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Original Research Paper

Pre-impact Studies of the 2000 MW Lower Subansiri Dam on Certain Aquatic Environmental Aspects of Downstream of the River Subansiri with Special Reference to Plankton and Fishes

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ABSTRACT

Pre-impact studies of the 2000 MW lower Subansiri dam have been carried out from January 2006 to December 2006 on certain hydrobiological aspects of downstream of the river Subansiri viz., physicochemical parameters, phytoplankton, zooplankton and freshwater fish diversity. The water quality is suitable for planktonic and fish diversity. In the downstream of proposed dam, a total of 199 taxa have been recorded and identified which include 48 species of algae, 23 species of zooplankton, and 128 species of freshwater fishes belonging to 9 orders, 27 families and 78 genera.

INTRODUCTION

Dam interrupts stream flow and generates hydrological changes along the integrated continuum of river ecosystem (Vannote et al. 1980, Junk et al. 1989). The impact of dam upon natural ecosystem and biodiversity has been one of the principal concerns raised by large dam (McCartney et al. 2000). Over the course of last 10 years in particular, considerable investments have been made in the development of measures to alleviate these impacts (Bergcamp et al. 2000). Yet today widespread concern remains that despite improvements in dam planning, design, construction and operation, they continue to result in significant negative impacts to a wide range of natural ecosystems and to the people who depend upon them for their livelihood.

There is lots of information on post-impact of dam on the ecology but on this aspect pre-impact study is very limited. Study of this nature will help in future to assess the impact of dams on various aspects of river ecology.

MATERIALS AND METHODS

Study Area: River Subansiri, the largest tributary of river Brahmaputra, originates from western part of Mount Pararu (5059 km) in the Tibetan Himalaya. After flowing for 190 km through Tibet, it enters India. It continues its journey through the Himalaya of India for 200 km and enters into the plains of Assam through a gorge near Gerukamukh of Dhemaji district of Assam. Its total length is 520 km and drains a basin of 37000 sq. km. The length of the downstream (from dam site to its confluence with River Brahmaputra is approximately 130 km.

For a systematic monitoring and study of aquatic environment, the total study area has been divided into three sectors namely, Chowal dhowa Ghat, Khabolo Ghat and Jamuguri Ghat.

Study of aquatic environment: Water samples were collected from January 2006 to December 2006. Water temperature was measured by using mercury thermometer, transparency by Secchi disc, pH by pen type digital pH meter, conductivity by conductivity meter, current flow according to Trivedy et al. *(*1987), TDS, total hardness, calcium hardness, chloride by APHA (1989), DO_2 by Winkler's modified method (APHA 1989), FCO_2, carbonate and bicarbonate alkalinity according to Welch (1952) and silicate by Jhingran et al. (1969).

Planktonic study: The qualitative analysis of the plankton was done with the help of literature (Lackey 1983, Nidham & Nidham 1966, Edmonson 1974). Monsoon was provisionally reckoned as the period from July to October, winter from November to February and summer from March to June.

Fish diversity: The specimens were identified according to the methods of Munshi & Srivastav (1988), Talwar & Jhingrang (1991), Biswas (1993) and Viswanath (2002).

One-way ANOVA on all physico-chemical parameters of water quality at different sampling stations were carried out using ORIGIN 6.1 version.

RESULTS AND DISCUSSION

Aquatic environment: Various physicochemical and biological characteristics of the water of downstream of River Subansiri are presented in Table 1. The air and water temperatures of the three sectors ranged between 20.4°C (January) and 32.5°C (July) and 14.3°C (January) and 31.2 °C (July) respectively. Transparency values ranged seasonally between 21.1 cm in May and 88.7 cm in March in Jamuguri ghat and Chowal dhowa ghat respectively. It was lowest during the monsoon months as the water was highly turbid. The water was recorded to be relatively alkaline throughout the year (pH 7.1-7.9), the highest recorded during the post monsoon months (September & October) in all the sectors. The total dissolved solids (TDS) values of all the sectors fluctuated seasonally between 132 and 201 mg/L. The lowest was recorded in May (Chowal dhowa ghat) and highest in July (Jamuguri ghat). The total suspended solids (TSS) range from 19 to 52 mg/L. The highest conductivity (160.3 mmho) was found in the month of April at Jamuguri ghat, and lowest in the month of September at Jamuguri ghat. The total alkalinity of the water ranged between 70.4 and 119 mg/L. The maximum and minimum contents were recorded in Chowal dhowa ghat in January and Jamuguri ghat in December respectively. In all the sectors, it ranged from 26.7 to 43.8 mg/L annually. The chloride content was relatively low in all the sectors with a range of 3.0 mg/L (December) to 9.8 mg/L (February). The silicate content ranged between 5.1 and 9.4 mg/L, the maximum recorded in the post monsoon period.

