CGIAR Aquatic Research Priorities Revisited:

A Case for a Higher Priority for Reservoir-Lake System Research

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Introduction

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Setting research priorities in fisheries and aquaculture is a continual challenge. Several years ago, ICLARM rose excellently to this challenge with a ground-breaking effort in its Strategic Plan (1992) and the consequent Medium-Term Plan (1993). Since this work was done well before my own association with ICLARM, I hope the reader will accept that I speak here with objectivity. Dr. Sena De Silva (Deakin University, Australia and Editor, Asian Fisheries Science), in the main, supports my assessment. He challenges, however, the priority given to reservoirs and lake systems and reapplies the ICLARM framework to show they should be given greater attention.

This article is very timely since ICLARM is now embarked on an exercise to plan potential research and related activities out of a research site in Egypt (thanks to a generous offer from the Government of Egypt). These activities certainly are related to African and West Asian regional priorities - area where lakes and reservoir fisheries feature prominently, as emphasized in the Strategic Plan (1992, p. 23) Dr. De Silva's contribution is therefore of immediate relevance.

Dr. De Silva closes with a challenge to continue the debate, along similar lines, for other ecosystems. ICLARM welcomes this and invites responses. We stress in addition, however, that the socioeconomic dimensions are equally critical to us as a CGIAR center. Indeed, the CGIAR has now embarked upon a series of ecoregional programs which are based on research priorities in defined agro-ecosystems within political-cultural regions. Thus, we are all moving a long way in our research from the commodity approach.

The approval in 1992 for ICLARM as the fisheries research center of the Consultative Group on International Agricultural Research (CGIAR), along the lines of the well known International Rice Research Institute (IRRI) for example, is a matter for rejoicing for all associated with the fishing industry, and in particular fisheries researchers and scientists, in the developing world.

The general mission of the CGIAR is to contribute to sustainable improvement in the productivity of agriculture, forestry and fisheries in developing countries in ways that enhance nutrition and well-being, especially among poor people. Within this framework the primary objectives of the new CGIAR center for fisheries research is to: (a) improve the biological, socioeconomic and institutional management mechanisms for sustainable use of aquatic resource systems; (b) devise and improve production systems that will provide increasing yet sustainable yields; and (c) strengthen national programs to ensure sustainable development of aquatic resources, to be achieved through international research and related activities and in partnership with national agricultural research systems (ICLARM 1992).

CGIAR centers are generally set up to conduct strategic or upstream research; centers are not expected to duplicate research agenda of national institutions but work closely and effectively with them in determining research strategy and conducting research. In the case of the CGIAR center for fisheries, the proposal was based on a program of activities by an already existing research institute/body which is ICLARM. CGIAR center' research priorities, as with all research priorities, are development oriented; but more so in the case of the former because it has to work towards poverty reduction in the developing world, and therefore the time factor has to be a very important denominator in its strategies and priorities. This is being turned around through the CGIAR renewal process. ICLARM has recently won more priority in the CGIAR system, e.g., in the Lucerne Declaration and research part of the Action Plan. However, in an era when there is a squeeze on the research dollar in agriculture, the effect is perhaps doubly felt in the fisheries sector. It is therefore important that the research priorities and strategies in the sector are well thought out so that the return from the research input is optimal.

It is in the above context that research priorities of the new CGIAR center have to be constantly reviewed, and, if needed, reoriented and/or reinforced. In this article I wish to pose the question whether some of the present priorities as suggested by ICLARM and subsequently accepted by the TAC (Technical Advisory Committee) of the CGIAR are entirely valid.

The basis chosen for deriving priorities was that of the resource system, because such an approach (a) supported future ICLARM objectives and principles, especially those of sustainability and a system approach, (b) it encompassed many of the critical international research issues, and (c) it fitted with the comparative advantage of ICLARM in resource management (for details see ICLARM 1992). The steps involved from here on are best summarized schematically (see Fig. 1).

