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Taxonomic Composition, Diversity and Abundance of the Ichthyofaunal Assemblage of Iba-Oku Stream, Ikpa River, Nigeria

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ABSTRACT

Taxonomic composition, diversity and abundance of the ichthyofaunal assemblage of Iba-Oku stream, Ikpa River was carried out. Nineteen fish species representing 13 families were recorded. In all, 312 samples were caught with gill nets, hooks and lines. The Malapteruridae was the dominant family (48 specimens) (15.4%) while *Malapterurus electricus* was the dominant species by number and preponderance 48 (15.4%) and 67.23%, respectively. Monthly and seasonal abundance showed highest in March 71 (23.10%) during the dry season and July 68(21.79%) during the wet season, respectively. The largest fish sample was *Erpetoichthys calabaricus* (27.80 cm, SL; 41.70 g Tw) while *Epiplatys sexfasciatus* was the smallest (4.60 cm, SL; 3.00 g, Tw). Meanwhile, the heaviest fish was *Brycinus nurse* (17.4 cm, SL; 124.9 g, Tw). Diversity indices showed highly diverse conditions among the species. The mean condition factor (K) was (3.61) showing that the fishes were generally in 'good' condition.

Key words: Taxonomy, biodiversity, evenness, biotic indices, preponderance

INTRODUCTION

Agriculture and food security are indispensable tools in achieving Millennium Development Goals (MDGs) which seek to improve the living standard of the society (Ibrahim *et al*., 2009). Such can be achieved by making food available at all time through increasing technical efficiency (Bakhsh *et al*., 2006), with the view to alleviate poverty of rural farmers of the developing nations like Nigeria (Babatunde *et al*., 2007). In the agricultural sector of the Nigerian economy which employs about 70% of the active labour force, fish occupies a unique position in that it is the cheapest source of animal protein consumed by the average Nigerian, accounting for up to 50% of the total animal protein intake (FDF, 2009). Fish is best for human consumption as it is low in fat, calories and cholesterol. It is on recognition of this fact that the government has decided that fisheries development should be given prominence. However, before initiating any fisheries development, it is desirable to have a fundamental knowledge about the morphometrics and meristics of the fish in question, their phenology, habitats and methods of processing and preserving them as well as their abundance and many other biological facts about them (Mekkawy and Mohammad, 2011).

Akwa Ibom State, Nigeria is blessed with a network of streams, rivers and seasonal flooded plains and tidal creeks which play a major role in her development. They provide easy means of transportation, occupational activities, means of waste disposal and source of food. Streams are important habitat for freshwater fishes of high economic values and some of the marine intrusive species that use them as spawning and nursery grounds. Consequently streams contribute to fish

recruitment into the larger river and coastal fisheries. Some species serves as food for man; while others serves as food for piscine carnivores; many serves as ornamental species; which presently are rarely exploited. These, if well managed and sustained, can subsidized the high protein demand of the ever increasing population and also boost her economy.

Much research has been conducted on rivers, estuaries and streams within the state (Akpan, 2004; Akpan and Ufodike, 2005; Ekwu and Sikoki, 2005; Onuoha *et al*., 2010; Essien-Ibok *et al*., 2010; Ekpo *et al*., 2011) but there is dearth of information on Iba-Oku stream. Although Udoidiong and King (2000) studied the fish faunal assemblage of Iba-Oku stream, there is need for more studies in order to ascertain other assemblage parameters that will serve as useful tool in the resources management of this important stream which will boost fisheries development in Akwa Ibom State and alleviate poverty of rural farmers.

MATERIALS AND METHODS

This research was conducted at Iba-Oku stream, Ikpa River in Itu Local Government Area, Akwa Ibom State. It runs from Mfangfang pond, through Obot Uyo into Mfro Iba (Fig. 1). It is a perennial tributary stream west of the lower reaches of the cross river, Nigeria. The bottom of the

