THE VETIVER SYSTEM FOR THE TREATMENT OF CONTAMINATED WATER AND EFFLUENT

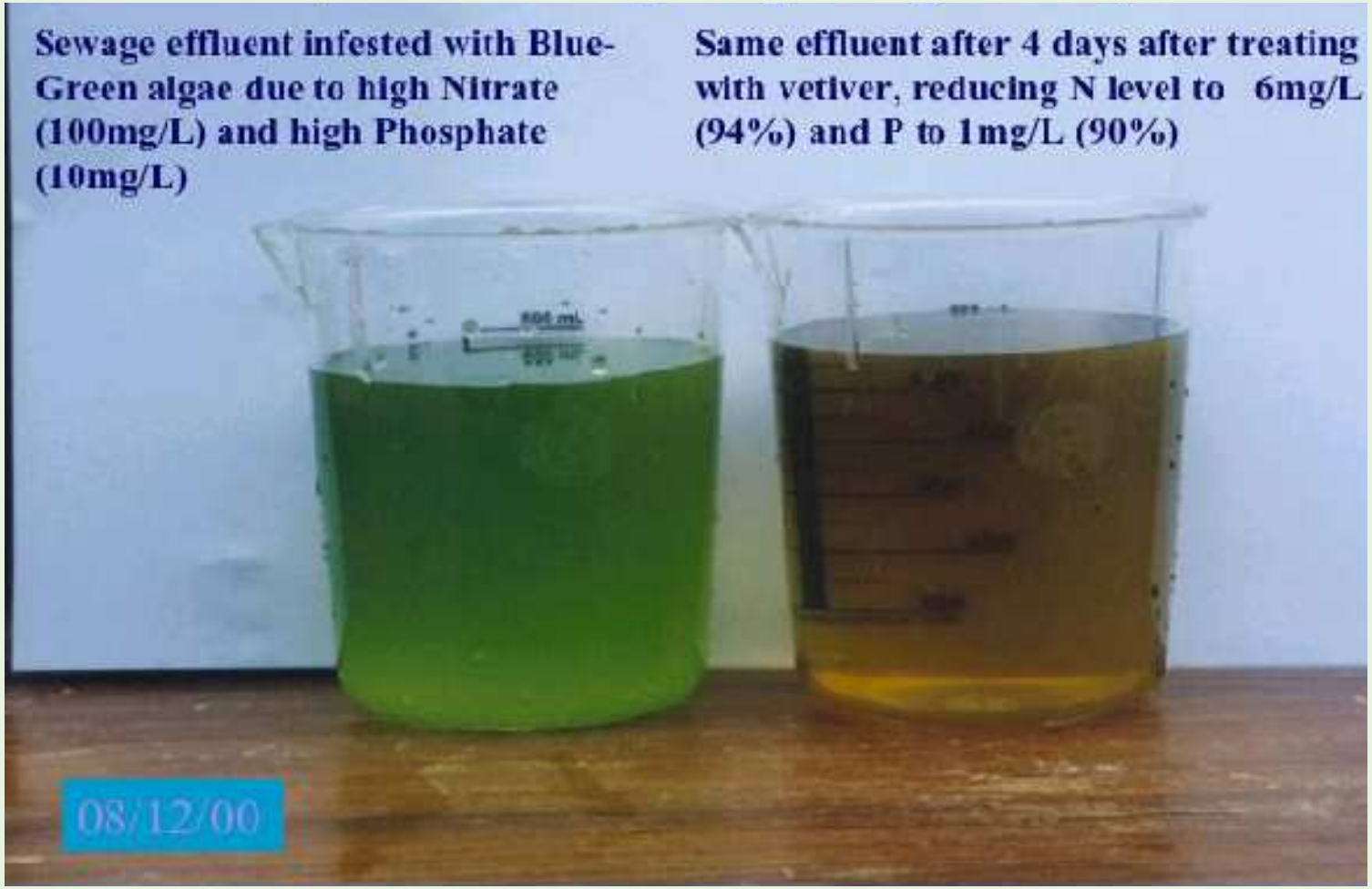
SPECIAL FEATURES OF VETIVER GRASS SUITABLE FOR WASTEWATER DISPOSAL AND TREATMENT

