Management Arrangements for Diversifying the Inherently Rice-Crop-Based Irrigation Systems in the Philippines

National Committee on Crop Diversification (NCCD)
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INTRODUCTION

IN THE PHILIPPINES, attention to crop diversification in rice-crop-based cropping systems started in the seventies when researchers began to focus on developing appropriate technology and strategies for optimizing small farm productivity. A pilot multiple cropping project by the University of the Philippines at Los Banos (UPLB) in cooperation with the International Development Research Center (IDRC) studied the adoption and impact of some intensive cropping patterns. The project succeeded in introducing production technology for some vegetables and upland crops in rice-based and cam-based systems.

The Rainfed Agricultural Development Project (RADP) in Iloilo Province and, consequently, the "KABSAKA" (literally, "bounty in the farm") program were successful in promoting the International Rice Research Institute (IRRI)-developed technology for the production of two rice crops and an upland crop in the same area within a 12-month period. The foci were on crop intensification and crop diversification in both rain-fed and irrigated areas. Nevertheless, diversification was by then only in the form of a third crop, i.e., an upland or nonrice crop, in areas where the norm was a single rice crop a year. It was strongly felt that there was still much room for increasing small-farm productivity and profitability.

In the eighties, the establishment of the Regional Integrated Agricultural Research System (RIARS) in the Department of Agriculture (DA) led to the vigorous technology verification type of research activity in all provinces of the country. Banking on the previous success of the "KABSAKA." most, if not all, of the technologies (which were verified in

on-farm trials) aimed at crop intensification and diversification not only in the rain-fed rice-based environments but also in the partially irrigated and fully irrigated environments as well. At this point, it can be stated that there are already developed technologies on the production of nonrice crops as alternatives to or supplemental to rice for most of the regions of the country. However, adoption is not as widespread in irrigated rice systems compared to that in the upland or rain-fed systems.

Ricelands, particularly the irrigated lands, are an already intensively used production resource, but in the face of the increasing population problem and the limited, if not decreasing, land and water resources, optimized and sustainable utilization of these resources becomes necessary. Crop diversification, although nota new practice to some upland as well as lowland farmers, still has vast potential, especially in lowland irrigated areas.

Table 1. Status of irrigation development in the Philippines, 1989

Region	Potential irrigable area (ha)	Service ea (ha)				Irrigation develop ment (%)
		National irrigation systems	Communal irrigation systems	Pump irrigation systems	Total	
1	309,810	45,386	132,782	5,520	183,688	59.29
2	539,710		83,486	36,593	273,366	50.65
3	482,220	172,064	84,817	22,946	279,827	58.03
4	263.590	55,455	69,818	27,948	153,221	58.13
5	239,650	16,209	50,887	16,943	84,039	35.07
6	197,250	53,500	32,285	21,677	107,462	54.48
7	50.740		18,611	2,481	21,092	41.57
8	84,380	15,633	36,100	2,176	53,909	63.89
9	76,500	13,348	21,337	2,804	37,489	49.01
10	230,150	20,282	44,636	2,045	66,963	29.10
11	290,250	38,370	62,564	6,872	107,806	37.14
12	362,080	37,610	58,621	4,123	100,354	27.72
Total	3,126,330	621,144	695,944	152,128	1,469,216	46.99

Irrigated Rice-Based Farming Systems

In the country, 9.00 M ha are identified as arable land of which, 3.13 M ha are considered as a potential irrigable area. Of this potential irrigable area, an aggregate of 47 percent (1.47 M ha) is already provided with irrigation facilities (Table 1). Of this irrigation service area, 621,000 ha are served by the government-managed national irrigation systems (NIS), 696,000 ha are under the farmer-managed communal irrigation systems (CIS) and 152,000 ha are benefited by private pump irrigation systems (PIS). In the NIS, mean cropping

intensity is only about 134 percent per year, i.e., 74 percent during the wet season and 60 percent during the dry season (Table 2).

Table 2. Service and irrigated areas and irrigated cropping intensity in national irrigation systems in the Philip ies, 1979-89.