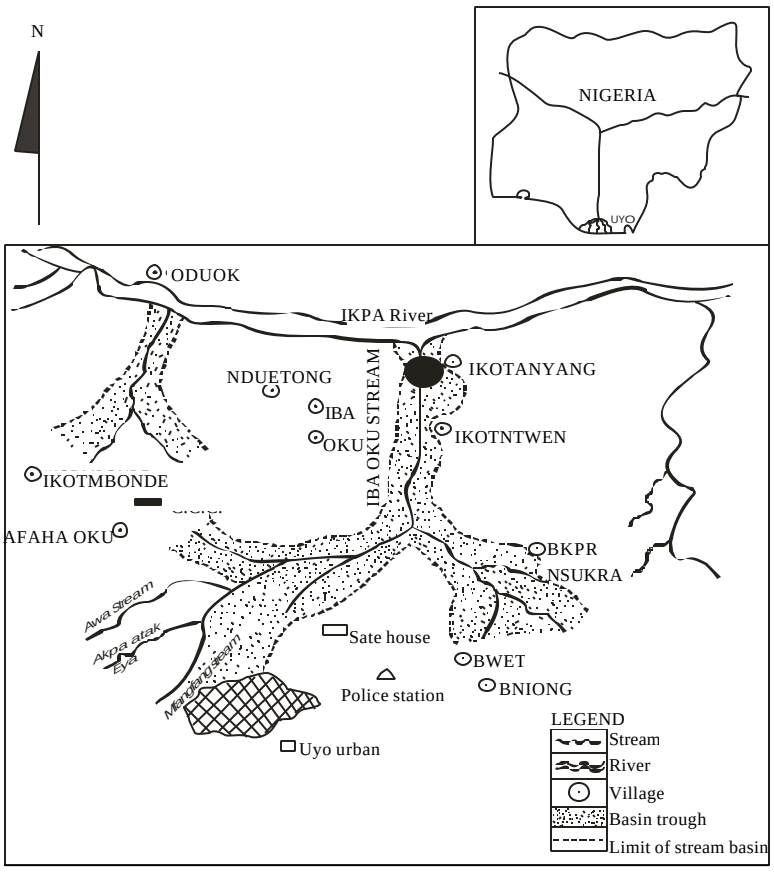

Fig. 1: Map of Iba-Oku steam of university of Uyo ravine in Uyo capital city

stream predominantly sandy and muddy while the edges are without mud. The topography of the catchments is sloppy, so that water current is moderately fast. Some parts of the water surface are covered with floating leaves of *Azolla* and *Salvinia* species. The riparian zone is dominated by stands of *Raphia hookeri* and *Raphia vinifera*.

A total of 312 fish samples (fin fish, crabs and shrimps) were collected for a period of 5 months (March-July 2008) from the subsistence and artisanal fisheries landings. Sampling was carried out fortnightly each month. Most of the fish were caught by gillnet (15-30 mm stretched mesh size). A few were collected by hook and lines. These samples were taken to the laboratory using cooler. The samples were preserved in 10% formaldehyde; they were later removed, rinsed in clean water and identification was done to the species level with the aid of identification keys (Holden and Reed, 1972; Olaosebikan and Raji, 1998; Idodo-Umeh, 2003; Adesulu and Sydenham, 2007). Measurements of standard length (SL, cm) and total weight (Tw, g) were taken.

The monthly percentage occurrence of each family and species was computed as follows:

$$FO = n/N \times 100 \quad (1)$$

where, FO is frequency of occurrence, n is number of individual fish species and N is total number of all the fish species.

The index of preponderance (%IP) was computed as follows:

$$IP = \%N.\ \%Wt \times 100/\Sigma\ (\%N.\ \%Wt) \quad (2)$$

where, N is number of fish species and Wt is weight of fish species.

The notations in Eq. 1 and 2 are as explained in Moses (1987). These were expressed as percentage of the total number and total weight of the fish caught (Watson and Balon, 1984a, b). Fishes with IP value of less than 0.50 were regarded as being of relatively insignificant contribution while those with IP values greater than 0.50 were regarded as being of significant contribution. The Shannon and Weaver diversity index (H) was used with the formula given as:

$$H = -\Sigma[(n_i / N) \times \ln (n_i / N)] \quad (3)$$

where, n_i is the number of individuals of each species (the ith species), N is the total number of individual or amount for the site and In is the natural logarithm (Shannon and Weaver, 1963). The Simpson's Index (D) was calculated using the equation:

$$D = (n/N)^2 \quad (4)$$

where, n is the number of individuals of the species, N is the total number of the individual. The species evenness (J) was calculated using Pielou's evenness index:

$$J' = H'/H'_{max} \quad (5)$$

where, H' is the number derived from the Shannon diversity Index and H'_{max} is the maximum value of H'. The equitability index (E_p) was used to compute the equitability or evenness of individual distribution among species in the community. The formula of this index is given as:

$$E_p = D/D_{max} \quad (6)$$

where, D is the Simpson's index, D_{max} is the maximum value of D. The Species Richness (d) was determined using Margalef's diversity Index (d) with the formula given as:

$$d = S\text{-}1/In\ (N) \quad (7)$$

where, S is the total number of species in the community and N is the total number of individuals and In is the natural logarithm (Margalef, 1968). The monthly condition factor (K) was calculated using the relationship for isometric growth from Gayanilo Jr. and Pauly (1997):

$$K = 100\ W/L^3 \quad (8)$$

where, K is condition factor, W is wet weight (g) and L is total length (cm).

Monthly condition factor values >1 were considered as high while those <1 were considered as being low. The biotic indices of species richness, diversity, evenness, etc. according to methods of Odum (1971) and King and Jonathan (2003) were used to analyze fish community structure and to evaluate the environmental perturbations in Iba-Oku stream, Ikpa River (Nigeria).

RESULTS

Ichthyofaunal assemblage and diversity indices: Summary of the ichthyofaunal assemblage and diversity indices are presented in Table 1. There was a total of 9 order, 13 families, 16 genera and 19 species. Values for species richness (d), Shannon-Weiner (H), Simpson's index of diversity (1-D), species evenness (J) and Equitability index (E) were 3.134, 2.623, 0.910, 0.891 and 0.583, respectively.

Relative abundance and index of preponderance: The study shows that *Malapterurus electricus*, which numerically constitute 15.4% of the total catch (N = 312) was the most abundant species (Table 2). It was closely followed by *Potamonates pacilli* (14.4%). Third in the sequence

Table 1: Ichthyofaunal assemblage and diversity indices of Iba-Oku stream, Ikpa river, Akwa Ibom state, Nigeria

Parameters	Total No. sampled	Significance
No. of order	9	-
No. of families	13	-
No. of genera	16	-
No. of species	19	-
Species richness (d)	3.134	Highly diverse
Shannon-Wiener (H)	2.623	"
Simpson's index (D)	0.090	"
Simpson's index of diversity (1-D)	0.910	"
Simpson's reciprocal index (1/D)	11.074	"
Species evenness (J)	0.891	"
Equitability index (E)	0.583	High

Table 2: Taxonomy, size composition, relative abundance index of preponderance and condition factor of fishes in Iba-Oku stream, Ikpa River, Nigeria

			Standard length (cm)		Total weight (g)			
Family/species	N	%N	Min-max	Mean	Min-max	Mean	IP	K
Malapteruridae								
Malapterurus electricus	48	15.4	9.7-16.0	13.7	15.8-115.9	67.3	67.23 (1)	2.62
Channidae								
Channa obscura	22	7.1	3.8-21.8	12.3	1.1-136	28.5	6.02 (4)	1.53
Channa africana	5	1.6	7.7-13.5	11.0	4.7-36.8	18.2	0.20 ns	1.37
Mormyridae								
Isichthys henryi	37	11.9	4.7-17.2	8.5	0.4-14	6.3	3.75 (5)	1.03
Brienomynus brachyistius	10	3.2	6.1-13.5	8.8	2.1-20.1	6.3	0.28 ns	0.92
Bagridae								
Parauchenoglanis ansorgei	10	3.2	1.6-11	7.8	3.8 -27	7.5	0.33 ns	5.79
Cyprinodontidae								
Epiplatys sexfasciatus	22	7.1	2.1-6.4	4.6	0.6-7.1	3.0	0.61 (7)	3.08
Characidae								
Brycinus longipinnis	8	2.6	6.8-8.1	7.5	9.3-13.5	11.7	0.32 ns	2.89
Brycinus nurse	7	2.2	16-19.2	17.4	82.8-224.5	124.9	2.60 (6)	3.45
Cichlidae								
Chromidotilapia guntheri	19	6.1	4.8-14.4	9.4	3.5-67.4	30.2	0.23 ns	3.64
Tilapia mariae	3	1.0	6.0-8.2	6.9	8.6-23.4	14.2	0.06 ns	4.32
Hemichromis fasciatus	2	0.6	6-7.1	6.6	3-4.2	3.6	0.01 ns	1.25
Polypteridae								
Erpetoichthys calabaricus	22	7.1	21.1-35	27.8	19.5-80.2	41.7	8.80 (2)	0.19
Notopteridae								
Papyrocranus afer	2	0.6	10.5-14.4	12.6	10.8-20.2	14.1	0.02 ns	0.70
Clariidae								
Heterobranchus longifilis	1	0.3	19.0	-	91.9	91.9	0.04 ns	1.34
Penaeidae								
Macrobrachium dux	14	4.5	3.7-8.6	5.4	1.3-13.5	3.5	0.31 ns	2.22
Macrobrachium vollenhovenii	10	3.5	3.5-5.3	4.3	1.5-3.3 1.9	0.16 ns	2.09	
Potamidae								
Potamonautes paecilli	45	14.4	1.5-4.1	3.1	0.7-23.5	9.7	8.51 (3)	32.56
Cyprinidae								
Barbus callipterus	25	4.6	2.3-5.8	4.9	0.4-9.5	3.4	0.52 (8)	2.89
Grand total	312				100			