The ecosystem approach, in contrast to a commodity approach adopted in determining the research strategy, is most welcome. Priority setting in regard to biological resources is no easy task. The fisheries sector has a number of distinct components, different species, environments, etc., and indeed such heterogeneity makes the development of a conceptual framework even more difficult. Issues relating to potential fish production of different ecosystems remain controversial and we are unlikely to see absolute answers in this regard. In my view, ICLARM's framework is acceptable in principle and is the best that has been developed for this purpose. However, my main concern is the relative priority that has been assigned to the different resource system(s). The prioritization of the resource systems (Ponds; Reservoirs and lakes; Streams, rivers and flood plains; Estuaries and lagoons; Coral reefs; Soft bottom shelves; Upwelling areas) were determined on the basis given in Table 1; the key factors here being the present yields and the potential to increase yield/production of each resource system, on the basis of which a simple index of potential gain for each system was obtained.

In the arguments that follow here, soft-bottom shelves and upwelling shelves will be ignored. In spite of the high index for potential gain in production from these resource systems equity factors and the involvement of other international research organizations in research on these resource systems, it has been determined that these systems should not be a priority for the new CGIAR center.

The case presented here clearly indicates that reservoir and lake resource systems, reservoirs in the Asian context and lakes plus reservoirs in the African context, have been given a lower priority than deserved in Table 1.

Firstly, there is no evidence to show in the documents (ICLARM 1992) that the projected increase in the reservoir resource was taken into account in the computations. The reservoirs are a major water resource in Asia, at present estimated to be about 85,925 km^2 (Petr 1994) and expected to reach 200,000 km^2 by the year 2000 (Costa-Pierce and Soemarwoto 1990). Moreover the reservoir resource in Asia is rural, and any immediate beneficiaries from utilization of this resource for fisheries activities are the poor. Therefore, the equity index in Table 1 should be comparable to any other source, i.e., not 3 but 4 as for some other resources such as coral reefs. I am yet to witness a reservoir fishery which is not artisanal and which is not rural based in Asia.

Secondly, fish catch from reservoirs is considered to be 1.8×10^6 t, as opposed to, for example, 4.0×10^6 t from coral reefs. The former is a gross underestimation, and as a result the potential to increase and therefore the index of potential gain for this resource system is underestimated. The total inland, inland aquaculture and therefore the inland capture fishery production for the period 1985-1991 are given in Table 2. The inland capture fishery production in Table 1 is highly weighted toward the streams-rivers-floodplain resource system; in a situation where there is a dearth of reliable, hard data, and in view of the general reports of the decline of riverine production due to pollution (biological and industrial), and indeed damming, and effects of deforestation in upstream catchments, etc. I would have considered giving equal weighting for the fish from the two resource systems. Such a weighting will obviously increase the index of potential to increase production from the reservoir-lake resource system very significantly.