Year	Service area SA)(ha)	Irrieated area				Area irrigated annually	Irrigated cropping intensity (%)
		Wet ison		Dry season	With 3rd crop (% SA)		
		(ha)	(%SA)	(ha)			
1979	475,174	372,232	78.34	285,845	60.16	658,077	138.49
1980	472,182	374,349	79.28	293,472	62.15	667,821	141.43
1981	491,729	372,038	75.66	300,416	61.09	672,454	136.75
1982	514.334	390,342	75.89	320,463	62.31	710,805	138.20
1983	549,930	362,340	65.89	293,329	53.34	655,669	119.23
1984	548,345	416,824	76.01	290,851	53.04	701,675	129.06
1985	568,203	430,888	75.83	349,424	61.50	780,312	137.33
1986	595,902	438,237	73.54	381,914	64.09	820,151	137.63
1987	596,953	433,151	72.56	370,351	62.04	803,502	134.60
1988	614,164	445,287	72.50	342,786	55.81	788,073	128.32
1989	621,144	461.613	74.32	389.562	62.72	851.175	137.03
Average			74.53		59.84		134.37

Many existing irrigation systems in the country are beneficiaries of improvement from irrigation operation support projects. These projects are principally aimed at increasing cropping intensity in the existing irrigation service areas. In addition to these projects, diversified cropping systems (DCS) or the planting of nonrice crops during the dry season in rice-based irrigated areas are seen as corollary measures.

Driving Factors in Crop Diversification

Acting singly or severally, the following factors are identified as significantly influencing crop diversification (planting of nonrice crops) in the country:

1. Inadequate water supply during the dry season to fully support the production of the high-water-requiring traditional crop of rice.
2. Increasing demand for vegetables and other nonrice crops as a result of increasing population and the expanding needs of the animal production sector.

3. Inherent better suitability of nonrice crops than rice on certain soil types.
4. Higher profitability per unit area of nonrice crops as against the rice crop, especially when harvest time is at a particularly advantageous period.
5. Strong desire among farmers and irrigation personnel to maximize utilization of available land and water resources.
6. Occasional occurrence of windfall prices and attractive market situations for the produce from particularly on-demand kinds of nonrice crops.
7. Adeptness of some farmers on the technique of identifying and growing promising high-market-potential and high-profit-potential nonrice crops in rice fields.
8. Generation, verification, and piloting works on cropping intensification and crop diversification technology in a number of sites in the country.

The decision of farmers to raise nonrice crops, particularly in irrigated areas, remains highly motivating as a consequence of the above factors. It is also a result of encouragement given by government technicians. This is, ofcourse, with the exception of a few farms where a contract-growing scheme is established between a fanners' group and a sure market.

Extent of Crop Diversification

Actual hectarage planted Io nonrice crops in irrigation service areas is not yet "closely" monitored, except in the limited areas where irrigation service fees are settled by the farmers concerned and the "commercial plantation" areas (e.g., those located at the Lasang River Irrigation System in Davao del Norte Province and in the Siluay River Irrigation System in South Cotabato Province) having irrigation service contracts with NIA. Monitoring is hampered as the individual areas actually planted to nonrice crops are small and widely scattered.

The actual extent planted to nonrice crops in the NIS service areas is, however, estimated to be about 6,000 ha. Aggregate potential area suitable for nonrice crops cultivation based on land class types within the NIS service areas is estimated at 186,000 ha. This indicates that where water is adequate, farmers tend to raise rice rather than nonrice crops. Obviously, the bulk of the volume of produce from nonrice crops comes from outside the service areas of irrigation systems.

Agencies Involved in Crop Diversification

Theagencies which have been in the forefront ofcropdiversificationactivities in the country are the Philippine Council for Agriculture, Forestry, and Natural Resources Research and Development (PCARRD), DA, IRRI, various state colleges and universities (SCUs) like UPLB, Central Luzon State University (CLSU), Mariano Marcos State University (MMSU), Isabela State University (ISU), the Visayas State College of Agriculture (ViSCA), etc., International Irrigation Management Institute (IIMI), National Economic and Development Authority (NEDA) and NIA.

