THE CREATION AND USES OF SMALL WATER BODIES IN BANGLADESH: CASE STUDY OF SHAHJADPUR THANA

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***Indian Journal of Landscape Systems and Ecological Studies* 28, 2 (2005), 1-7**

ABSTRACT

The paper seeks to fill a gap in our knowledge about small water bodies in Bangladesh. These are an important but under-researched resource. In our fieldwork we studied all of the small water bodies in four mouzas of Shahjadpur thana, a representative area of the central floodplains, using a mixture of methods that included questionnaires, focus groups, and on the spot measurements. In addition, we used a series of remotely sensed images taken over a thirty-year period to estimate the changing number of small water bodies. The paper also discusses the size, shape and depth of small water bodies and their changing usage pattern.

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INTRODUCTION

Water is a destroyer of resources in Bangladesh. This is well-known according to the disaster-orientated global imagination of this low-lying deltaic country, which is fed by media images of floods. But the reality is that we know surprisingly little about one of the most important and potentially positive aspects of the country's water resources - her many small water bodies (SWB). An estimate by the Bangladesh Bureau of Statistics, through the Non-Crops Statistics Section of its Agricultural Statistics Wing, indicated 1.86 million ponds in 1982 (BBS 1984), and 1.3 million were found at the same time by extrapolation from a sample survey using satellite imagery and aerial photographs in 40 selected thanas (SPARRSO, 1984). The Second Phase Agricultural Census Project (1985-90) also carried out a survey, in 1989, and found 1.95 million (BBS, 1994). Since then there has been no comprehensive inventory, which is very surprising given the multiplication during the intervening years of relevant methodologies and datasets.

We chose to look in detail at all of the SWB in four sample mouzas of Shahjadpur thana, in the floodplain of the River Jamuna, an area typical of lowland Bangladesh. We found five classes of SWB. First, the 'doba' or 'pagar' is the smallest feature at about 25-400 sq. m. It is a rectangular/round pit or linear ditch that is invariably human-made and which holds water during the wet season and then dries out. Most dobas are found very close to homesteads. Second, a 'pukur' is a somewhat larger feature (150-1,000 sq. m) and, perhaps because of its size, it is a perennial water source and is often therefore used for fish farming. Most dobas and pukurs are residual landforms, left following excavation to build up house mounds, a vital means of mitigating the impact of the annual flood waters. Third, a 'dighi' is a small tank or reservoir, of over 750 sq. m and comparatively deep. Fourth, there are ‘jolas’ or ‘khals’, which are linear SWB, again deliberately excavated, used as canals for transport and irrigation. Many jolas are the result of Food for Work projects, where the idea was to create additional means for floodwaters to drain away rather than let them lie staganant for months. The fifth and final type of SWB, common across the floodplains of Bengal, is the ‘beel’, ‘baor’ or ‘haor’. This is a natural, saucer-shaped depression, varying considerably in size but sometimes forming large lakes. It is the geomorphological result of a highly dynamic local river environment. Beels are intensively used for fishing and for irrigation.

RESEARCH METHODS

The fieldwork was conducted between 2001 and 2004 (Huda, 2004). A traditional questionnaire survey of SWB uses was an important basis for the data collection on the ground but this was complemented by a number of the qualitative techniques that are now fundamental to fieldwork in social science. Among these, semi-structured interviews with key informants yielded general information about the economic and social contexts of each mouza, and these were especially helpful for eliciting historical trends in use patterns. Focus groups and participatory observation encouraged villagers to volunteer issues about SWB, generating much new and valuable background data. Extensive video recordings were also made of meetings and of field walks. This wealth of individual, family and village-scale data was then supplemented with remote sensing images of the area. Starting in 1972 with two metre resolution panchromatic imagery from the declassified American spy satellite, CORONA, we collected and analysed aerial photography from 1974, 1983 and 1990, and SPOT, LANDSAT, IRS and other images from the period 1989-2003 (Table 1). Having both human-based and satellite-based datasets, we then integrated them with the aid of a complex Geographical Information System to provide comparative estimates of the varying characteristics of SWBs across time and space.

<Table 1 here >

CREATION OF SMALL WATER BODIES

From the questionnaires and focus groups, we were able to establish the dates at which the various human-made SWB were created. This information was double-checked against the remote sensing images at appropriate dates. The results are interesting because they show that SWB are continually being created and renewed, right up to the present day. In Table 2, note particularly that the acceleration of SWB creation has been quite remarkable since 1990. 151 new ones are visible, mainly pukurs and dobas. This is a landscape in the throes of active creation and modification. Family members usually dig their own dobas but for pukurs and dighis it is the custom for hired labour to be involved.