Planktonic diversity: A total of 48 phytoplankton species were recorded (Table 2a). The phytoplankton is composed of three classes of algae namely Myxophyceae (blue green algae, 8 species), Chlorophyceae (green algae, 17 species) and Bacillariophyceae (diatoms, 23 species). Bacillariophyceae showed dominance over the other two groups of algae. Similarly, a total of 23 different species of zooplankton belonging to four different categories namely Protozoa (7 species), Rotifera (6 species), Cladocera (5 species) and Copepodes (5 species) were recorded and identified (Table 2b).

Fish diversity: A total of 128 fish species belonging to 9 orders, 27 families and 78 genera were

Table 1: One-way ANOVA on test values of various physicochemical characteristics among different sampling stations.

Parameters	Station	Mean	Variance	N	F value	P value	Comment
Air Temp.(°C)	1	26.74	19.29	12	F = 0.01186,	p = 0.99821;	NS
	2	26.74	21.96	12			
	3	26.66	18.94	12			
Water Temp. (°C)	1	22.23	21.65	12	F = 0.21964	p = 0.88225	NS
	2	22.87	24.93	12			
	3	21.25	27.45	12			
Transparency (cm)	1	39.77	430.06	12	F = 0.23441	p = 0.87191	NS
	2	43.72	423.52	12			
	3	46.90	504.22	12			
pH	1	7.25	0.04455	12	F = 0.7153	p = 0.54814	NS
	2	7.36	0.12242	12			
	3	7.40	0.10447	12			
TSS (mg/L)	1	30.75	84.02	12	F = 0.51173	p = 0.67629	NS
	2	30.41	77.90	12			
	3	27.83	32.15	12			
TDS (mg/L)	1	162.33	335.15	12	F = 0.2359	p = 0.87086	NS
	2	168.41	350.62	12			
	3	167.25	321.84	12			
Total Solids (mg/L)	1	193.08	728.08	12	F = 0.36031	p = 0.78194	NS
	2	200.66	644.06	12			
	3	195.08	440.81	12			
Conductivity (μmho)	1	109.40	171.41	12	F = 0.63203	p = 0.59828	NS
	2	115.81	292.26	12			
	3	116.96	430.75	12			
Alkalinity (mg/L)	1	103.22	168.33	12	F = 1.28999	p = 0.28969	NS
	2	97.76	228.68	12			
	3	91.35	246.53	12			
Total hardness (mg/L)	1	69.35	83.80	12	F = 2.2203	p = 0.09913	NS
	2	61.27	85.02	12			
	3	64.92	90.83	12			
Calcium hardness(mg/L)	1	37.35	12.70	12	F = 4.988	p = 0.00459	NS
	2	35.65	15.34	12			
	3	31.26	21.20	12			
Chloride (mg/L)	1	7.34	3.83	12	F = 2.23884	p = 0.09703	NS
	2	6.35	2.43	12			
	3	5.63	1.87	12			
Silicate (mg/L)	1	7.72	2.62	12	F = 1.0187	p = 0.39352	NS
	2	7.30	2.38	12			
	3	6.65	1.66	12			
Dissolved oxygen (mg/L)	1	8.65	0.73364	12	F = 5.44892	p = 0.00283	NS
	2	10.64	1.43114	12			
	3	9.941	3.56174	12			
Free carbon dioxide (mg/L)	1	5.333	3.686	12	F = 1.15841	p = 0.33636	NS
	2	5.458	2.488	12			
	3	4.55	1.788	12			