was *Isichthys henryi* (11.9%) while *Barbus callipterus* (8.0%) was the fourth in abundance. *Parachanna obscura, Epiplatys sexfasciatus* and *Erpetoichthys calabaricus* had the same percentage contribution (7.1%). Less important contribution came from *Parauchenoglanis fasciatus* (3.2%), *Macrobrachium dux* (4.5%), *Macrobrachium vollenhovenii* (3.2%), *Chromidotilapia guntheri* (6.1%), *Brycinus longipinnis* and *Brycinus brachyistius* (3.2%). Each of *Brycinus nurse, Channa africana* and *Tilapia mariae* formed 1-2.2% of the catch; each of the other species contributed less than 1.0% of the catch with *Heterobranchus sp.* (0.3%) as the least abundant. According to Index of preponderance (Table 2), the species may be graded as follows: *Malapterurus electricus* (1), *Erpetoichthys calabaricus* (2), *Potamonautes paecilli* (3), *Channa obscura* (4), *Isichthys henryi* (5), *Brycinus nurse* (6), *Epiplatys sexfasciatus* (7) and *Barbus callipterus* (8). Others had insignificant contributions.

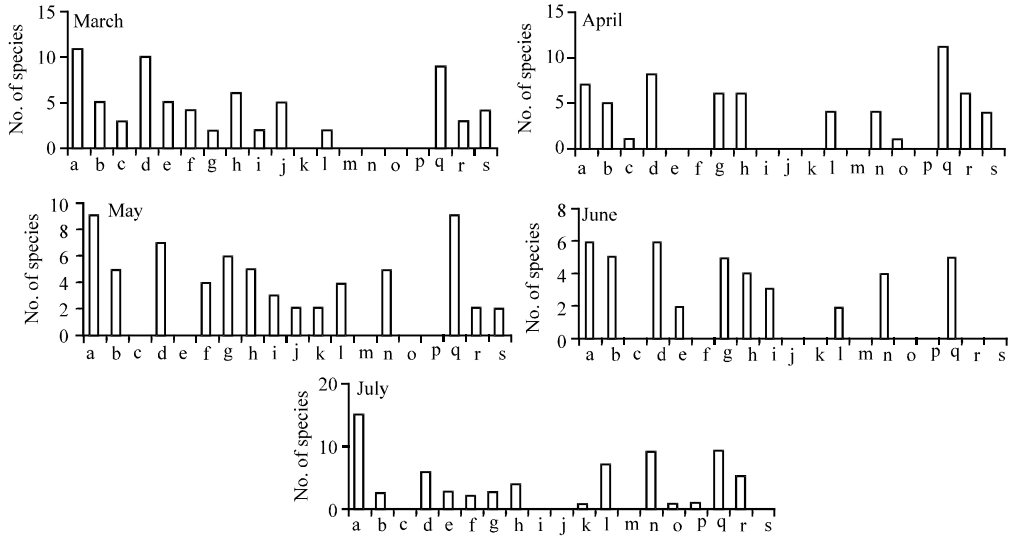

Fig. 2: Monthly species numerical abundance. a: *Malapterurus electricus*, b: *Channa obscura*, c: *Channa africana*, d: *Isichthys henryi*, e: *Brienomyrus brachyistius*, f: *Paracheunoglanis fasciatus*, g: *Epiplatys sexfasciatus*, h: *Barbus callipterus*, I: *Brycinus longipinnis*, j: *Brycinus nurse*, k: *Tilapia mariae*, l: *Chromidotilapia guntheri*, m: *Hemichromis fasciatus*, n: *Erpetoichthys calabaricus*, o: *Papyrocranus afer*, p: *Heterobranchus* sp., q: *Potamonautes paecilli*, r: *Macrobrachium dux*, s: *Macrobrachium vollenhovenii*

Size composition: The mean sizes of fishes from the study area are presented in Table 2. *Erpetoichthys calabaricus*, *Malapterurus electricus*, *Channa obscura*, *Channa africana*, *Paracheunoglanis fasciatus*, *Brycinus nurse*, *Chromidotilapia guntheri*, *Papyrocranus afer* and *Heterobranchus* sp. Attained mean size exceeding 10 cm SL; only a few others measured less. The absence of a large number of juvenile fishes can be linked to gear selectivity. In terms of body weight, *Malapterurus electricus*, *Channa obscura*, *Paracheunoglanis fasciatus*, *Brycinus nurse*, *Chromidotilapia guntheri*, *Erpetoichthys calabaricus* and *Heterobranchus* sp. Attained mean weights exceeding 20 g; only a few others measured less. The lowest in terms of weight was *Epiplatys sexfasciatus* (3.0 g) followed by *Barbus callipterus* (3.4 g).

