in different geographical and climatological regions, with the whole continuum of capabilities represented. Nevertheless, effective WUAs were built in each of these (USU 2001).

[2] PROMASIR and PROMATREC, USU follow-up projects to the USU On-Farm Water Management Project, have been operating in the Dominican Republic since 2001.

2. Make Technology Functional, Friendly, and Affordable

Any introduction of change, including technology, must take into account the receiver. Just as in training in institutional innovation and technical skills, the characteristics and culture of water users in each WUA must be respected and taken into account when introducing technology. Water users who have higher education, entrepreneurial experience, and financial resources are more mentally and financially receptive to technological modernization. In contrast, water users who have limited educational and entrepreneurial background and financial resources require a more stepwise approach. New technology must be demonstrated to provide real advantages, and it must be introduced in a simpler, more "friendly," way.

An example of this took place in the introduction of greenhouses in the Andean WUAs. One WUA already used sophisticated greenhouses in rose production. At a higher elevation, in WUAs with limited educational and financial resources, simple rustic greenhouses of eucalyptus poles and inexpensive plastic covers were built and produced a dramatic increase in agricultural production, including production of tomatoes, which normally could not be grown there. The success won over many water users, as well as non-project farmers in the area, and rustic greenhouses started sprouting all over. As production and income increased, water users were able to upgrade the technology of their greenhouses, switching from surface irrigation to pressurized systems and improving their crop production techniques, thus increasing their use of technology in a stepwise, affordable way (USU 1997-2001).

The age of water users is also an important consideration. Many water users in developing countries are older because of the difficulty of rural, agricultural life; their children often leave the countryside for the cities. Thus introduction of technology must be more gradual and demonstrative, taking into account the fact that older farmers are often more inflexible and "set in their ways."

3. Provide Continuity

Continuity is necessary in three areas. One form of continuity involves the water users themselves; a second involves the government; and a third involves government assistance projects and programs.. Continuity is essential to the life of WUAs, and to their technological modernization. Interrupting or cutting short the process to prepare WUAs to receive new technology is analogous to taking a cake out of the oven early; the results are not optimal.

Continuity in the WUAs: As already mentioned, there are fewer young people to be found among water users; many flee to the cities seeking a better

life; a few find it, but the growth of urban slums in many developing countries attests to the failure of many such dreams (Yap-Salinas 1996). Poverty, in turn, leads to social unrest, and the objective of keeping the farmer on the land is a valid one. Young people, furthermore, are often more open to technology and can provide new life to the WUAs. One solution is to provide programs that encourage young people to become involved in agriculture and in WUAs to provide continuity to the agricultural enterprise.

Continuity in Government: Continuity also means government commitment to the irrigation system management transfer process and to WUA formation and strengthening. This commitment, or political will, must be at the national level, and it must also be at the district level as well (Yap-Salinas 2003a). When the national government makes this a national policy, dictated from above, tolerating no obstruction from district level officials, WUAs receive government support and their progress can continue (Carrasco 2004). When officials at the national level are not committed and district officials do not cooperate for fear of change, progress is more halting and limited (USU 2001).

Thus political will is necessary at all levels of government, and a state commitment to WUAs is essential. While much easier said than done, demonstration of success and effectiveness of WUAs can often achieve national government commitment, as it did, with time, in the Dominican Republic with the IIC's On-Farm Water Management Project and follow-up IIC projects.[3]

If there is government commitment to continuity, with political will, red tape can be minimized for importation of technology; programs for technological modernization will be supported, and funding will sought.

Continuity in Projects and Programs: Providing continuity in projects and programs aimed at strengthening WUAs and implementing technological modernization is essential. This continuity can be interrupted by various events:

- change of governing party or group
- social unrest
- lag time between projects or programs
- politicization of WUA leadership

Change of governing party or group. Because in many developing countries, a change of political party as a result of an election or a coup often results in a change of administrative and technical personnel at all levels of governments, assuring continuity in government assistance projects and programs is often a serious problem (Yap-Salinas 1994b, USU 1997-2001). Following a "clean

[3] PROMASIR and PROMATREC, mentioned earlier.

sweep," new personnel, often political appointees, come in, and there is often a time lag of even months as these new personnel become acquainted with ongoing projects and programs. In addition, these new personnel frequently lack political will and interest, and the latter must be cultivated all over again; this situation results in further delay in progress in any program benefiting WUAs, including those supporting technological modernization.