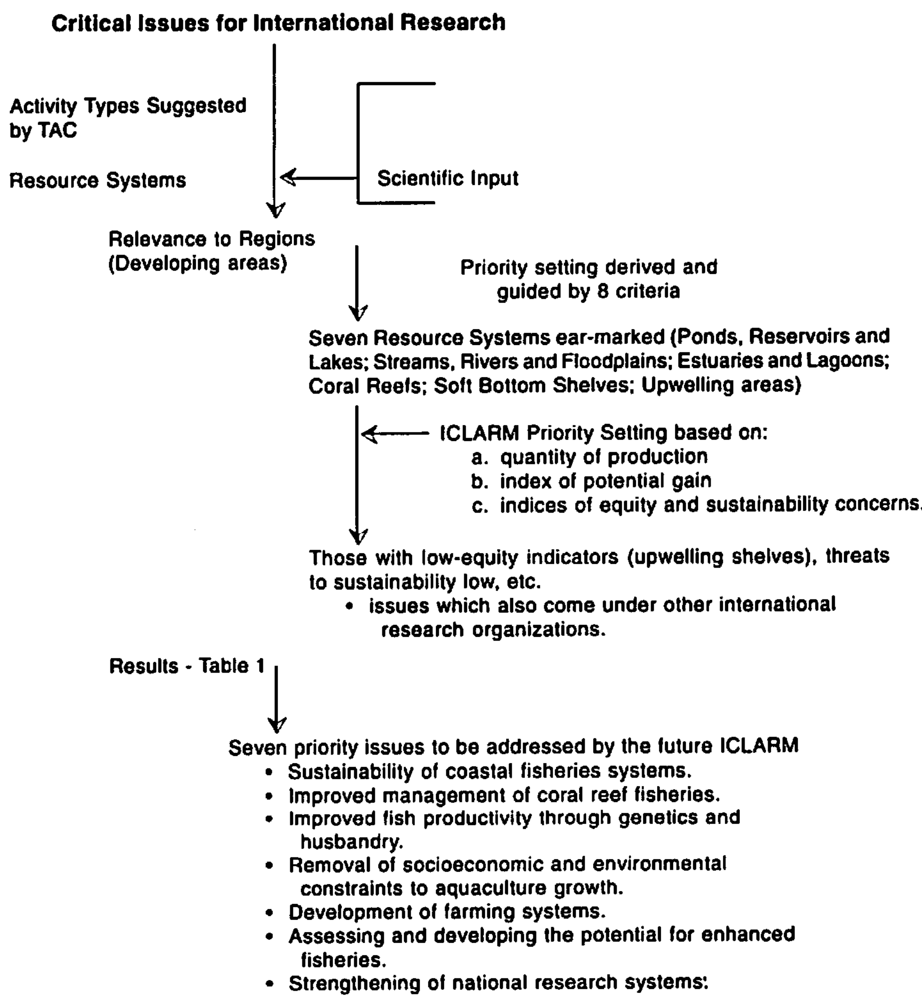

Fig. 1. A schematic representation of the summary of the steps that were involved in determining the priority issues for the CGIAR center in fisheries.

Table 1.Priority setting for the balance of effort of the future ICLARM, by aquatic resource system, based on fish production, potential for increase, threats to sustainability and equity (from ICLARM 1991).

	Resource systems						
Criteria	Ponds	Reservoirs, lakes	Streams, rivers floodplains	Estuaries, lagoons	Coral reefs	Soft-bottom shelves	Upwelling shelves
Fish catch (t x 10^6)[a]	-	1.8	3.5	7.1	4.0[i]	11.1	14.0
Aquaculture production (t X 10^6)[b]	5.0	0.2	0.1	3.0	0.5	0.0	0.0
Potential to increase production[c]							
Capture fisheries	0	2	0	1	2[i]	1	1
Aquaculture	2	2	1	1	1	0	0
Index of potential gain[d]							
Fishery	0.0	3.6	0.0	7.1	8.0	11.1	14.0
Aquaculture	10.0	0.6	0.1	3.0	0.5	0.0	0.0
Combined	10.0	4.2	0.1	1.1	8.5	11.1	14.0
Combined prioritye	4	2	1	5	3	6	7
Modifiers							
Threats to sustainability[f]	2	2	3	4	4	2	1
Equity[g]	4	3	4	3	4	2	1
Modified index	30.0	10.5	0.4	35.4	34.0	22.2	14
Modified priority[h]	5	2	1	7	6	4	3

