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1997 ESTIMATES OF ENVIRONMENTAL DAMAGES IN IRRIGATION SYSTEMS[1]

Department of Environment and Natural Resources

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1997 ESTIMATES OF ENVIRONMENTAL DAMAGES IN IRRIGATION SYSTEMS[1]

ENRAP IV TECHNICAL PAPER

by

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1. Introduction

Water pollution and sedimentation affect irrigation systems, agricultural production, and aquatic life, among others. Water pollution can result from surface runoff with loads of agricultural and industrial pollutants, and also from mine tailings. Previous studies have documented the impacts of sedimentation on irrigation canals and river systems, and the ensuing decline in agricultural production, particularly in rice production (Santos et al, 1985; Ebarvia, 1994; and Buenaventura, 1995).

Santos, et al (1985) conducted a survey of national irrigation systems (NIS) and communal irrigation systems (CIS) covering both the wet and dry seasons in the different regions of the country. Their results showed that in both the national and communal irrigation systems, affected areas were larger during the wet season. Table 1 shows the affected irrigated areas in NIS and CIS for both seasons by source of pollution. Soil erosion and sedimentation were the primary sources of pollution during the wet season with an affected area of 14,191 hectares (or 49.4 percent). During the dry season, mine tailings and salt intrusion were the primary pollution sources for the NIS and the CIS, respectively.

The Santos study also revealed that mine tailings, soil erosion and sedimentation affected as much as 47 percent of the length of the irrigation canal (1,827 kilometers) for NIS and 37 percent (122.3 kilometers) for CIS. These sources were noted to create problems with the implementation of proper crop and water management; reducing canal discharge capacity and benefited area, and eventually causing a decrease in the irrigation service fee collection every cropping season.

Table 1. Affected Irrigated Areas in National and Communal Irrigation Systems during the Wet and Dry Seasons by Source of Pollution, in hectares

SOURCES OF POLLUTION	NATIONAL IRRIGATION SYSTEMS (has)		COMMUNAL IRRIGATION SYSTEMS (has)	
	Wet Season	Dry Season	Wet Season	Dry Season
Mine Tailings	9,600	8,738	487	398
Soil Erosion & Sedimentation	14,191	6,549	323	226
Piggery	709	627	492	320
Chemical Plants or Distilleries	607	395	58	58
Food Manufacturing or Processing Plants	1,465	1,465	214	194
Salt Intrusion	270	460	699	718
Schistosomiasis	1,880	1,229	97	97
TOTAL AREA	**28,722**	**19,463**	**2,370**	**2,011**

Ebarvia (1994) and Buenaventura et al (1995) estimated off-site damages of water pollution which included damage to coral reefs and marine fisheries, fisheries (municipal and commercial), reservoirs, inland fisheries, irrigation systems and agricultural production. Study results showed that in 1988, the estimated cost of damage amounted to PhP425.1 million for both the national and communal irrigation systems (CIS). They estimated the impact of water pollution on irrigation systems using the following formula:

$$I_d = A \times Q_p \times P_p$$

where:

I_d = value of damage to irrigation system
A = irrigated area not served due to pollution of national and communal irrigation systems
Q_p = average palay production per hectare
P_p = average value of palay; total value/total volume of palay production

The assumptions and data used in deriving the damage estimates were as follows:

1. The affected irrigated area by water pollution in NIS and CIS is 47,116 hectares. (Santos, et al,1985)
2. 1988 figure for average palay production per hectare was 2.64 mt/ha. (1993 Philippine Statistical Yearbook)
3. Price per ton of palay was P3,412.00 (1990 Philippine Statistical Yearbook)

The purpose of this study is to re-estimate the environmental damage caused by sedimentation to irrigation systems for the year 1997.

2. Methodology

One method of estimating environmental damages is to derive the foregone palay production given the foregone yield and gross value added. Data from the National Irrigation Administration (NIA), Bureau of Agricultural Statistics (BAS), and the National Statistical Coordination Board (NSCB) were used to derive the foregone palay production for both the wet and the dry season. The following formula was used:

$$D = F \times GVA \text{ per production}$$

where:

(a) D = damage to irrigation system; value of foregone palay production

(b) F = foregone yield; yield per hectare in area not served

(c) GVA per production = Gross Value Added of the palay sector per production (GVA/Total Palay Production)

(d) The design service area of 1997 is based on 1999 data; the design service area is the unit area intended to be irrigated by the system.