< Table 2 here >

THE DIMENSIONS OF SMALL WATER BODIES

Table 3, an account of SWB sizes, is compiled from observation data (January 2002), questionnaire data (February 2002) and data from the IRS satellite (March 2003), so in theory one would expect there to be minimal difference between the data sets in terms of year and season. In fact, the correspondence is quite good. One would probably predict the research team’s observations to be the most accurate, the villagers’ perceptions to contain some errors, and the remote sensing to be less precise because of the difficulty of detecting the smaller SWB. The results show this to be so in broad terms. All three figures for dobas and pukurs are within a close band, a pleasing outcome given that these are the smallest SWB. For dighis, beels and jolas the variation is greater. The remote sensing for these larger SWB was technically difficult given that there are edge problems of recognition.

< Table 3 here >

About two-thirds of the sample mouzas' SWBs have a surface area of less than 800 sq. m. An important finding of our work is that remote sensing methods cannot be used with confidence to detect whole SWBs with a size of less than 200 sq. m, thus undermining the completeness of previous inventory surveys employing this technology. One problem is the resolution of the sensors and another is that SWB signatures can be confused with other land surface features such as the vegetation in neighbouring homestead gardens. The date and season of the remotely sensed image in question is important because many SWB were wholly or partly dry on one of our fieldtrips in February/March 2002.

Table 4 records the shape characteristics of SWB. Rectangular and square shapes are the most popular because the local custom of payment for excavation is by a calculation of length and breadth, modified by depth. The overall volume of earth is easier to work out this way in rectangular shapes than round or hexagonal. Irregular banks may indicate original excavation or modification by the owners/users themselves, where payment is unnecessary. Alternatively, natural features, especially in beels and jolas, are incorporated into the system of SWB.

< Table 4 here >

The questionnaires and fieldwork measurement also yielded information concerning the depth of SWB (Table 5), something beyond the capability of the remote sensing data available to us. Depth is very much a seasonal feature, being affected in turn by the monsoon rains, riverine floods, and then evaporation in the winter. All of the different types of SWB vary in depth, and therefore usefulness. The ratio is 6.29 times more water in dobas in the wet than in the dry season; 4.84 for pukurs; 3.28 for dighis; 2.64 for beels; and 6.25 for jolas. The low ratio for beels shows their reliability as large permanent lakes, whereas dobas, as the smallest features, are the most likely to dry up. Dighis are the deepest, at between 2.08 and 6.83 metres on average, the other SWB having similar depths.

< Table 5 here >

USES OF SMALL WATER BODIES

As Table 6 shows, the uses of SWB are varied - mainly economic and household functions. Most uses speak for themselves, apart perhaps from aquaculture. By this we mean the common *kachuripana* or water-hyacinth (*Eichhornia crassipes*), which grows profusely in watercourses in Bangladesh and is used in this region as a biological manure, cattle fodder, and packing material. Sprinkle irrigation refers to the irrigation of house gardens, with poor people growing vegetables, especially those such as bottle gourd and beans which can supplement their diet during lean periods, and the wealthier families growing tree fruit.

< Table 6 here >

The uses of SWB have changed over time. Among the biggest shifts have been away from uses associated with industry such as jute retting, in favour of clothes and cooking utensil washing, and growing water hyacinth. There has also been trend for some people to use them as open sewers, with obvious consequences for water-borne diseases and the general degradation of the sanitary environment. In Daya and Paschim Kharua mauzas, for instance, we found that most households use *kacha* latrines draining directly into SWB where, astonishingly, bathing was still common and fish were farmed.

One of the most striking changes overall has been the abandonment of SWB for drinking and cooking water. This was because of their identification in the 1970s and 1980s with a broad spectrum of bacterial contamination, and their condemnation as causes of diarrhoea and premature infant deaths. This led to a negative appraisal of SWB in many people's minds and there was a universal switch to drinking water pumped from underground via tubewells. It is worth noting that the recent scare with regard to arsenic poisoning from contaminated aquifers may change people's perceptions of risk and a return to the consumption of surface water, this time in some filtered or chemically treated form, cannot be ruled out.

Figure 1 gives a convenient general visual impression of SWB usage throughout the day and a few comments here will assist the interpretation. First, there are only a few activities (fish farming, hyacinth cultivation, jute retting, and use of privies) that go on all day. Other activities are clustered at certain times, with the early hours from 6am to 9am, midday (12 noon to 3pm) and the early evening (5-7pm) being popular slots for bathing, laundry work, washing crockery, and the collection of water for cooking purposes. In short, the uses of SWB fit with the general daily rhythms of people's lives.

A gender division of SWB use is also notable. Women and girls perform fewer SWB-related activities and are restricted in their time of access to bathing and collecting cooking and drinking water to the midday period. They are busy at other times but there are also cultural issues of modesty here that are constraining.