[a] As derived from the Appendix (ICLARM 1991).
[b] Distribution of production as estimated by ICLARM from FAO aggregate data.
[c] Scale is 0-4. Estimate based on an analysis of potential, constraints and feasibility. Information for capture fisheries is summarized in the Appendix. Aquaculture potential for ponds is based on early successes of expansion of semi-intensive aquaculture in SE Asia, Bangladesh and preliminary results from Malaŵi all with new entrants; for reservoirs and ponds, see Costa-Pierce and Soemarwoto 1990 (Reservoir Fisheries and Aquaculture Development for Resettlement in Indonesia, 378 p. ICLARM, Manila). Estuaries and lagoons have recently shown considerable increase in aquaculture production. However, there are considerable socioeconomic constraints in addition to equity issues and pollution which limit the potential.
[d] Derived by multiplying current fish catch /aquaculture production by potential.
[e] High number indicates high priority.
[f] This index acknowledges the downstream cumulative effect of unsustainable practices. Thus, estuaries and lagoons and coral reefs receive the effect of all the unsustainable agriculture, and forestry practices plus the impact from industrialization and urbanization. In addition they are subject to conflicting resource use and habitat destruction (e.g., conversion of mangroves and destructive fishing).
[g] This index interprets the contribution of the production to the livelihood of the poor and the availability of the production of food to the poor. For example in upwelling shelves, the fishery is carried out by industrialized fleets often from developed countries while the catch is converted to nonhuman food, contrasted to ponds where production is carried out largely by small-scale producers who either consume the products or sell them in local markets.
[h] Derived from combined index of potential gain modified by sustainability and equity, assuming equal weight. High number indicates high priority.
[i] Conservative figures used for these indexes to reflect the concerns raised by the External Review Panel. The following changes were made (numbers in parentheses reflect numbers presented to the Panel): Fish catch in Estuaries, lagoons 7.1 (5.1); Coral reefs 4.0 (6.0), Potential to increase production - Capture fisheries in Coral reefs 2(3).

Table 2. Total[1], inland[1] and inland aquaculture[2] production and the estimated inland capture fishery production for the years 1986 to 1991. The percentage contribution from Asia to the total inland production is given in parenthesis. All values are in tonnes.

Production (t)	1986	1987	1988	1989	1990	1991
Total	92,803,500	93,378,600	99,016,100	100,208,300	97,433,500	96,925,900
Total inland	11,727,600 (67.0%)	12,681,500 (67.6%)	13,382,100 (68.8%)	13,832,500 (69.6%)	14,622,500 (70.5%)	15,177,200 (72.1%)
Inland aquaculture	5,190,902	6,332,936	6,993,457	7,219,032	7,666,324	8,060,063
Inland capture	6,536,698	6,348,564	6,388,643	6,613,468	6,956,176	7,117,137

[1] Source: FAO Yearbook 1991
[2] Source: FAO Fish. Circ. 815, Rev. 6.

The index used in potential to increase production in Table 1 was such that only three values (0, 1, 2) were used. A finer scale would have allowed better differentiation between the resource systems.

This brings me to the third point; in Table 1 the potential to increase capture fisheries from reservoir-lake, and coral reef resource systems is given equal weighting (=2). In my view this is not justified for a number of reasons. Reservoirs in particular are more manageable and relatively more easily manipulated and hence provide more opportunities to increase fish production. For example, reservoirs are 'closed' systems for all intents and purposes and therefore culture-based fisheries can be developed to obtain high returns; water-level management can be used to trigger higher recruitment of certain species and thereby gain higher production; proper stocking practices can ensure an increase in production and so forth. None of these strategies are adoptable for coral reefs. Instances where proper management has significantly increased fish production are documented (Table 3), and similarly it has been shown that in China the stocking efficiency (ratio of the yield in kg/ha to weight stocked in kg/ha) in reservoirs is between 5 and 15 and is considered to be higher than in culture ponds (Li 1988). It is evident from Table 3 that the rate of return through scientific management (hence research input) of reservoir fisheries is considerably higher than perhaps the potential increase in aquaculture through genetic improvement, nutrition, etc.

There is also evidence that reservoir capture fisheries production can be improved further by harnessing stocks of indigenous fish species which recruit naturally (De Silva and Sirisena 1987, 1989; Sirisena and De Silva 1989); a resource system which offers new stocks for exploitation is unknown to the author. All of the above facts go to show that the reservoir-lake resource system has a great potential to increase production, far more than those given priority so far.