(e) The 1999 figures for actual area served are used; the actual area served is the area actually irrigated by the system and the area not served is the area not irrigated (it is the difference between the design service area and actual area served).

(f) The area not served due to pollution is estimated by multiplying the computed area not served by the pollution attribution factor derived from the Santos study (See Appendix A).

(g) The foregone yield is the loss in palay production due to water pollution and sedimentation. It is derived by computing the yield for area not served.

3. Results and Discussion

Table 2 shows that the major rice producers in 1997 for both seasons were Regions XI, III and VI with yields of 306,094, 256,077, and 238,528 metric tons, respectively. Nationwide production during the wet season totalled 1.08 million metric tons and .9 million metric tons during the dry season. Estimated foregone production for the wet and dry seasons were 0.22 million metric tons and 0.26 million metric tons, respectively. The GVA per production used in the estimation were PhP5,249.40 (1994 price) and PhP6,551.30 (current price). As expected, the estimates of foregone production showed that the impacts of pollution were more severe during the dry season when production systems mostly depend on irrigated water. Regions III, II, and I were the regions mostly affected by pollution. This can be attributed to the large area not served due to pollution and higher yield per hectare in these regions.

Table 2. Comparison of Palay Production and Foregone Production in metric tons

Region	Production		Foregone Yield	
	Wet	Dry	Wet	Dry
CAR	24,931	29,600	10,596	8,846
I	122,795	84,748	28,462	44,105
II	80,238	107,642	42,188	31,679
III	126,673	129,405	52,386	51.920
IV	108,705	96,523	24,657	29,854
V	38,300	43,986	6,851	4,648
VI	132,829	105,699	13,613	24,686
VII	10,710	7,160	2,277	3,732
VIII	49,818	26,321	-1,382	8,050
IX	35,567	31,498	5,507	7,210
X	44,500	45,266	13,285	13,138
XI	152,067	154,028	8,189	7,500
XII	114,840	99,205	12,399	48,836
XIII	37,117	35,248	5,443	6,260
TOTAL	**1,079,089**	**996,330**	**224,472**	**260,461**

Table 3 displays the value of foregone production in current and constant prices. As expected, Region III was the most affected among the regions with a loss of PhP547 million (in 1994 prices). Most regions posted significant production losses during the dry season—amounting to PhP1.4 billion compared to PhP1.17 billion during the wet season. Estimated foregone production for both seasons totalled PhP2.5 billion.

The same observations can be noted on the estimated foregone production using current prices. A total of PhP3.2 billion was lost due to irrigation problems, with the dry season posting a loss of PhP1.7 billion. Again, Region III experienced the greatest loss, followed by Regions II and I.

Table 3 . Value of Foregone Palay Production ('000 PhP)

REGION	Value of Foregone Production at 1994 Price	
	Wet	Dry
CAR	55,620	46,437
I	149,410	231,524
II	221,462	166,293
III	274,995	272,550
IV	129,436	156,714
V	35,963	24,397
VI	71,457	129,585
VII	11,953	19,590
VIII	-7,253	42,257
IX	28,909	37,846
X	69,739	68,965
XI	42,988	39,368
XII	65,088	98,875
XIII	28,574	32,863
TOTAL	1,178,341	1,367,265

Table 4 shows that soil erosion and sedimentation, and mine tailings were the major causes of foregone palay production for the wet and dry seasons, respectively. Total foregone yield due to soil erosion and sedimentation was estimated at PhP23 billion. Region III was the most adversely affected area with a loss of PhP5 billion. Foregone production due to mine tailings, on the other hand, posted an estimated loss of PhP24 billion during the dry season.