The Philippine Rice Research Institute (PhilRice), created in 1985, also implements a national research and development program on improving and sustaining rice and nonrice crop production and crop diversification in the country.

In essence, line government agencies, the state colleges and universities and locally based international institutions work together for the promotion of crop diversification.

Recently, the National Committee on Crop Diversification (NCCD), composed of 14 representatives from various concerned government and private institutions, was created. The committee is mandated to:

1. Coordinate the formulation, development and implementation of a comprehensive program on crop diversification in the country to include research, development, training and extension.
2. Facilitate the provision of necessary technical, financial and other support services for the implementation of such a program.
3. Formulate and recommend policies.
4. Serve as a link between the national program and other related programs within as well as outside of the country.

PLANNING FOR AND OPERATION OF THE SYSTEMS

Practices in the Rice-Based Systems

Planning for the cropping season

Three main plans are usually prepared for the operation and maintenance (O&M) of NIS. They include the composite cropping plan (CCP), annual activity network (AAN) and the system management plan (SMP). These plans are also developed for the CIS and the PIS with variations. Collectively, these plans indicate, among others, the following:

1. Target schedule for the execution of the various farming activities and irrigation stages.
2. Extent and location of the irrigation-programmed areas in a particular cropping season.
3. Value of design operation water duty at any given time within the irrigation period.
4. Schedule for the carrying out of the various O&M activities for the system.

These plans serve as guides for the systems' O&M personnel is the execution of their tasks during the irrigation season. They also guide the fanners and provide the necessary information to prepare their own farm plan and budget. Cropping calendars of most irrigation systcins reflect only the rice-rice pattern. Major reasons for this may include the following:

1. Most irrigation systems in the country were designed for rice alone.

2. The fields planted lo nonrice crops are usually outside the area programmed for irrigation in a particular cropping season, generally mixed with rice fields in small patches designed on farmers' initiative.
3. Production ofvegetables and other nonrice crops under irrigated conditions receives low priority in most of the irrigation system due, presumably, to lack of adequate skill and knowledge to handle it.

Assessing and matching water supply and demand

The CCP enforced in a particular irrigation system is also the plan used in determining how many hectares of the system are to bc prograinmed for irrigation service for every cropping season. This is done by dividing the projected available streamflow during the "land soaking stage," by the calculated net water duty (i.e., the estimated effective rainfall) of this stage. Well-designed cropping calendar and pattern, and a well-derivedwaterdutyvalueare known as important prerequisites to a water supply well-matched to demand.

Projected streamflows are taken from feasibility reports and from records of observations made during the period (5-7 years, usually) of project conslruction. Data collected in the course of system operation are also considered therein.

Severe irrigation water shortages occasionally occur. This is usually brought about by a combination of the following factors:

1. Lower-than-normal actual streamflow level in run-of-the-river systems, in particular, although reservoir-fed irrigation systems are equally adversely affected by it.
2. Lower-than-expected actual effective rainfall in service areas due to erratic climatic pattern.
3. Higher-than-programmed actual irrigation-served cropped area due to farmers taking the risk of planting rice even in areas which are unprogrammed for irrigation.
4. Higher-than-needed actual irrigation diversions in certain headgates partly due to farmers' desire to maintain a high water level ill their fields or to irrigate upper-lying cropped areas.

Allocation of water supply and land area

The area programmed for irrigation service is only about 82 percent of the perceived service area of the irrigation system. The programmed area is usually limited by the standing agricultural and land development status of the service area. Some areas are still to be developed from second growth forests (e.g., parts of the service area of the Andanan River Irrigation Systems in Bukidnon Province). During Ihe dry season. the area programmed for irrigation service is only about 65 percent due primarily to inadequate water supply, particularly of the direct diversion type.

