

# WATER FOR FOOD AND ENVIRONMENTAL SECURITY

Bart Schultz<sup>1</sup>

## ABSTRACT

The cultivated area on earth is 1,500 million ha. At 1,100 million ha agriculture takes place without a water management system. Irrigation covers 260 million ha and is responsible for 40% of crop output. Drainage of rainfed crops covers 130 million ha and is responsible for 15% of crop output. Thus 55% of the food production is obtained with the support of a water management system.

During the Second World Water Forum in March 2000 a sector vision of 'Water for Food and Rural Development' was presented. It indicates a required duplication in food production - primarily from already cultivated land - in the forthcoming 25 years and gives recommendations how this can be achieved.

In this contribution focus is on how the concerned issues may play a role in the development of irrigation and drainage under different climatological and socio-economic conditions. It is illustrated which measures may be required, including increase in storages and transbasin water transfers. In line with this the Strategy for Action of the International Commission on Irrigation and Drainage (ICID) is presented, showing which contributions ICID is planning to give to the realisation of the challenges.

*The pace of change in our world is speeding up, accelerating to the point where it threatens to overwhelm the management capacity of political leaders. This acceleration in history comes not only from advancing technology, but also from unprecedented world population growth, even faster economic growth, and the increasingly frequent collisions between expanding human demands and the limits of the earth's natural systems.*

Lester R. Brown, 1996

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<sup>1</sup> President of the International Commission on Irrigation and Drainage (ICID)

Professor Land and Water Development, International Institute for Infrastructural, Hydraulic and Environmental Engineering (IHE), Delft, The Netherlands

Head of the Environmental Engineering Department. Directorate-General for Public Works and Water Management, Utrecht, The Netherlands

## INTRODUCTION

During the Second World Water Forum in March 2000 a sector vision of 'Water for Food and Rural Development' was presented. It indicates a required duplication in food production - primarily from already cultivated land - in the forthcoming 25 years and gives recommendations how this can be achieved.

Having in mind the required increase in food production in the forthcoming decades, the increased water use by other users and the general recognition of the need for sustainable rural development a wide range of issues is of major importance. In this contribution focus will be on how the concerned issues may play a role in the future development of irrigation and drainage under different climatological and socio-economic conditions. It will be illustrated what measures may be required, including increase in storages and transbasin water transfers. In line with this the Strategy for Action of the International Commission on Irrigation and Drainage (ICID) is presented, showing what ICID considers of relevance and which activities the Commission is planning to develop to contribute to the realisation of the future challenges.

## POPULATION, ITS GROWTH AND ITS STANDARD OF LIVING

Basis for the water management requirements is the worlds' population, its growth and its standard of living. The present worlds' population and a prognoses of the population growth are shown in Figure 1 (after Van Hofwegen and Svendsen, 2000). Of special interest in this figure is the distinction in least developed countries, emerging developing countries and developed countries. The majority of the worlds' population lives in the emerging developing countries. This category comprises Asia (excluding Japan), Latin America, the Caribbean and some other small regions. From Figure 1 it can be further derived that population growth will take place in the least developed countries and the emerging developing countries. In the developed countries a slight reduction of the population is expected.