Fourthly, aquaculture production in the reservoir-lake resource system is estimated to be 0.2 x 10^6 t compared to 0.5 x 10^6 in coral reefs. Here again, there is a dearth of hard data, but there is evidence that reservoirs in particular are increasingly playing a major role in aquaculture production. For example in China, in addition to the culture-based fishery in reservoirs, the relatively new practice of cove culture has augmented fish yields significantly. According to Lu (1992), in Jiangsu Province, east China, the area under cove culture increased from 0.2% to 0.73% of the reservoir acreage between 1986 and 1990. The total yield and the yield/ha from cove culture for the corresponding years were 223.25 t and 895 t and 4,549 kg/ha and 5,029 kg/ha, respectively (Table 4). Needless to say the potential to increase production in reservoirs using well known and increasingly popular cage culture practices, carried out intensively, is likely to be much higher. Both practices are likely to become increasingly popular, resulting in significant increases in fish yields from reservoir-lake resource systems. Increase in culture practices may also indirectly have a positive influence on fisheries in such water bodies, further augmenting the overall fish yields.

Obviously, aquaculture production can be increased either by further intensification of existing practices, hand-in-hand with improvements in husbandry techniques, genetic makeup, nutrition, etc., and by opening up more areas for aquaculture. The scope for the latter to increase significantly is limited because land is at a premium in most developing countries. Moreover, there is an increasing need to rehabilitate a large number of old ponds in most countries which could possibly reduce yields from pond culture activities, in quantum and in diversity, in developing countries. Therefore, further increases in aquaculture activities become possible mainly in existing impoundments, and to this end the reservoir-lake resource system has much to offer. Already, signs of this are evident, for example in Indonesia (Costa-Pierce and Soemarwoto 1990) and in China (Fig. 2).

For the above reasons, the potential increase for aquaculture in the reservoir-lake resource system is likely to become considerably higher than in any other resource system.

I have endeavored to demonstrate that the reservoir-lake resource system has been under-prioritized in the final evaluation in determining the research strategy for ICLARM. ICLARM has the chance to remedy this as it revises its strategic direction in future, and particularly in view of the opportunity for more work in Africa from its new facility in Abbassa, Egypt. I have attempted to justify the need to reconsider the priorities, using the same conceptual framework, particularly in respect of reservoir-lake systems. As pointed

Table 3. Production trends in scientifically managed small reservoirs in India (from Jhingran 1992).

Reservoir	Area (ha)	Yield (kg/ha) Before scientific management	Yield (kg/ha) After scientific management
Gulariya, Uttar Pradesh	150	33	100
Bachhra, Uttar Pradesh	140	a	139
Aliyar, Tamil Nadu	646	27	202

[a] New reservoir

Table 4. Status of cove fish culture with earthen embankments in Jiangsu Province, east China (from Lu 1990).

	1986	1987	1988	1989	1990	1991
Total reservoir aquaculture area (ha)	24,286	25,253	25,653	25,680	24,460	NA*
No. of sites	6	16	22	26	33	37
Total cove area (ha)	49.06	109.8	128.3	153.1	177.9	195.0
% of total reservoir area	0.2	0.43	0.5	0.6	0.73	
Total yield (t)	223.25	502.8	647.95	760.9	895	NA
Yields (kg/ha)						
reservoir	153.3	198.15	213.45	226.8	258.15	NA
coves	4,549.5	4,579.5	5,012.0	4,969.5	5,029.5	NA