The actual irrigated area for both seasons ranges from 83 to 93 percent of the programmed area and the actually benefited area (harvested with relatively good crop yields) is only 80

to 90 percent. During the wet season, there is a relatively adequate water supply from both irrigation and rainfall. At this time when the water supply is abundant, farmers usually prefer the planting of rice. They do not prefer nonrice crops because of their susceptibility to damage from likely inundation and waterlogging.

Coping with low water availability situations

When the water supply falls critically low and becomes inadequate to fully serve the standing rice crop, several measures are employed by irrigation officers to cushion the impact. Remedial measures employed under such an eventuality include:

1. Rotation of the irrigation water supply schedule by section of the main canals or long lateral canals, with the cooperation of the farmers.
2. Suspending or stopping irrigation water delivery to standing rice crops which are planted in areas unprogrammed for irrigation service.
3. Regulating actual water diversions at canal headgates and turnouts according to planned levels so as to avoid undue water deprivation in areas at the lower reaches of the systems.
4. Augmenting the system's water supply with water that is pumped (usually supplied directly to farms with standing crops) from creeks, rivers and/or wells.
5. Inducing rainfall through cloud seeding (done in coordination with concerned cloud-seeding agencies and still done in a limited scale due to inadequate number of aircraft).

Encouraging farmers to shift to cultivation of nonrice crops from rice crops is not yet aggressively done by irrigation staff. Lack of adequate skill and knowledge in the cultivation and irrigation of nonrice crops is still a serious limiting factor in this regard.

Changes in irrigation implementation strategies

There are still no major changes in NIA's planning, designing, and operating procedures that are focused at accommodating DCS but there are several policies and strategies directed toward this goal. The policy established five years ago to implement a reduced irrigation service fee (ISF) rate for nonrice crops, i.e., only 60 percent of the prevailing rate for rice, was envisioned to encourage farmers to diversify their farms. The response of the farmers lo this incentive is, however, rather sluggish. They continue to prefer cultivating rice crops in imgated areas even at comparatively higher ISF rates.

The "1990-2000 Corporate Plan of NIA," however, includes promoting accelerated crop diversification in irrigation service areas as one of its new thrusts. This is aimed at increasing cropping intensities through maximization of the use of the available land and water resources. The Diversified Crops Irrigation Engineering Project (DCIEP) implemented through the project-type technical assistance and grant-aid programs of the Japan International Cooperation Agency (JICA) is the first concrete move of NIA toward crop diversifica-

tion. The project is currently formulating planning and design criteria for project-type irrigated nonrice crop production farms. A training program to hasten the institutionalization of crop diversification in NIA is also being prepared.

Two medium-scale conventional irrigation projects of NIA (one each in the provinces of Cavite and Tarlac) have vegetable production as one of their components. The nearness of the service areas of these projects to urban centers in addition to suitable soil and climatic types comprise the main factors considered in this arrangement The production scheme selected in these projects focuses on individual household farm holdings (HF) and covers an aggregate potential area of 36,800 ha. Experiences in carrying out this project component will provide invaluable information in future undertakings on crop diversification.

On irrigated areas where lands and climate types are suitable for DCS, the farmers practice the following to accommodate nonrice crops:

1. They plant their wet-season rice crop early, e.g., usually within the first month of the irrigation season. This enables them to plant the succeeding nonrice crop also relatively early, to avail of the favorable soil moisture and relatively high prices for their produce. Early crops usually get into the "sellers' market" situation.
2. They allot the high lying rice fields of their farms for the cultivation of nonrice crops. These areas are difficult to irrigate due to their high elevation but are the ones least prone to waterlogging.
3. They supplement irrigation water through pumping from wells or creeks. This gives them a dependable source of irrigation water even if their farms are located in the lower reaches of the system.

A recent study of IRRI revealed the feasibility of growing a nonrice crop (corn) alongside lowland irrigated rice fields during the rainy season with good crop yields. The only field manipulation needed under this mixed cropping system is the establishment of 1-m deep narrow trenches along the border rows of the nonrice (corn) plot to check the incidental shallow water table. This scheme has a high potential for adoption by the farmers to accommodate nonrice crops.