Condition factor: Table 2 also shows the mean condition factor of all the fish species (K = 3.61) indicating that the fishes were in relatively 'good' condition. The minimum condition factor was seen in *Erpetoichthys calabaricus* (0.19) while the largest was seen in the crabs (*Potamonautes paecilli* = 32.56). Among the fin fish, the healthiest fish was *Paracheunoglanis fasciatus* (5.79).

Monthly occurrence: Figure 2 depicts the monthly species occurrence of the fish species sampled. A closer look at the figure shows all round occurrences of *Malapterurus electricus*, *Isichthys henryi*, *Potamonautes paecilli* (crab). Others were either low in occurrence or seasonal. Monthly contribution to the total catch shows highest (23.1%) in March during dry season and highest in July (21.8%) during wet season (Fig. 3).

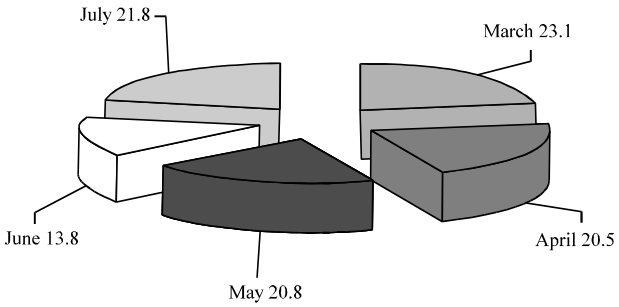

Fig. 3: Monthly occurrence of fish species in Iba-Oku stream Ikpa river, Akwa Ibom state, Nigeria

DISCUSSION

The results indicate that ichthyofaunal assemblage and diversity of Iba-Oku stream were generally high. Fish composition compares favourably with earlier reports on similar streams in Southern Nigeria. For instance, Udoidiong and King (2000) reported on species composition of two second order streams in Akwa Ibom State as follow: Esedeke, 25 fish species belonging to 23 genera representing 16 families and Iba-Oku, 18 fish species belonging to 17 genera representing 13 families were recorded. In a similar study, Onuoha *et al.* (2010) recorded 26 fish species belonging to 7 families during the study of Ntak Inyang stream. This is very similar to the present study which recorded 19 species belonging to 16 genera representing 13 families. Sikoki *et al.* (2008) investigating the fish assemblages of Onu-Iyi-Ukwu stream in South Eastern Nigeria recorded 17 species belonging to 15 genera and 11 families. Generally, it has been observed that there seems to be high biodiversity in second and third order streams than the first order streams (King, 1989; Udoidiong and King, 2000; Sikoki *et al.*, 2008), due to the expanded living space and a mixture of species from the first order streams uniting to form subsequent orders in the stream hierarchy. The observed differences in the results of this present study and others especially Udoidiong and King (2000) may be as a result of great difference in research periods and sampling frequency.