At the 0.05 level, the means are not significantly different in the sampling stations; NS - Not significant

recorded in the study area (Table 3). Observations revel that near Chowal dhowa ghat fish species like *Tor putitora, Tor tor, Acrossocheilus hexagonelips, Labeo pungusia, Labeo dyocheilus* are present. The species of Tors are endangered, while rest of the fishes are threatened. The migratory fish *Hilsa hilsa* and culture fishes namely *Cirrhinus mrigala, Ctenophyryngodon idellus* and *Cyprinus carpio*

Table 2(a): Phytoplankton composition in the downstream of River Subansiri.

Sl. No.	Name of the species	Sl. No.	Name of the species
	Myxophyceae		**Chlorophyceae**
1.	*Anabaena fertilissima*	25.	*Zygnema khannae*
2.	*Anabaena vaginicoda*		**Bacillariophyceae**
3.	*Gloeocapse compacta*	26.	*Asterionella gracillima*
4.	*Lyngbya allorgii*	27.	*Calonesia* sp.
5.	*Lyngbya limnetica*	28.	*Coconeis* sp.
6.	*Nostoc vaginicola*	29.	*Cylotella ocellata*
7.	*Oscillatoria limnetica*	30.	*Cymbella affinis*
8.	*Oscillatoria homogeneae*	31.	*Cymbella kalbei*
	Chlorophyceae	32.	*Denticula elegans*
9.	*Ankistrodesmus convolutes*	33.	*Diatoma elogatum*
10.	*Bulbochaete varinis*	34.	*Diploneis elliptica*
11.	*Chaetophora elegans*	35.	*Epithemia sorex*
12.	*Chlorella vulgaris*	36.	*Eunotia pectinalis*
13.	*Cladophora glomerata*	37.	*Fragilaria capucina*
14.	*Closterium turgidium*	38.	*Frustulia rhomboids*
15.	*Coelastrum reticulatum*	39.	*Gomphonema montanum*
16.	*Cosmarium granatum*	40.	*Gyrosigma spencerii*
17.	*Microspora quadrata*	41.	*Melosira varians*
18.	*Mougeotia calcarea*	42.	*Navicula spp.*
19.	*Oedogonium gracilius*	43.	*Nitzchita thermalis*
20.	*Pediastrum tetras*	44.	*Pinnularia undulate*
21.	*Spirogyra pratensis*	45.	*Raphidonema sp.*
22.	*Spirogyra singularies*	46.	*Stauroneis acuta*
23.	*Tetradesmus smithii*	47.	*Surirella ovalis*
24.	*Ulothrix zonata*	48.	*Syndera pulchella*

Table: 2 (b): Zooplankton composition in the down stream of river Subansiri.

Sl. No.	Name of the species	Sl. No.	Name of the species
	Protozoa		**Protozoa**
1.	*Arecella vulgaris*	13.	*Monystyla lunaris*
2.	*Arecella discoides*		**Cladocera**
3.	*Amoeba adiosa*	14.	*Alona species*
4.	*Centropyxis ecornis*	15.	*Daphnia carinata*
5.	*Euglena species*	16.	*Diaphanosoma exisum*
6.	*Paramoecium caudatum*	17.	*Diaphanosoma sarsi*
7.	*Vorticella campanula*	18.	*Moina brachiata*
	Rotifera		**Copepoda**
8.	*Brachionus calcyflorus*	19.	*Cyclops vicinus*
9.	*Brachionus anagularies*	20.	*Heliodiaptomus exisum*
10.	*Filinita longiseta*	21.	*Mesocyclops bankart*
11.	*Keratella tropica*	22.	*Nauplius* larva
12.	*Lecane luna*	23.	*Phyllodiaptomus* sp.

were found to be present in the river. Many of the fishes have ornamental values such as *Channa stewarti, Chaca chaca, Xenetedon concilla,* members of colisa (5 species), *Tetradon cutcutia, Semiplotus semiplotus, Botia rostrata, Macrognathus pancalus, Chanda nama, Garra kempi, Chela cachius, Psilorhynchus balitora, Barilius barna, Botia dario, Lepidocephalus guntea,* etc. are present in the downstream basin.