STRATEGIES TO ADDRESS CONSTRAINTS/OPPORTUNITIES

Studies conducted in the country have identified a number of strategies that can be considered to effectively irrigate rice and nonrice crops under a mixed cropping system. These strategies are grouped into two categories: improvement of the irrigation facilities, and improved procedures and practices.

Improvement of Irrigation Facilities

Recommended works on this aspect are focused on effecting better water control and measurement as these are prerequisites in the implementation of an efficient water distribution plan. Construction of new irrigation systems and rehabilitation and/or improvement of existing ones are, of course, continuing to be carried out by NIA. Rehabilitation works are focused on the following:

1. Physical facilities of irrigation system: canals, structures and roads.
2. Farmer-irrigators' associations: formation, training, mobilization and participation.
3. Irrigation staff: training and experience exchange.
4. Irrigation office facilities: communication and office equipment, parcellary maps, and O&M manuals.
5. O&M equipment.
6. Watershed.

Standing criteria for these rehabilitation works are, however, not yet directed at accommodating the requirements of DCS referred to above but just to rebuild the older systems and make them more efficient and effective in meeting desired functionality. They, nonetheless, are supportive of the thrust to promote crop diversification in irrigation service areas as both water control capability and water supply availability render the irrigation effort more efficient.

Improvement in Procedures and Practices

Under this aspect, the following are the recommendations:

1. More detailed characterization of the agro-hydrological and physiographic properties of irrigation systems for use as inputs to computer-aided mapping, determination of the suitability of DCS and improved water allocation.
2. More accurate methods of predicting streamflows and rainfall to ensure more realistic irrigation delivery schedules by using the incomplete gamma distribution function (IGDF).
3. Expanded utilization of groundwater even in service areas of run-of-the-river system through drainage reuse dams and water pumps drawing water from creeks and wells.
4. Scheduling planting earlier than normal to avert crop damage due lo the usual late-dry-season scarcity of water supply and to make use of early-dry-season tail-end rains.
5. Mustering greater participation of farmers or fanners' organizations in the development of system operation and maintenance plans to ensure their better cooperation in the execution of such plans.

Location-specific research studies are being conducted in earnest to generate more data useful in the promotion of crop diversification in rice-crop-based irrigated areas and in the improvement of the O&M of irrigation systems to accommodate nonrice crop cultivation

therein. IIMI, out of its collaborative research projects, has already evolved a recommendatory set of innovative schemes on the operation of irrigation systems.

DIRECTION OF CROP DIVERSIFICATION

Research and Development

The Medium-Term (1987-92) Philippine Development Plan (MTPDP) stipulates crop diversification as a strategy for increasing farm productivity and encourages expanded research and development (R&D) activities thereon. Efforts in crop diversification should be intended to support the objectives of attaining food security and minimizing the country's dependence on traditional export commodities like sugar and coconut. For this reason, new and potentially viable agricultural crops based on comparative advantage should be promoted in all regions. The substitution of appropriate crops in areas where traditional crops are no longer economically viable should be initiated.

The development of production systems supportive of nontraditional crops, as well as of complementary processing activities for the conversion of primary commodities into high-value products (e.g., coffee, cacao, rubber, etc.) that are in demand both domestically and internationally or that have market development potentials, should be given priority.

A comprehensive review, in 1988, of past accomplishments on R&D showed that there was still a lack of information on crop diversification in relation to irrigation. This information deficiency rested on two issues: water management and socioeconomics for crop diversification. The following aspects were recommended for consideration under the area of water management:

1. Trials, in farmers' fields, of new and modified water application methods;
2. Case studies of small successful irrigation units or systems to determine their merits for promotion.
3. Generation of more data needed in system design, planning and operation.
4. Verification of doubtful information or data on irrigation system design, planning and operation.

Under the area of socioeconomics, the following were recommended for consideration:

1. Characterization of the various factors affecting crop diversification in different locations and field conditions.
2. Determination of the factors that encourage fanners to engage in crop diversification.
3. Comparison of financial returns of promising nonrice crops in a single location and across locations.
4. Investigation of the competition among different crops in a certain system for farm resources.