UNIQUE ATTRIBUTES

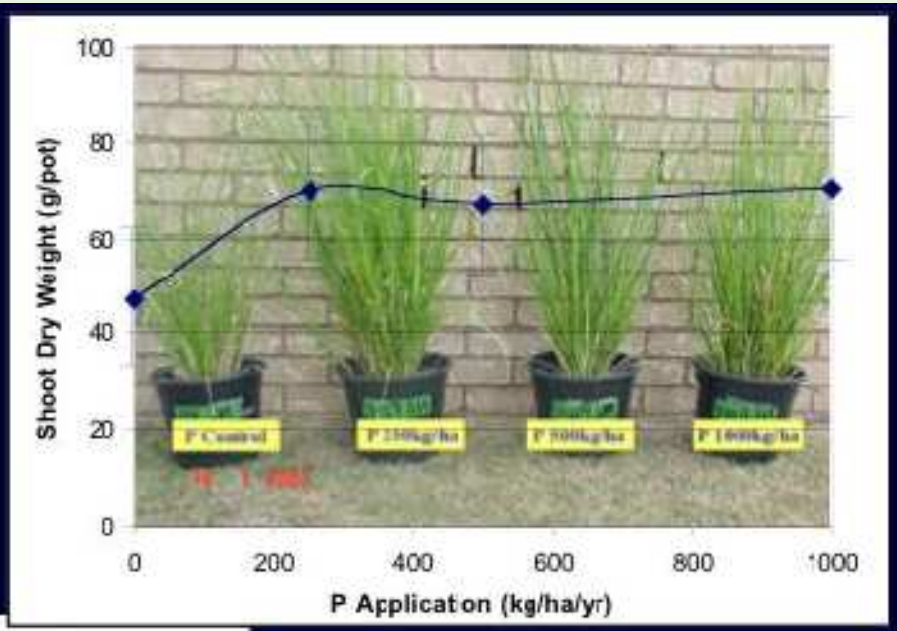
Stiff and erect stems up to 2m tall and over 2.5m with flower head. It flowers but does not set seeds.