CONCLUDING REMARKS

As Kränzlin (2000) has pointed out, SWB are major sustainable resource that is presently under-utilised. Government planners seem to have little information about them but we argue that the technological means of producing accurate inventories is within their grasp. Our use of a mixture of ground-based and satellite data shows the way, but, as we write, new, super high resolution images are being released. The IKONOS and Quickbird satellites are producing panchromatic images at a resolution of 1 m and 61 cm respectively and multispectral images at 4 m and 2.4 m. Even smaller SWB are therefore now capable of detection than was possible for us.

Assuming that government and aid donors can be persuaded to take SWB seriously, how could they be better utilised? A management plan could start by persuading householders not to use them as cess pools. The restoration of the strict usage codes that were in place until the 1970s would help and we envisage some SWB being allocated to drinking water in those regions were there is dangerous contamination with arsenic in the groundwater. This would only be possible with water treatment to contain the microbial pollution, so this would not be a universal solution due to shortage of funds. Other, increased uses for SWB might be for small-scale fish farming and the intensification of village gardening, both means of ensuring more secure food supplies.

We studied only four mouzas. We hope that others will replicate our methodology in other parts of Bangladesh, West Bengal and perhaps elsewhere in south Asia. We have identified a combination of techniques that we think has broad applicability to academic research and practical planning purposes.

ACKNOWLEDGMENT

The senior author would like to express his sincere thanks to the Commonwealth Association for providing financial support for his Ph.D. The paper is based on his thesis.

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Table 1. Remote sensing data.

Platform	Sensor	Year	Mode	Media	Resolution/Scale
CORONA	KH-4B	1972	Panchromatic	Film	2 m
Aerial Photography	-	1974	Black and White	Printed	1:30,000
Aerial Photography	-	1983	B&W-Infrared	Printed	1:30,000
Aerial Photography	-	1990	B&W-Infrared	Printed	1:40,000
SPOT-3	HRV	1989	Panchromatic	Digital	1:50,000
ERS-1	SAR	1993	C-Band	Digital	12.5 m
SIR-C	SAR	1994	X-Band	Digital	30 m
X SAR	SAR	1994	C-Band	Digital	25 m
Landsat 5	TM	1997	Band 2-4	Digital	30 m
Landsat 5	TM	1998	Band 2-4	Digital	30 m
IRS	ID	1999	Panchromatic	Digital	6 m
IRS	ID	2003	Panchromatic	Digital	6 m
IRS	LISS	2003	XS	Digital	23 m

Table 2. The number and types of SWB in the study area

	Doba	Pukur	Dighi	Jola	Beel	Total
1960	30	31	3	6	4	74
1965	32	31	3	6	4	76
1970	34	32	3	6	4	79
1972	35	34	3	6	4	82
1974	35	34	3	6	4	82
1975	35	34	3	6	4	82
1980	37	38	3	6	4	88
1983	41	43	4	6	4	98
1985	47	50	4	6	4	111
1990	62	61	4	6	4	137
1993	79	84	5	6	4	178
1994	85	91	6	7	4	193
1995	94	95	7	7	4	207
1997	117	108	7	7	4	243
2000	129	119	7	7	4	266
2002	137	132	7	7	4	287
2003	147	143	7	7	4	308

Table 3. Results of the mixed methods: mean size of water bodies (sq. m)

Mouza	Method	Doba	Pukur	Dighi	Beel	Jola
Baoikhola	Observation	141.9	570.4	2736.8	35097.8	2043.6
	Questionnaire	157.9	597.7	2429.0	42153.3	3481.0
	Remote sensing	203.0	639.5	n/a	41710.6	2633.5
Daya	Observation	168.0	287.2	1497.3	n/a	9233.2
	Questionnaire	189.9	304.2	1259.9	n/a	n/a
	Remote sensing	188.6	289.4	1509.1	n/a	9344.3
Narayandaha	Observation	218.1	449.9	n/a	n/a	26098.8
	Questionnaire	222.1	439.9	n/a	n/a	26312.0
	Remote sensing	232.7	389.2	n/a	n/a	26617.0
Paschim Kharua	Observation	162.9	851.1	5707.8	26717.0	26717.0
	Questionnaire	208.0	848.8	4924.7	35374.3	34873.3
	Remote sensing	165.3	757.1	10067.3	7548.1	35297.7
Total study area	Observation	172.7	539.6	3313.9	30907.4	16023.2
	Questionnaire	194.5	547.7	2871.2	38763.8	21555.4
	Remote sensing	197.4	518.8	5788.2	24629.3	18473.1

Table 6. The shapes of small water bodies in the study area

Shape	Number	Shape	Number
Hexagonal	19	Round	32
Linear	9	Square	43
Parabolic	29	Triangular	2
Rectangular	153	Total	287