*Not available

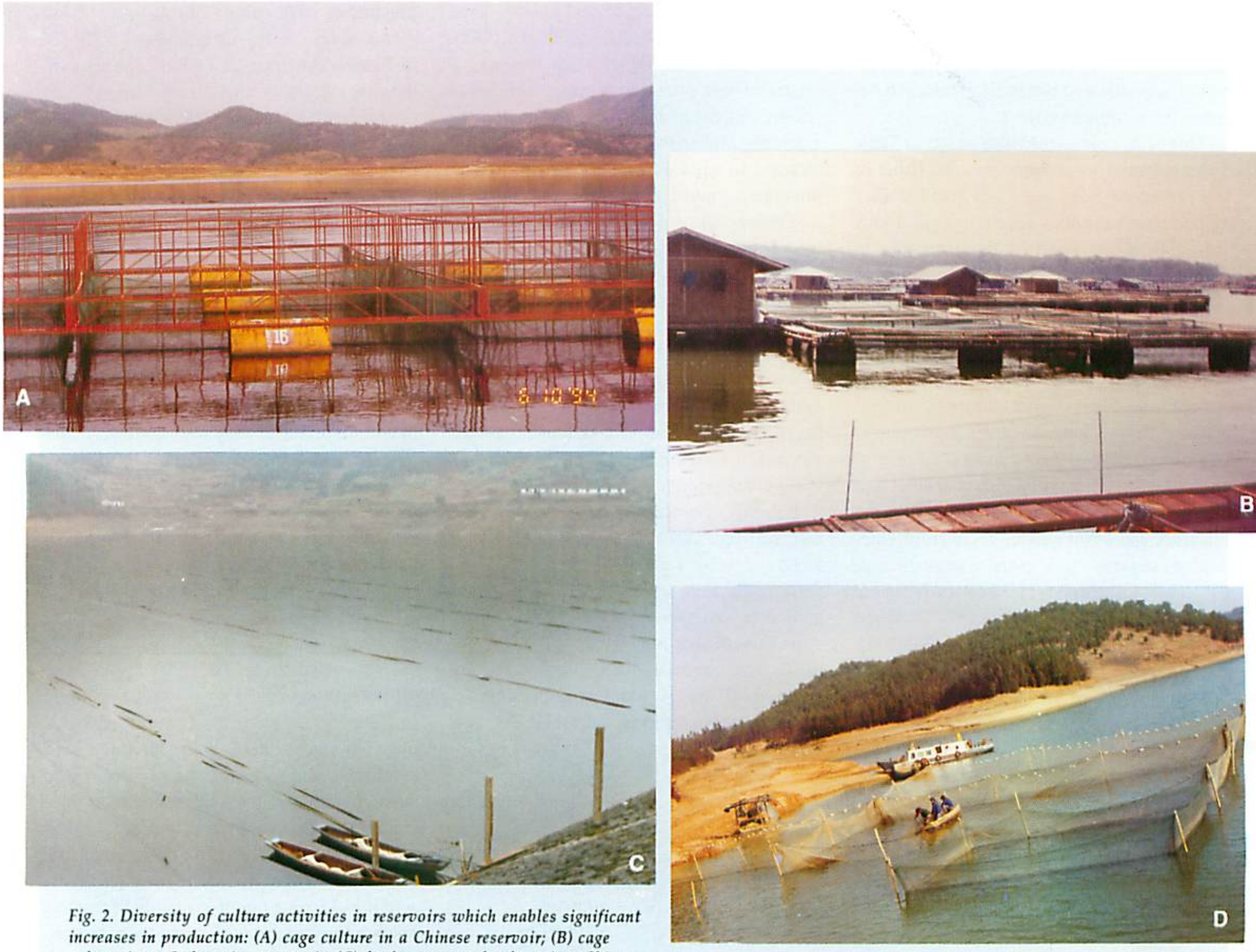

Fig. 2. Diversity of culture activities in reservoirs which enables significant increases in production: (A) cage culture in a Chinese reservoir; (B) cage culture in an Indonesian reservoir; (C) freshwater pearl culture in a Chinese reservoir; and (D) fish catch from cove culture kept ready for delivery to the market.

out earlier, in a climate where research priority setting is becoming ever more important, it is important that these priorities are re-evaluated as often as possible. I also hope this article will induce other researchers to think along similar lines on other ecosystems, and open the dialogue more widely.

Further Reading

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