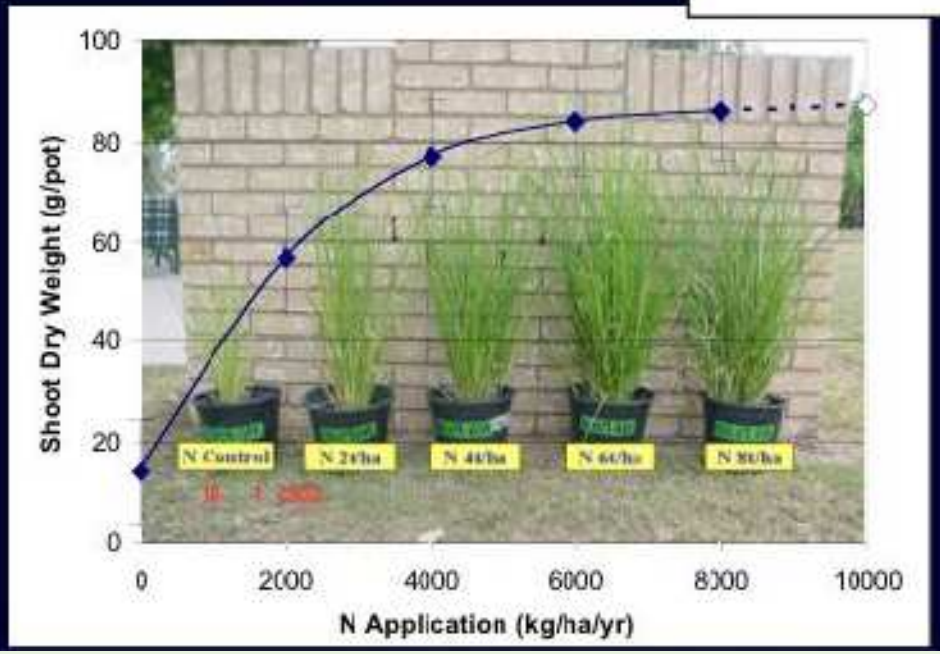
N AND P REMOVAL

HIGH CAPACITY FOR REMOVING N AND P FROM POLLUTED WATER. VETIVER CLEANED UP BLUE GREEN ALAGAE IN 4 DAYS



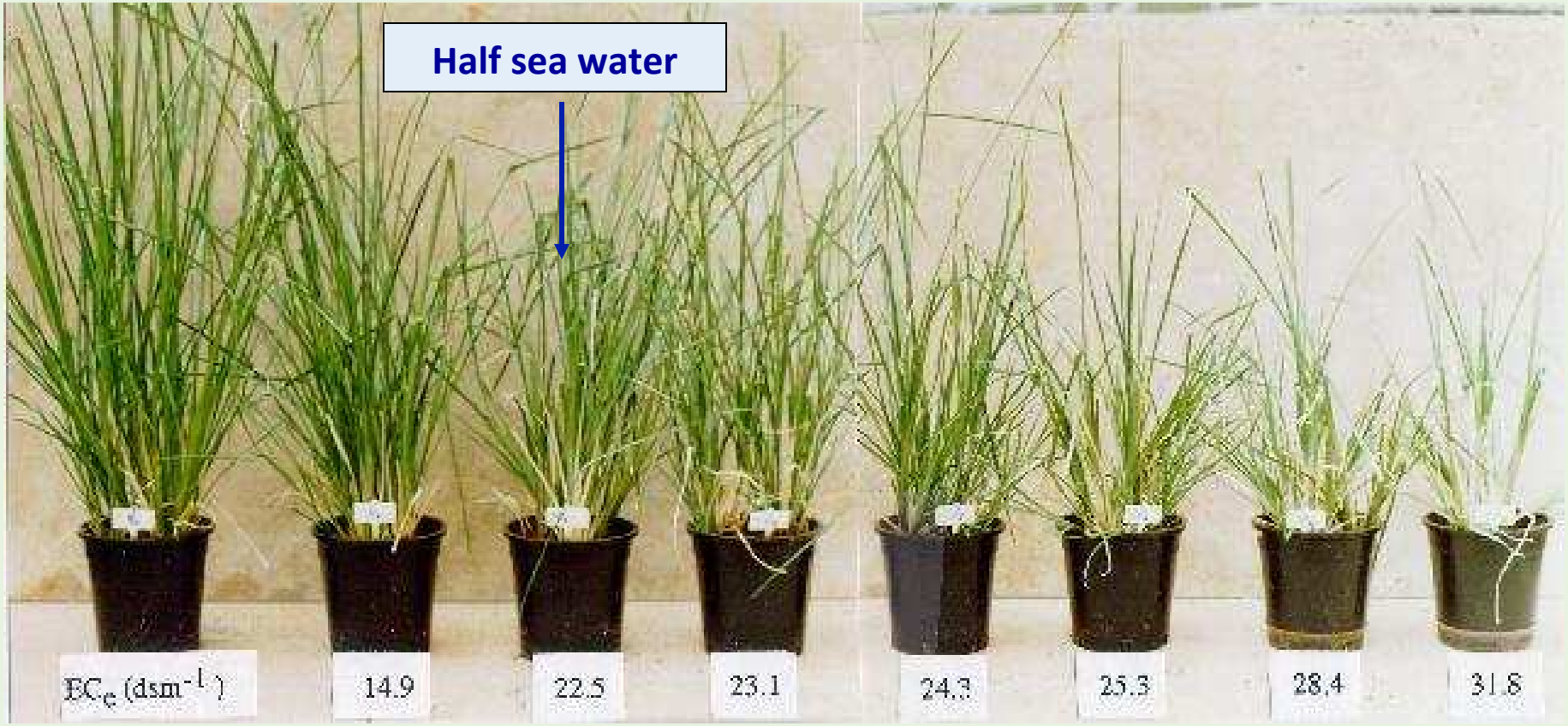
Tolerance to extremely high levels of nutrients





HIGHLY SALT TOLERANT

Saline threshold level is at EC_e=8 dsm^{-1}, and vetiver can survive at 47.5 dsm^{-1} under dry-land salinity conditions