Table 5. The average depths (metres) of small water bodies in the study area

	Season	Doba	Pukur	Dighi	Beel	Jola
Baoikhola	Dry	0.31	0.63	2.00	0.83	0.50
	Wet	3.61	4.45	5.50	5.00	3.50
Daya	Dry	0.94	1.31	2.25	n/a	1.50
	Wet	3.63	4.21	6.00	n/a	5.00
Narayandaha	Dry	0.90	0.89	n/a	n/a	0.50
	Wet	4.63	4.99	n/a	n/a	7.50
Paschim Kharua	Dry	0.71	1.33	2.00	0.00	1.00
	Wet	6.24	6.47	9.00	6.00	6.00
Total	Dry	0.72	1.04	2.08	0.42	0.88
	Wet	4.53	5.03	6.83	5.50	5.50

Table 6. The changing uses (percentages) of small water bodies in Shahjadpur thana

	1970	1980	1990	2002
Drinking water	32	1	1	0
Cooking water	10	8	3	3
Washing cooking utensils	19	19	30	41
Bathing	43	42	51	58
Sewerage	39	44	41	48
Irrigation	18	19	16	17
Duck raising	78	80	77	75
Fish farming	82	70	84	75
Aquaculture	34	34	43	43
Cattle washing and watering	23	23	21	21
Washing clothes	35	45	53	61
Dyeing	4	3	4	6
Jute retting	24	22	17	1

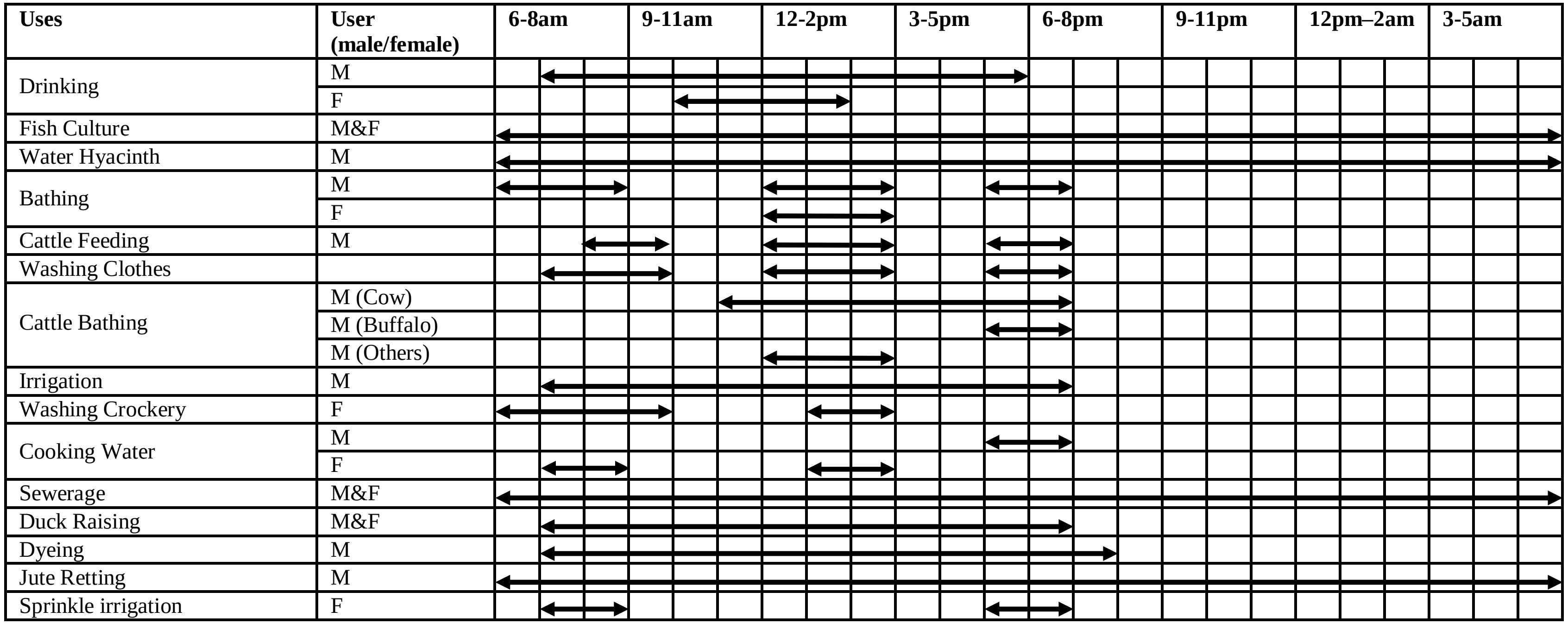

Figure 1 The use times of small water bodies