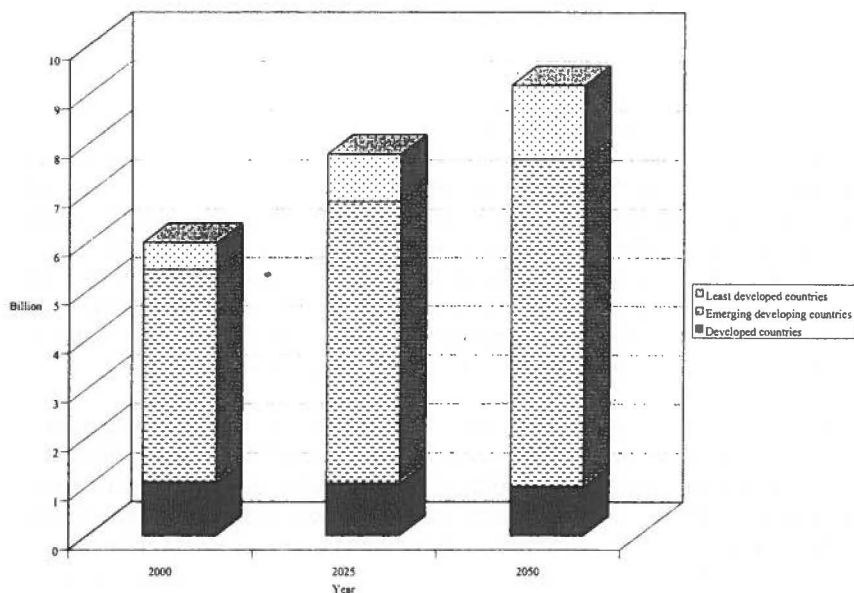


Figure 1. World population and growth in least developed countries, emerging developing countries and developed countries (van Hofwegen and Svendsen, 2000)

Another interesting feature related to population growth are the migration from rural to urban areas. The expectation is that due to these developments the population in the rural areas in the least developed and emerging developing countries will more or less stabilise and that the growth will be concentrated in the urban areas in these regions.

Especially in the emerging developing countries the standard of living is rapidly rising. One of the implications is the increase and change in food consumption per person. However, about 1.2 billion people in the least developed and emerging developing countries are still poor and have to live from a minimal diet, or has hunger. Out of them about 70% live in the rural area.

### WATER MANAGEMENT FOR AGRICULTURE

With respect to water management related to agricultural production there are broadly speaking three agro-climatologic zone's, being: temperate humid zone, arid and semi-arid zone and humid tropical zone. In addition, in principle, four types of cultivation practices may be distinguished, being:

- rainfed cultivation, without or with a drainage system;

- irrigated cultivation, without or with a drainage system.

Dependent on the local conditions different types of water management with different levels of service will be appropriate (Schultz, 1993). In the temperate humid zone agriculture generally takes place without a water management system, or with a drainage system only. Supplementary irrigation may be applied as well. In the arid and semi arid zone agriculture is normally impossible without an irrigation system. Drainage systems may be applied as well for salinity control and the prevention of water logging. In the humid tropical zone generally a distinction is made in cultivation during the wet and the dry monsoon. During the wet monsoon cultivation is generally possible with a drainage system only, although quite often irrigation is applied as well to overcome dry spells. In the dry monsoon irrigation is generally required to enable a good yield.

In Figure 2 the development of the cultivated area without a water management system and under irrigation since the beginning of the 19<sup>th</sup> century are shown. For drainage only the present area is given, while no reliable data on the development are available. The total cultivated area on earth is about 1,500 million ha, which is 12% of the total land area. At about 1,100 million ha agricultural exploitation takes place without a water management system. However, in a certain part of these areas methods like water harvesting, or soil treatment may be applied. Presently irrigation covers more than 260 million ha, i.e. 17% of world's arable land. Some characteristic figures of the ten countries with the largest irrigated area are given in Table 1. Irrigation is responsible for 40% of crop output. It uses about 70% of waters withdrawn from global river systems. About 60% of such waters are used consumptively, the rest returning to the river systems, in principal enabling its reuse downstream. Drainage of rainfed crops covers about 130 million ha, i.e. 9% of world's arable land. In about 60 million ha of the irrigated lands there is a drainage system as well. From the 130 million ha rainfed drained land it is roughly estimated that about 15% of crop output is obtained. Some characteristic figures of the ten countries with the largest drained area are given in Table 2. In this Table the total drained areas are given, while it is very difficult to differentiate between rainfed drained areas and drainage in irrigated areas.

30% of water withdrawn is put to other uses like drinking, municipal, industrial, hydropower generation, and recreation. Only a small part of this is used up consumptively, while a large unconsumed part either treated or untreated is returned to the river systems and reused. Due to population growth, increase in standard of living - especially in the emerging developing countries -, urbanization and industrialization the withdrawals for these uses are increasing.