5. Identification of the support services necessary for crop diversification.
6. Assessment of the market potential of selected crops and characterization of existing ones.

The MTF'DP suggests that R&D activities in this sector should be concentrated on the development of low-cost and low-input technologies for food crops, the production of traditional and nontraditional export commodities, and the development of natural resources conservation and management systems. Current efforts in rain-fed and upland areas should be sustained and expanded.

Advanced technologies should be applied in diversifying agriculture and increasing soil-crop yield per unit of input. Biotechnology, nitrogen fixation. water conservation technologies, and multiple cropping offer distinct possibilities. Resources for R&D in these areas should be further augmented and mobilized.

Research institutions in the country are well aware of these needs and the expanded participation of the private sector in this regard, just like in the development of better varieties of diversified son-rice crops, labor-intensive-substitute farm implements, etc., should be encouraged. PCARRD should continue providing overall direction along these lines.

Information Dissemination and Exchange

The NCCD, as one of its responsibilities, is obligated to provide direction and initiate the exchange of information on crop diversification among the various institutions involved using the following fora and media: symposia, workshops, seminars, and printed material.

Individual agency-initiated efforts to effect information exchange should, of course, be encouraged and pushed through. Development, printing, and dissemination of newsletters, pamphlets and booklets on the various aspects of crop diversification should also be aggressively undertaken.

The NCCD should likewise maintain, through IIMI, close linkage and all-out participation in the activities of the Regional Research Network on Irrigation Management for Rice-Based Farming Systems. Attainment of this strategy will, of course, depend on the operationalization of corresponding thrust on the part of the Network.

Funding

Much financial resources are channeled by government agencies to research, development and promotional activities on crop diversification. Pertinent multidisciplinary programs should be formulated by the NCCD and offered for funding by the government and from traditional sponsoring agencies for implementation. Currently, foreign institutions like JICA and the United States Agency for International Development (USAID) provide some financial assistance for projects on crop diversification in the country.

SUMMARY

1. Inadequate water supply during the dry season is identified as one factor, among seven others, which tends to push diversified cropping systems (DCS) in the country.
2. In the National Irrigation Systems (NIS), only 1 percent of the irrigated area is presently devoted to diversified cropping out of an estimated potential of about 30 percent.
3. The Department of Agriculture (DA) together with at least 11 more institutions is involved in the promotion of crop diversification in the country.
4. In the irrigation systems of the country, except those with vegetable production components, nonrice crops are still not considered in the planning of operations.
5. Programmed area for irrigation during the dry season is traditionally based on predicted streamflows as against calculated net operation water duty.
6. Irrigation water shortages are believed lo be rooted in erratic predictions of streamflows and rainfall, and caused by unscrupulous farming practices like planting in unprogrammed areas and excessive water diversions.
7. Programmed area for irrigation in NIS is only 82 and 65 percent during the wet and dry season, respectively, due to inadequate water supply, development status of the area and other factors.
8. Encouraging farmers to shift from rice to irrigated noiuice crop cultivation to help alleviate recurring watcr shortages is not yet extensively done due to know-how deficiency.
9. Formulation of technical criteria for project-type nonrice crop production farms in irrigation service areas is one of NIA's roles in tbe promotion of crop diversification in the country.
10. Suggested research studies on water management for crop diversification deal with the generation and verification of more data on the planning, design and operation of irrigation systems.
11. On the aspect of socioeconomics, recommended research direction addresses the characterization of the various factors that tend to hinder or promote crop diversification.
12. Crop diversification is recognized by the national government as a strategy in enhancing farm productivity. and research and development (R&D) works thereon are promoted.
13. In addition to pursuing current thrusts and schemes, expanded participation of the private sector in R&D on crop diversification should also be explored and tapped.
14. Exchange of inforination on crop diversification should he, as usual, vigorously pursued and related multidisciplinary projects should be evolved and undertaken.

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