A further problem of change of governing party in many developing countries is that, unlike the situation in developed nations, the new party in power often feels no obligation to continue projects and programs started by the previous administration. These projects and programs may simply be cut (Yap-Salinas 1994a, USU 2001).

Social unrest. Social unrest can also result in halts and serious delays in project progress. Roads may be blocked, and transit may be dangerous for technical personnel traveling to agricultural areas (USU 2001).

Lag time between projects or programs. Another problem in continuity occurs at the end of a project or program. Even if a project or program supporting WUA growth and technological modernization has not been slowed by the above factors, often its objective is just part of the progress needed to give optimal strength to the WUAs. There may be a follow-up project planned, but that project may not start for months or years later, or because of political or other problems, it may never start. Water users may have been given new technology and started to use it, but they may run into problems with it, or they may need more technology to support it as their WUAs grow, and the necessary project and government support may not be there.

In view of this latter problem, the IIC built, toward the end of its technical assistance project in Ecuador, a cadre of young engineers at the government district level that could serve as resource help to WUAs during a lag period between projects. However, this type of solution is not permanent; if the lag period is too long, elections and other factors that cause change of personnel can intervene to diminish the government help available to WUAs.

Politicization of WUA leadership. In addition to the above situations affecting project and program continuity, a further problem arises when political parties attempt to gain control of WUA leadership and divert WUA goals for political gain. We call this process politicization. This is most often a danger around election time, but can occur at any time; for example, populist parties often promise water users certain benefits if those parties win elections. Politicization is especially serious if it takes place at the start of WUA formation, but whenever it takes place, it can derail the whole concept of water users' self-governance through their WUAs (USU 2001). As WUAs

gain strength through national confederation of WUAs, they are even more vulnerable to attack by those who wish to use them as political instruments.

4. Provide Legal Protection and Stability

Once again, political will at all levels of government, and a state commitment to WUAs is essential. When water users have legal property rights, when WUAs have legal jurisdiction for action, and when water laws are modernized and effective, WUAs have legal protection and the stability necessary for growth, including technological growth. In contrast, when protection and stability are lacking, WUAs, just like the private sector, hesitate to invest in technological modernization.

5. Provide Market Stability and Increased Financial Resources

As in the private sector, financial resources and financial stability are necessary for WUAs to be able to invest in technological modernization. "Closed" market systems, i.e., where markets are assured for agricultural production, reduce farmer risk and assure farmer income. Accordingly, marketing assistance should be provided in programs to WUAs as a complement to increasing agricultural production. In addition, WUAs need to be motivated to plan for the future in generating aggregated value; this helps provide sustainability, particularly in monocrop areas.

6. Provide Opportunities for Professional Continuing Education

In many developing countries, irrigation engineers and other irrigation professionals receive no continuing training past their university graduation. There are very few conferences or journals that are available or affordable in-country, and most do not have the means to travel abroad or subscribe to foreign journals. Thus, for lack of "refreshing" by continuing education, their concepts and understanding essentially "fossilize" at graduation. They are often unaware of new technology and may be afraid to use it. As a result, when a project or program is proposed or contracted for WUA technological modernization, there may be resistance or even fear of losing face. This resistance, in turn, can translate into a lack of political will and cause delays and obstruction of the technological modernization process of WUAs.

There is, therefore, a need to provide some means of "updating" professionals' technical knowledge so that they can be optimal resources for WUAs, guiding them in managing new technology. Education for the professionals, particularly government personnel at district level, who work with WUAs should be incorporated as part of any WUA technological modernization program. National professional organizations should also be encouraged and assisted in providing continuing education programs.

CONCLUSION

Water users associations are quite analogous to the private sector in their required conditions for growth and stability. Growth means technological modernization in today's world in order to be competitive. Stability means sustainability, and it requires continuity. For developing countries that depend on agricultural exportation, strengthening WUAs in the irrigated agricultural subsector is necessary in the areas of self-governance and institutional innovation, which in turn enable effective technological modernization. However, technology must be introduced carefully, with respect, taking into account the unique characteristics of each WUA, and efforts need to be made to provide supporting external conditions, conditions outside the WUA, that promote the introduction and effective use of technology.

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