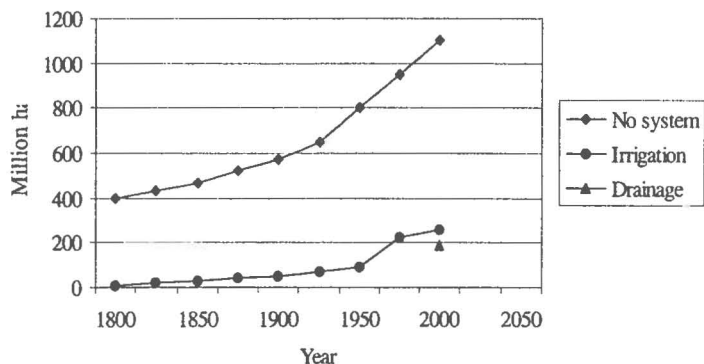


Figure 2. Development of cultivated area in the world without a water management system and under irrigation and the presently drained area

Table 1. Some key figures for the ten countries with the largest irrigated area (International Commission on Irrigation and Drainage, 2000)

Country	Population in 10 <sup>6</sup>	% of population in agriculture	Total area in 10 <sup>6</sup> ha	Arable land in 10 <sup>6</sup> ha	Irrigated area in 10 <sup>6</sup> ha
India	960	61	329	170	57
China	1,243	68	960	96	50
USA	272	2	936	188	21
Pakistan	144	48	80	22	17
Iran	72	28	163	18	7
Mexico	94	23	195	27	6
Russia	148	11	1,171	208	5
Thailand	59	59	51	20	5
Indonesia	203	50	190	30	5
Turkey	63	48	77	27	4
Total	3,258		4,152	806	177
World	6,000		13,000	1,500	260

Water management originates from about 6,000 years ago when irrigation was practised in the plains between Tigris and Euphrates rivers. Strange is, however, that although there is such a wealth of experience, and we have at the moment the best know how, the best technology and the highest financial means, the problems in certain regions are enormous. I like to mention the major types of problems:

- water shortages;
- inefficient water use;
- waterlogging and salinization;
- inadequate operation and maintenance;
- pollution through fertilisers and pesticides;
- flooding of cultivated, urban and industrial areas.

Table 2. Indicative key figures for the ten countries with the largest drained area (International Commission on Irrigation and Drainage, 2000, and data base CEMAGREF)

Country	Population in 10 <sup>6</sup>	% of population in agriculture	Total area in 10 <sup>6</sup> ha	Arable land in 10 <sup>6</sup> ha	Drained area in 10 <sup>6</sup> ha
USA	272	2	936	188	47.0
China	1,243	68	960	96	28.5
Indonesia	203	50	190	30	15.4
India	960	61	329	170	13.0
Canada	30	3	997	46	9.5
Brazil	163	19	851	66	8.0
Yugoslavi a	144	48	80	22	5.7
Pakistan	82	3	36	12	4.9
Germany	39	23	32	15	4.2
Poland					
Total					142.0
World	6,000		13,000	1,500	190

With the above in mind we can look forward. First of all I like to sketch who are the actors in the field of agricultural water management (Figure 3). Responsible are government, irrigation and drainage agencies and farmers. This implies that in order to achieve sustainable solutions these three parties have to agree on their role and share in water management and flood protection in a region. All others contribute. They are needed and have a function for various reasons, but they are not responsible.

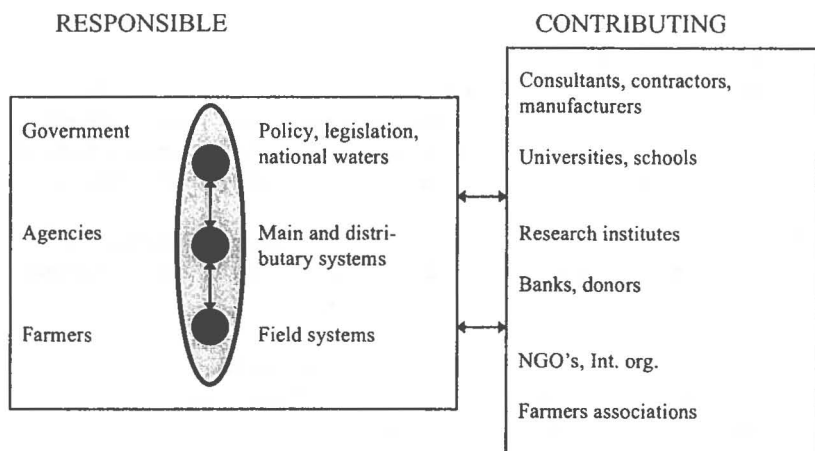


Figure 3. Indicative schematisation of actors in agricultural water management

For urban water management a similar scheme can be presented, although in this case the municipalities, and not the individual citizens, are generally in charge of the urban systems: the sewerage, the water treatment and the urban drainage. Citizens can contribute by efficient water use in their homes, as well as by proper waste disposal, and last but not least financially.