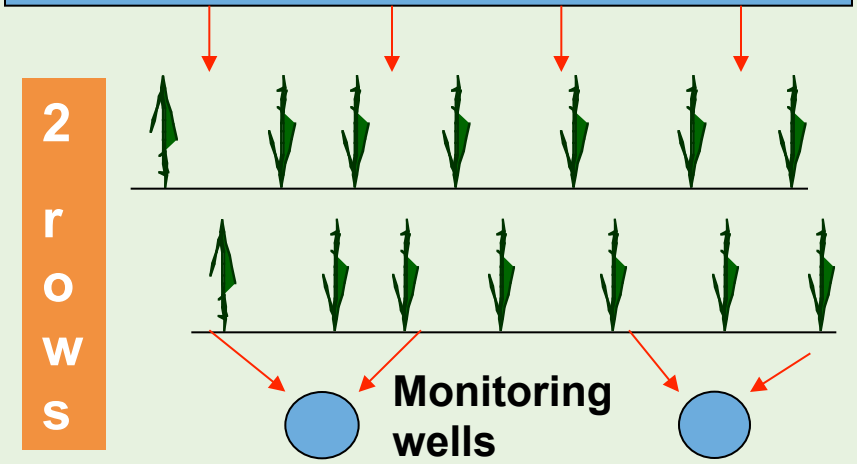


ABSORBING POLLUTANT: Much higher capacity for N and P absorption as compared with other plants.

Plant species	Nitrogen (kg/ha/year)	Phosphorus (kg/ha/year)
Vetiver hydroponic	13,688	1,026
Vetiver pot trials	2,040	153
Vetiver field trial	1,142	149
Rhodes grass	600	90
Kikuyu	500	90
Green Panic	430	70
Forage sorghum	360	70
Bermuda grass	280	30-35
Eucalypts trees	90	15
Rye grass	200-280	60-80
Wheat (6)	23-208	3-27

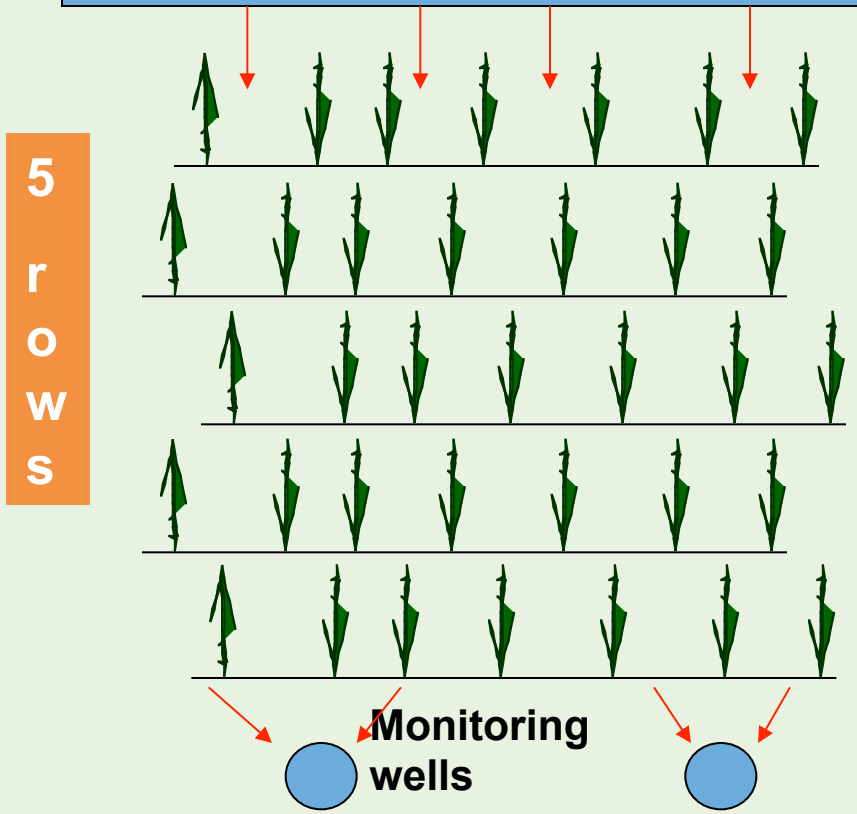
Effectiveness of vetiver in reducing N level in domestic blackwater