Table 4. Value of Foregone Production by Source of Pollution and by Season, ('000 PhP),1997

Region	Mine Tailings		Soil Erosion & Sedimentation		Piggery		Chemical Plants		Food Mfg.		Salt Intrusion		Schistosomiasis	
	Wet	Dry	Wet	Dry	Wet	Dry	Wet	Dry	Wet	Dry	Wet	Dry	Wet	Dry
CAR	738,634	838,193	1,091,820	628,296	54,508	60,368	46,721	38,079	112,909	140,705	20,579	44,115	144,612	117,951
I	1,984,165	4,179,002	2,932,917	3,132,515	146,422	300,981	125,504	189,849	303,302	701,517	55,282	219,947	388,466	588,070
II	2,941,011	3,001,587	4,347,297	2,249,943	217,033	216,181	186,028	136,360	449,568	503,868	81,941	157,978	575,801	422,384
III	3,651,928	4,919,524	5,398,143	3,687,599	269,495	354,315	230,995	223,491	558,239	825,826	101,748	258,922	714,986	692,276
IV	1,718,910	2,828,693	2,540,831	2,120,344	126,847	203,729	108,726	128,506	262,755	474,844	47,891	148,879	336,534	398,054
V	477,590	440,361	705,959	330,088	35,244	31,716	30,209	20,005	73,005	73,922	13,306	23,177	93,505	61,968
VI	948,955	2,339,013	1,402,705	1,753,288	70,028	168,461	60,024	106,260	145,058	392,643	26,439	123,106	185,789	329,146
VII	158,741	353,602	234,643	265,055	11,714	25,467	10,041	16,064	24,265	59,358	4,423	18,611	31,079	49,759
VIII	-96,321	762,737	-142,378	571,736	-7,108	54,934	-6,093	34,651	-14,724	128,038	-2,684	40,144	-18,858	107,332
IX	383,918	683,127	567,492	512,061	28,331	49,200	24,284	31,034	58,686	114,674	10,696	35,954	75,164	96,130
X	926,138	1,244,816	1,368,983	933,095	68,345	89,654	58,581	56,551	141,571	208,964	25,804	65,517	181,322	175,171
XI	570,879	710,597	843,850	532,652	42,128	51,179	36,110	32,282	87,265	119,286	15,905	37,400	111,768	99,995
XII	864,366	1,784,703	1,277,671	1,337,785	63,786	128,538	54,674	81,078	132,128	299,593	24,082	93,932	169,228	251,144
XIII	379,464	593,179	560,905	444,638	28,002	42,722	24,002	26,948	58,005	99,575	10,572	31,220	74,292	83,472
TOTAL	15,648,371	24,679,134	23,130,838	18,499,096	1,154,774	1,777,445	989,807	1,121,157	2,392,033	4,142,813	435,986	1,298,902	3,063,687	3,472,853

4. Recommendations

i. Exert more effort in improving data management, particularly focusing on those sources of pollution that greatly affect the irrigation systems. Surveys may also be conducted to determine the actual impacts of the different sources of pollution.

ii. Strict implementation of pollution control measures to lessen the impact of identified sources of pollution on irrigation systems.

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Appendix A
Affected Area due to Pollution

Sources of Pollution	Irrigated Area Affected (in has)		% Attributable to Pollution	
	Wet	Dry	Wet	Dry
1. Mine Tailings	9,600	8,738	13.28	18.05
2. Soil Erosion And Sedimentation	14,191	6,549	19.63	13.53
3. Piggery	709	627	0.98	1.30
4. Chem. Plants/Distilleries	607	395	0.84	0.82
5. Food Mfg./Processing	1,465	1,465	2.03	3.03
6. Salt Intrusion	270	460	0.37	0.95
7. Schistosomiasis	1,880	1,229	2.60	2.54
TOTAL	28,722	19,463	39.72	40.21

Appendix B

Value of Foregone Palay Production at Current Price

REGION	Value of Foregone Production ('000 PhP)	
	Wet	Dry
CAR	69,414	57,954
I	186,465	288,944
II	276,386	207,535
III	343,196	340,145
IV	161,537	195,581
V	44,883	30,447
VI	89,179	161,724
VII	14,918	24,449
VIII	-9,052	52,737
IX	36,079	47,233
X	87,035	86,069
XI	53,649	49,132
XII	81,230	123,398
XIII	35,660	41,013
TOTAL	1,470,581	1,706,360