During the Second World Water Forum, which was held in March 2000 in The Hague, The Netherlands, the World Water Council (WWC) has presented a global 'Long Term Vision on Water, Life and the Environment in the 21<sup>st</sup> Century'. In the framework of the vision preparation process, among others, three major sector visions were prepared: 'Water for Food and Rural Development', 'Water for People' and 'Water and Nature'. The scope of these visions is 25 years. ICID has played a prominent role in the preparation of the sector vision of 'Water for Food and Rural Development' (Van Hofwegen and Svendsen, 2000).

The sector vision of Water for Food and Rural Development indicates a required duplication in food production and gives general recommendations how this increase can be achieved. The major part of the increase in production would have to come from already cultivated land, among others, by water saving, improved irrigation and drainage practices, and increase in storages. It became fully clear during the vision preparation process that, especially in the developing countries, huge efforts are required to feed the still growing world's population, to improve the standard of living in the rural area, and to develop and manage land and water in a sustainable way.

In order to achieve the required increase in food production in the framework of sustainable rural development, the following issues are generally considered to be of major importance:

- availability of water and availability in space and time;
- links between irrigation, drainage and flood protection, and food security, protection of the environment, sustainable rural development and livelihood;
- rural development, agriculture based infrastructure, socio-economic and ethical issues, poverty alleviation, employment generation, migration from rural to urban areas;
- need for increasing withdrawals with 15 - 20% to bridge mismatch between demand and supply in combination with water saving and improved efficiency in irrigation;
- need for increasing storages with 10 - 15%;
- basin wide planning for integrated development and management;
- transbasin water transfers, shared rivers, conflict management;
- governance, legal, institutional and environmental issues;
- stakeholder involvement, youth and women participation;
- financing integrated water resources development and management (IWRDM), modernisation and replacement;
- equity, efficiency and economy.

Related to figures on the increase in withdrawals and storages it is questioned whether the assumptions regarding the increase in efficiency in irrigation can indeed be achieved in time and whether present unsustainable practices, like depletion of groundwater resources have sufficiently been taken into account. If not, the required increase in withdrawals and storages would become even higher.

### **FUTURE DIRECTIONS**

This brings us to the future directions. We cannot forecast these directions in detail, but tendencies can be observed that may sooner or later result in policy decisions, actual guidelines, or standards for design, implementation, operation, maintenance and management. These directions can be put under the following headings:

- integrated water management;
- developments in irrigation and drainage;
- integrated planning;
- sustainable development;
- acceptable environmental impacts.

Some background on each of these directions will be given.

#### **Integrated Water Management**

For many centuries water management was mainly focused on water quantity control, by water supply or drainage. In an increasing number of countries



nowadays we may speak about water quantity and water quality control, although at different levels of service, more or less dependent on the respective standards of living. What also can be observed is that water management in many regions is becoming more adapted to diversification in land use, and not exclusively anymore for agricultural use only. In future most probably another step will be taken and we will come to an ecosystem approach. In light of this we also have to consider the theme of this conference.

### **Developments in Irrigation and Drainage**

In irrigation and drainage there are certain specific issues that deserve our attention. Here we see that in the developed countries a lot has already been achieved, but that especially in the emerging developing countries these issues are far from being solved and that significant efforts will be required from the parties concerned (Figure 3) to find sustainable solutions. It regards especially:

- required increase in efficiency and water saving;
- institutional reforms in the direction of stakeholder controlled management and government support for modernisation, rehabilitation and reclamation;
- increased stakeholder participation;
- transfer of systems, or of responsibilities;
- modernisation;
- cost recovery.

With respect to the theme of this conference the issues of increase in efficiency and water saving are of special importance, while in several cases these are more or less linked to the need for transbasin water transfers. In light of this the modernisation of irrigation and drainage systems, especially in the emerging developing countries, will also have its influence. With respect to this it has to be realised that a significant part of the existing systems is more than thirty years old. While most of the increase in food production will have to come from existing cultivated land, the issue of modernisation, including the related institutional reforms and cost recovery aspects will deserve major attention in the coming period. Such modernisations will also have to be considered in light of water availability.