Entry: Total N level at 95.2mg/L



Exit: Total N level at 16mg/L or a reduction of 83%

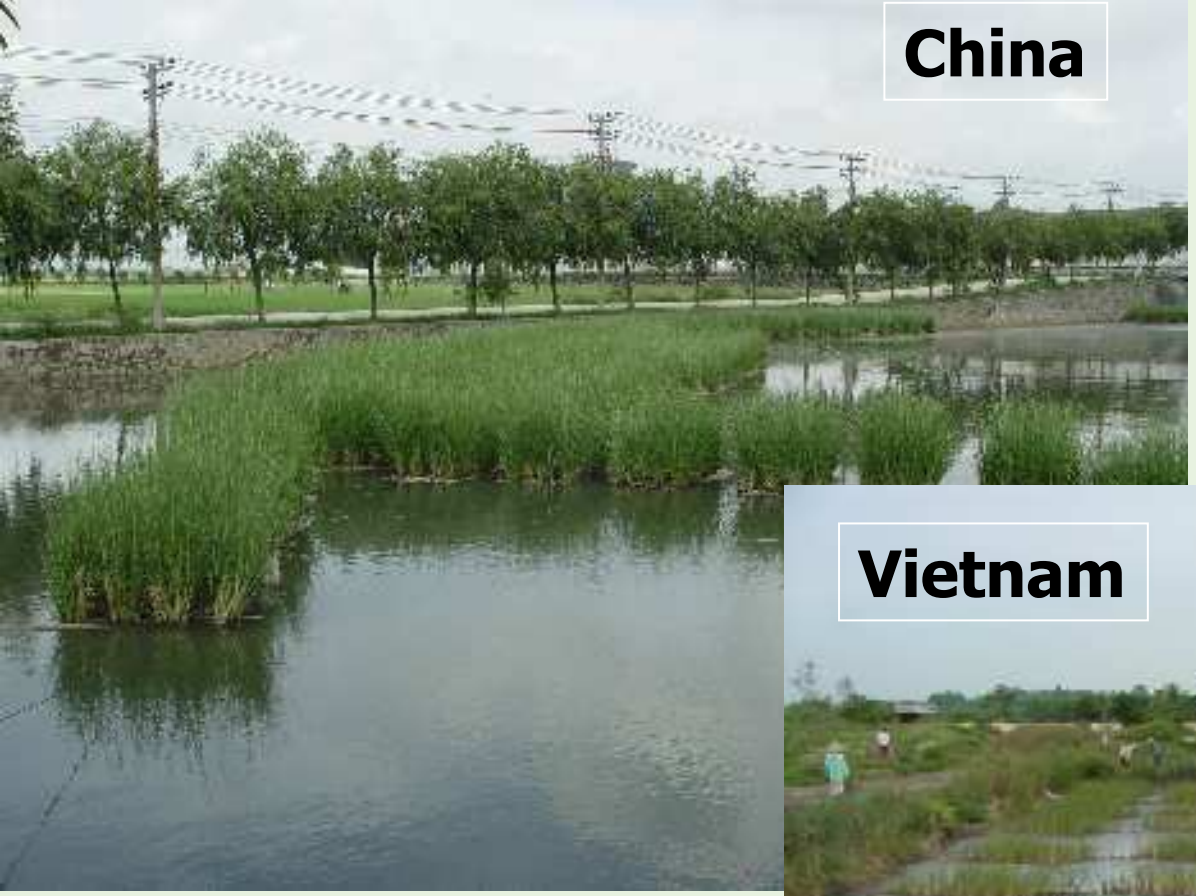
Entry: Total N level at 95.2mg/L



Exit: Total N level at 1.2mg/L or a reduction of 99%

Australia: Vetiver planted to dispose effluent discharged from a public toilet block in a park in Brisbane