The ichthyofaunal assemblage of rivers has also been recorded. For instance, Okereke (1990) recorded 46 fish species from 20 families in studies of Otamiri River, Abia State. Kouadio *et al.* (2006) observed 44 species belonging to 35 genera and 20 families with Cyprinidae and Alestidae dominating in Mé River, Ivory Coast. Mondal and Kaviraj (2009) also reported 49 species belonging to 23 families dominated by Cyprinidae with 11 species in the study of the piscine assemblage of two floodplains Lakes of North 24-Parganas in West Bengal, India. Forty six species belonging to 23 families was also recorded in Littoral of Colima, Mexico with the most species-rich family being Pomacentridae. These also depict rich assemblage as compared to the streams.

The most dominant or superior in importance were Malapteruridae. This disagrees with the report of Udoidiong and King (2000) that saw Cichlidae as the most dominant species in Iba-Oku Stream and Onuoha *et al.* (2010) which reported that Characidae were the most abundant in terms of taxa, while *Malapterurus* and some other important stream genera such as; *Papyrocranus*, *Erpetoichthys*, *Mormyrus* and *Epiplatys* and were missing in Ntak Inyang Stream all in Akwa Ibom State. Some stream families such as Citharinidae, Hepsetidae, Schilbeidae, Distichodontidae, which have been well reported of in other studies (Udoidiong and King, 2000; Onuoha *et al.*, 2010; King and Akpan, 2002; Nwosu *et al.*, 2009) were conspicuously absent in this study. Their absence may be explained by the short study period, methods of sampling, gear-types, the frequency and intensity of sampling.

Seasonal variation occurred in the species and number of specimens sampled. *Malapterurus electricus*, *Isichthys* henryi and *Brienomyrus brachyistius* showed greater abundant in the dry season while *Epiplatys sexfasciatus* and *Erpetoichthys calabaricus* showed greater abundant in wet season. This agrees with the results of King (1989) where *Brienomyrus brachyistius* showed greater abundance during the dry season. In the other hand, it disagrees with some findings that more specimens are recorded during the rainy season than in the dry season. The rainy season is considered to be the feeding period when fish utilize the expanded feeding areas, due to the inundation as a result of the surface-offs. More so, more allochthonous food materials and nutrients are brought into the expanded habitat. King (1989) found a positive correlation which corroborated with the assertion that feeding intensity increases with food availability. It has been reported that many tropical freshwater fishes have a broader trophic spectrum during the rains, high species preponderance/ dominance during the rainy season (Welcomme, 1979, 1985). The difference was as a result of schooling of *Malapterurus electricus* and *Brienomyrus brachyistius* during the dry season which increased the total fish number.

The relatively higher diversity indices in Iba-Oku stream might have resulted in part from the management and conservation practices adopted by the Oku Uyo community which prohibits fishing during closed seasons and the use of obnoxious fishing methods thus conserving the natural stock. According to Odum (1971), species diversity is higher in old communities than newly established ones. This is probably due to the creation of additional niches (Udoidiong and King, 2000). This postulate is true of this stream since it is an old community. Condition factor is an index of general well-being or fitness of fish population and assumes that the heavier fish of a given length is in better condition and vice-versa. Fishes of Iba-Oku stream were generally in good condition.

Assemblage study is very useful in the assessment of fish catch to know whether it is declining or not (Ahmed *et al*., 2005). It can also help in the evaluation of anthropogenic activities on the fish assemblage as well as study the effect of water quality to fish abundant (Othman *et al*., 2001). When the effect of catch on the total fish abundance is negative regulatory measures is necessary to ensure the conservation of this species.

CONCLUSION

The ichthyofaunal assemblage of Iba-Oku stream was rich. The Malapteruridae were the most abundant with *Malapterurus electricus* having the highest index of preponderance. Species occurred mostly in the dry season (March) than the wet season. Species richness and diversity were high depicting a polydiversed community. There is need for intensive 12 months study on the physico-chemical parameters and macrobenthos for a proper conservation and management of these important resources in this important stream which provide food security to rural dwellers and the nation as a whole.

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