### **Integrated Planning**

Irrigation and drainage are no isolated activities. They play a role in societies and have to be treated, also taking into account such issues. Therefore of importance are:

- links between irrigation, drainage and flood protection, and food security, rural development and livelihood;
- basin wide planning for integrated development and management.

Especially related to the second issue the possibilities and constraints of transbasin water transfers will have to be considered.

### **Sustainable Development**

We are more and more concerned about the sustainability of our activities. In the past we did not have to bother so much about this, but increasing population pressure, changes in food production practices, and mining, or even exhaustion of resources have increased our concern. The following tendencies can be observed that in different ways will have an impact on our sector:

- migration of people from rural to urban areas;
- requirement of higher yields per ha;
- increase in farm sizes, higher value crops, or part time farming;
- mechanisation in agriculture;
- competition for water;
- increased application of fertiliser and pesticides;
- depletion of surface and groundwater resources.

As indicated before, especially in the emerging developing countries, there is the ongoing urbanisation and industrialisation. Another interesting feature is that within 50 years 80% of the worlds population is expected to live in coastal and deltaic areas. By far the majority of them in urban areas. In light of this the issue of flood management and flood protection of densely populated areas deserves special attention. In many densely populated flood prone areas the safety against flooding is less than once in fifty years, which is in fact significantly below the optimal level when the risk of loss of human lives and economic damage are evaluated. However, most of the countries where such situations exist don't avail of sufficient financial resources to realise higher levels of safety. In such cases transbasin water transfer may be an effective means for on the one hand realising the reduction in risk of flooding and on the other hand transferring water to an adjacent water scarce river basin.

### **Acceptable Environmental Impacts**

All our projects have side effects. The challenge has been and will be to keep the negative environmental impacts at an acceptable level and to support positive environmental impacts as far as reasonably possible. Of special importance for our sector are:

- controlled application of fertiliser and pesticides;
- quality criteria and quality control for drainage waters;
- prevention of water logging and salinization;
- prevention of depletion of surface and groundwater resources.

Transbasin water transfers may play a role related to the last issue. Increasingly we see depletions occurring, especially in the arid and semi-arid region. When solutions by way of transfers are being considered, the acceptable environmental impacts will also have to play a considerable role in decision making. This makes the decision making process generally very complicated while the environmental impacts of these, quite often large scale, works may be far reaching and very difficult to forecast and to quantify. Elaborate studies are generally required to identify the environmental values in the concerned areas and to forecast the environmental impacts of the envisaged works.

### RESERVOIRS AND TRANSBASIN WATER TRANSFERS

In the past years there has been quite some discussion on dams and reservoirs. The issue of transbasin water transfers did not get so much attention yet, although related to specific projects the discussions may be heated and decisions increasingly controversial.

In light of the global debate on dams and reservoirs ICID was asked in 1998 to clarify its position. This has resulted in a position paper on the 'Role of dams for irrigation, drainage and flood control', which was almost unanimously approved by our National Committees during the International Executive Council meeting in Granada, Spain (International Commission on Irrigation and Drainage, 1999). Most probably this was the first time that ICID took a position regarding a certain issue. In the near future ICID may prepare more of such position papers on topics that concern our National Committees. One main statement in the position paper reads.

*Irrigation, drainage and flood control of agricultural lands are no longer options. They are necessary for feeding billions of people, for providing employment for rural poor and for protecting the environment. With respect to this ICID stresses that dams have played and will continue to play an important role in the development of water resources, especially in developing countries. A balance needs to be found between the requirements based on the needs of society, acceptable side effects and a sustainable environment.*

*From ICID Granada Statement, 19 September 1999*

While irrigated agriculture is the largest water user at a global scale and an increase in withdrawals for irrigation is considered to be required in realising the required increase in food production, more storages will have to be developed for irrigation water as well. We may expect that increasingly such storages can only be developed in conjunction with transbasin water transfers. Therefore our sector may be considered as a major stakeholder in such developments.