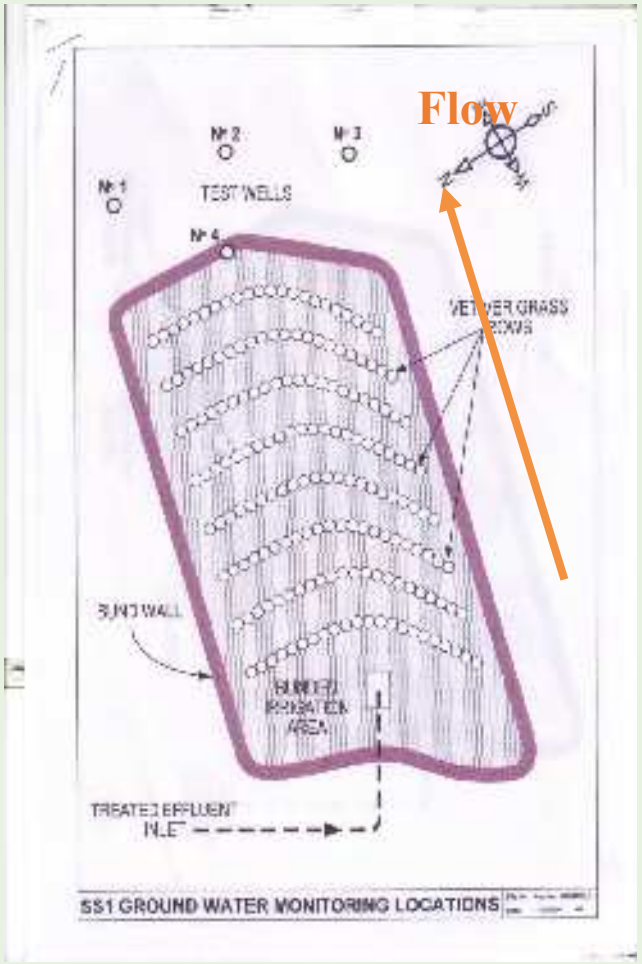
Australia: Industrial wastewater disposal at a food processing factory in Queensland.



Hydroponic treatment of piggery effluent

CASE STUDY 1

Disposal of sewage effluent a small community



 # rows vetiver (10m long) = 8
Row spacing = 1m
Plant spacing = 20cm
Total plants = 400
Land area = 100 m²

RESULTS

IN FLOW

Average daily flow: 1 670L

Average total N: 68mg/L

Average total P: 10.6mg/L

Average Faecal Coliform:>8 000

OUT FLOW

Average daily flow: Almost Nil*

Average total N: 0.13mg/L

Average total P: 0.152mg/L

Average Faecal Coliform:<10

* Only flow after heavy rain

First and second planting areas, with aerial photo showing the whole site. Note the poor growth area due to lack of effluent

CASE STUDY 2:

Disposal of municipal domestic sewage effluent by hydroponics and ephemeral wetland treatment