Table 3: Freshwater fishes of the Subansiri Floodplain.

Sl. No.	Order	Family	Scientific Name	Habitat & Status
1.	Osteoglossiformes	Notopteridae	*Chitala chitala*	R, W,/++
2.			*Notopterus notopterus*	R, W,/++
3.	Anguilliformes	Anguillidae	*Anguilla bengalensis*	R, W,/R
4.	Clupeiformes		*Gudusia chapra*	R/+++
5.			*Hilsa hilsa*	M
6.			*Gonilosa manmina*	R, W,/+++
7.		Engraullidae	*Setipinna phasa*	R, W,/+
8.	Cypriniformes	Cyprinidae	*Aspidoparie jaya*	R, W,/+++
9.			*Aspidoparie morar*	R, W,/+++
10.			*Amblypharyngodon mola*	R, W,/+++
11.			*Barilius barna*	R, W,/++
12.			*Barilius bendelisis*	R/+
13.			*Barilius tileo*	R/+
14.			*Barilius vagra*	R/+
15.			*Barilius barila*	R/+++
16.			*Bengana elanga*	R, W,/En
17.			*Brachydanio acuticephala*	R, W,/+
18.			*Chela cachius*	R, W,/+++
19.			*Chela laubuca*	R, W,/+++
20.			*Danio dingala*	R, W,/+++
21.			*Danio regina*	R, W,/+++
22.			*Esomus danricus*	R, W,/+++
23.			*Raiamas bola*	R/+
24.			*Rasbora daniconius*	R, W,/++
25.			*Rosbora rosbora*	R/+
26.			*Salmophasia phulo*	R, W,/+++
27.			*Salmophasia bacalia*	R, W,/+++
28.			*Bangana dero*	R, W,/++
29.			*Catla catla*	R, W,/+
30.			*Chagunius chagunio*	R/En
31.			*Cirrhinus mrigala*	Cul
32.			*Cirrhinus reba*	Cul
33.			*Ctenopharyngodon idellus*	Cul
34.			*Cyprinus carpio*	Cul
35.			*Labeo bata*	R, W,/+++
36.			*Labeo calbasu*	R, W,/+++
37.			*Labio Gonius*	R, W,/+++
38.			*Labio nandina*	R/+++
39.			*Labeo rohita*	R, W,/++
40.			*Labeo pangusia*	R/+
41.			*Neolissochilus hexasticus*	R/+
42.			*Neolissochilus hexagonoleps*	R/+
43.			*Oreichthys cosuatis*	R, W,/++
44.			*Osteobrama cotio*	R, W,/++
45.			*Puntius conchonius*	R, W,/+++
46.			*Puntius guganio*	R, W,/+++
47.			*Puntius phutunio*	R, W,/++
48.			*Puntius sarana sarana*	R, W,/+
49.			*Puntius saphorea*	R, W,/+++
50.			*Protopuntius clavatus*	R, W,/++
51.			*Semiplotus semiplotus*	R/+

Table cont...