### ROLE OF ICID

ICID is a scientific and technical, non-governmental international organisation. Its objectives are to stimulate and promote the development and application of irrigation, drainage, flood control, river training and environmental management in all their technical, economic, social and environmental aspects, as well as the needed research leading to the use of modern techniques. One of the interesting aspects of ICID is that, although it is a non-governmental organisation, there is a very good representation of government officials from ministries of Agriculture, Public Works, or Water Resources, as well as of the multilateral organisations that have programmes or projects in the sector. In this way ICID functions as a forum where representatives of the public and private sector, active in the field of water management and flood protection, can discuss and study subjects of joint interest. In addition to its forum function ICID disseminates its messages through the Journal Irrigation and Drainage, guidelines, books, congresses, conferences and workshops and the new media, like CD-ROM, ICID's website [www.icid.org](http://www.icid.org) and websites of various National Committees and Work Bodies.

In order to show its contribution to water for food and rural development ICID has prepared its Strategy for Action reflecting its specific ideas, position and plans as a key international association of professionals in the sector. Together with the Country Position Papers which were made by the National Committees the draft Strategy for Action was presented during the Second World Water Forum. The Strategy for Action also formulates what ICID considers of importance for guiding decisions and activities by the actors in the sector. In line with that ICID's own contribution has been formulated. The Strategy for Action has been discussed during the ICID Council Meeting in October 2000 in Cape Town, South Africa, where several suggestions for improvement were made and the strategy was approved. Several activities as outlined in the strategy will be described.

ICID is in the privileged position that its National Committees in many countries are very well organised and develop a wide range of activities that contribute to the development of the sector. A few key data on developments and activities are:

- *Meetings and conferences.* The list is impressive and the topics presented and discussed are all very relevant for the sector. In chronological order for this year:

- \* European regional conference on Sustainable Use of Land and Water, 4-8 June 2001, Brno and Prague, Czech Republic
- \* USCID conference on Transbasin Water Transfers, 27-30 June, Denver Colorado
- \* 4<sup>th</sup> IRCEW Competitive Use and Conservation Strategies for Water and Natural Resources, 27-30 August 2001, Fortaleza, Brasilia Brazil
- \* 52<sup>nd</sup> council meeting and 1<sup>st</sup> Asian Regional Conference on Agriculture, Water and Environment, Seoul, Korea

ICID's Congresses and Council Meetings are allocated up to 2006 with themes and topics that are all relevant to the problems of and developments in the sector. An additional service that is now available is that all the papers can be downloaded from ICID's Text Delivery Service at Central Office. This will make all this valuable information much more accessible than could be done in the past;

- ***Irrigation and Drainage***. ICID's scientific Journal that is now being published by John Wiley & Sons under ICID's full editorial responsibility. I sincerely hope that the Journal will have a bright future and encourage potential authors to submit quality papers;
- ***ICID products***. Several of ICID's other products have relevance for the sector and are gaining increasing interest. With respect to this specifically have to be mentioned:
  - \* web site: *www.icid.org*, including the Text Delivery Service;
  - \* multilingual technical dictionary in English and French, which is now also available on CD-ROM;
  - \* *ICID's books*. Reference is made to ICID's web site and to the forthcoming publication on Historical Dams that will be presented in the ICID Council meeting in Seoul, Korea in September;
  - \* *WatSave prices*. These prices focus on the promotion of water saving technologies and activities. This year the prices will be awarded already for the fourth time.
- there is an impressive list of activities that ICID is developing jointly with other organisations. Of special importance in relation to the theme of this conference is the *Dialogue on Water, Food and Environment*. If the International Executive Council meeting approves the proposal ICID will participate in the consortium that will be established for this dialogue. The other partners will be: UNEP, IWMI, FAO, IUCN, WHO, WWF, GWP.

Above are mentioned various specific activities and developments, which will directly, or indirectly contribute to improved water management for increased

agricultural production, poverty alleviation and sustainable development of the rural area. With respect to this I even did not mention all the work that is being done by ICID's working groups. If you are not familiar with this it is recommended to have a careful look at ICID's web site. You will undoubtedly find information that will be of use for you.

### CONCLUSION

There are tremendous challenges for the irrigation and drainage sector. Generally speaking we are prepared to deliver our contribution, but we have to be very keen to maintain and improve our position in light of scarcity and increased competition for water. In this light the theme of this conference is very relevant and has to be dealt with carefully and professionally. When we further develop our profession in a sustainable way we can serve societies in the way they have to be served.

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