Phase 1: Hydroponic treatment in storage ponds

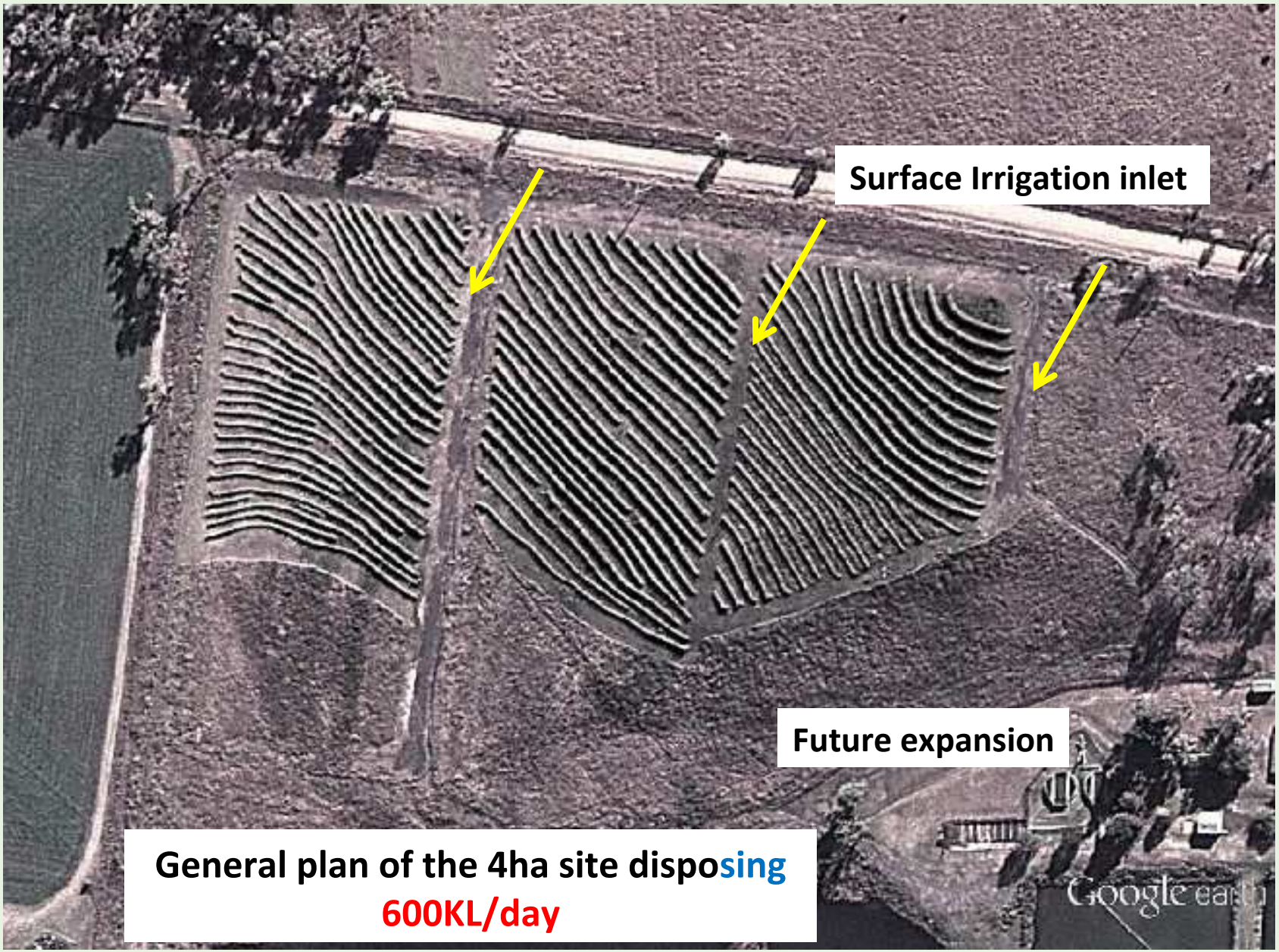
Phase 2: Ephemeral wetland treatment of municipal sewage effluent

Effluent quality before and after the vetiver treatment

Tests * (license requirements)	Effluent Input	Effluent Output
PH (6.5 to 8.5)8*	7.3 to 8.0	7.6 to 9.2
Dissolved Oxygen (2.0 minimum) *	0 to 2 mg/l	8.1 to 9.2 mg/l
5 Day BOD (20 - 40 mg/l max) *	130 to 300 mg/l	7 to 11 mg/l
Suspended Solids (30 - 60 mg/l max) *	200 to 500 mg/l	11 to 16 mg/l
Total Nitrogen (6.0 mg/l max) *	30 to 80 mg/l	4.1 to 5.7 mg/l
Total Phosphorous (3.0 mg/l max) *	10 to 20 mg/l	1.4 to 3.3 mg/l

CASE STUDY 3

Disposal of municipal domestic sewage effluent by land irrigation in Australia



General plan of the 4ha site disposing 600KL/day

Australia: Vetiver planted to dispose effluent discharged from a municipal sewage treatment plant in Queensland

VETIVER HEDGEROWS ON SEWAGE DISPOSAL LEACHATE FIELD

Six month old

12 month old

Six month old

This planting has totally disposed 500-600KL/day

Effluent quality before and after the vetiver treatment

Results	BOD mg/L	COD mg/L	Conductivity us/cm	pH	Suspend. solid mg/L	NH3 mg/L	Total N mg/L
Inlet	341	738	1550	8.0	515	71	96
Outlet	23	10	350	8.0	80	4.6	7.6

CASE STUDY 4

A Sewage Treatment Pilot Project (2016) with VGT in Caixin Village, Puding County, Guizhou Province, Southwest China. This pilot includes sewage lines and connections to village households. 30 more are under current execution and another 100 under design.

Ziyaun Feng: Guangzhou Vetiver Grass Industry Science and Technology Co Ltd.

Hanping Xia: South China Botanical Garden, Chinese Academy of Science

Yuan Xiong; People's Government of Anshu City

Project Description

- Caixin village is located in the Shawan Development Zone, Chengguan Town, Puding County, belonging to an economic tourism development demonstration site of municipal orchards.
- The village is 6 kilometers away from the county town and 1.5 km away from the drinking water source, "Yelang Lake" reservoir of Anshun City.
- The whole village has a total of 129 households, of which 400 people are permanent residents; about 20 mu of fishing pond, 1000 mu (15 mu = 1 ha) of vineyard and 5 peasant-restaurants are built nearby. This village is one place of vacation lands for country or town residents.
- Sewage treatment capacity of this project is 60 m^3/day, and "biochemical reaction integrated system of ecological three-dimensional micro- circulation" is adopted in this project.
- The project was funded by Agriculture Commission of Guizhou Province and Mayor's Foundation of Anshun City

PROJECT EXECUTING PROCESSES

The original apperance of construction site

The installing sewage pipes to houses

Propagating vetiver seedlings in advance

Vetiver filter tank construction

Note green vetiver floats placed in polishing tanks

Vetiver seedlings transplanted to floating island

Floated vetiver filtering system

General view of project at completion

1 st sampling test on 14 April 2016 Achieved the National First Class Standard

No.	Testingsections andNo. Testingitems	Entrance FS16041501	Exit FS16041502	Unit	NationalUrban Sewage Comprehensive DischargeStandard (G18918-2002) FirstClassStandard	Achieved orexcessive situation
1	pH	6.45	7.02	—	6—9	Achieved
2	Dissolvedoxygen	0.28	3.6	mg/L	—	—
3	BOD-5	30.2	9.7	mg/L	10	Achieved
4	COD	56	23	mg/L	50	Achieved
5	NH_3-N	4.463	2.674	mg/L	5	Achieved
6	TotalP	0.97	0.42	mg/L	0.5	Achieved
7	TotalN	7.24	1.75	mg/L	15	Achieved
8	Oils	1.54	0.47	mg/L	1	Achieved
9	Anionicsurfactants	0.76	0.08	mg/L	0.5	Achieved
10	Fecalcoliform	2400	700	numbers/L	1000	Achieved
11	SuspendedMatters	33	5	mg/L	10	Achieved

Note:Theresultswereexpressedastestinglimitsplus"L"whentheresltswerelowerthanthetestinglimits.

2 nd sampling test on 15 September 2016
Achieved the National First Class Standard

No.	Testingsections andNo. Testingitems	Entrance FS16041501	Exit FS16041502	unit	NationalUrban Sewage Comprehensive DischargeStandard (G18918-2002) FirstClassStandard	Achieved orexcessive situation
1	pH	7.98	8.01	—	6—9	Achieved
2	Dissolvedoxygen	8.02	7.46	mg/L	—	—
3	BOD-5	28	3.5	mg/L	10	Achieved
4	COD	40	5	mg/L	50	Achieved
5	NH_3-N	32.761	0.207	mg/L	5	Achieved
6	TotalP	1.47	0.01	mg/L	0. 5	Achieved
7	TotalN	19.83	0.69	mg/L	15	Achieved
8	Oils	1. 03	0. 58	mg/L	1	Achieved
9	Anionicsurfactants	0. 4	0. 1	mg/L	0. 5	Achieved
10	Fecalcoliform	1400	340	numbers/L	1000	Achieved
11	Suspendedmatters	37	8	mg/L	10	Achieved

Note:Theresultswereexpressedastestinglimitsplus"L“whentheresultswerelowerthanthetestinglimits.