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52.			*Tor putitora*	R/En
53.			*Tor tor*	R/En
54.			*Tor progensus*	R/++
55.			*Schizothorax richardsoneei*	R/+
56.			*Schizothoraichthys progastus*	R/+
57.			*Crossocheilus laticus*	R/++
58.			*Garra annandalei*	R/+
59.			*Garra kempi*	R/+
60.			*Garra lissarhynchus*	R/+
61.			*Garra rupecula*	R/+
62.			*Gara nusta*	R/+
63.		Psilorhynchusynchidae	*Psilorhynchus balitora*	R/+
64.			*Psilorhynchus homaloptera*	R/+
65.		Balitoridae	*Aborichthys kempi*	R/H +
66.			*Acanthocobitis botia*	R/H +
67.			*Acanthococobitis paronaceous*	R/H +
68.			*Mesonoemacheilus reticulofasciatus*	R/H +
69.			*Nemacheilus corica*	R/H +
70.			*Nenoemacheilus assamensis*	R/H +
71.			*Schistura devdevi*	R/H +
72.			*Schistura rupesola inglisi*	R/H +
73.		Cobitidae	*Botia Dario*	R/+
74.			*Botia rostrata*	R/En
75.			*Botia histironica*	R/En
76.			*Acantophthalamus pangia*	R, W,/+++
77.			*Lepidocephalus guntea*	R, W,/+++
78.	*Scturiformes*	Bagridae	*Aorichthys aor*	R/+
79.			*Aorichthys senghola*	R/+
80.			*Mystus bleekeri*	R/+
81.			*Mystus montanus*	R/+
82.			*Mystus tengara*	R, W,/+++
83.			*Mystus vittatus*	R/+
84.		Siluridae	*Ompok bimaculatus*	R, W/En
85.			*Ompok pabda*	R, W/+
86.			*Ompok pabo*	R, W/+
87.			*Wallago attu*	R, W,/+++
88.		Schilbeidae	*Ailia coila*	R/++
89.			*Clupisoma gaura*	R/+
90.			*Eutropiichthys vacha*	R/+
91.		Sisordiae	*Bagarius bagarius*	R/+
92.			*Bagarius yarrellii*	R/+
93.			*Conta conta*	R/+
94.			*Erethistes pussilus*	R/H +
95.			*Gagata gagata*	R/H +
96.			*Gagata cenia*	R/H +
97.			*Hara hara*	R/H +
98.			*Gangra viridiscens*	R/H +
99.			*Pseudochenis sulcatus*	R/H +
100.			*Sisor rhabdophorus*	R/En
101.		Claridae	*Clarias batrachus*	W/+
102.		Heteropneustidae	*Heteropneustes fossilis*	W/+++
103.		Chacidae	*Chaca chaca*	R/+
104.		Olyridae	*Olyra langicuda*	R, W/+
105.	*Beloniformes*	Belonidae	*Xenentodon cancila*	R, W/+++

Table cont...

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106.	*Synbranchiformes*	Symbranchidae	*Monopterus cuchia*	W/++
107.			*Monopterus albus*	W/++
108.			*Macrognathus oral*	R,W/+++
109.			*Macroganthus pancalus*	R,W/+++
110.			*Mastacembalus armatus*	R/+
111.		Chaudhuridae	*Chaudhuria khajuriae*	R/+
112.	*Perciformes*	Chandidae	*Chanda nama*	R,W/+++
113.			*Parambassis ranga*	R,W/+++
114.		Nandidae	*Nandus nandus*	RW/+++
115.			*Badis assmensis*	W/++
116.			*Badis badis*	W/++
117.		Gobidae	*Glossogbius giuris*	R,W/++
118.		Anabantidae	*Anabas testudineus*	W/++
119.		Belontidae	*Colisa fasciatus*	W/+
120.			*Colisa sota*	W / ++
121.		Channidae	*Channa barca*	W/En
122.			*Channa marulius*	W/++
123.			*Channa orientalis*	W/++
124.			*Channa punctatus*	W/+++
125.			*Channa belheri*	R/En
126.			*Channa stwartii*	W/+
127.			*Channa striatus*	W/+
128.	*Tetradontiformes*	Tetradontidae	*Tetradon cutcutia*	R,W/+++

R = River, W = Wetland, ‘+’= Rare, ‘++’ = Normal, ‘+++’ = Abundant, En = Endangered, M = Migratory, Cl = Fishes released from culture fisheries

Physicochemical characteristics of the downstream of River Subansiri indicate its pollution free environment. All the parameters are suitable for growth and development of plankton and fishes. Observations revealed that the phytoplankton and zooplankton numbers are fairly good in the study area. Phytoplankton production was directly related to the dissolved oxygen and inversely related to the free carbon dioxide. Due to low photosynthesis carbon dioxide was easily detectable throughout the year and the growth of phytoplankton did not affect the concentration of free carbon dioxide. This is in agreement with the earlier findings of Biswas et al. (1996). Among the phytoplankton and zooplankton, diatoms and rotifers respectively showed superiority over other groups in terms of their species richness. Phytoplankton are main producers of an aquatic ecosystem controlling biological productivity. They not only provide an estimation of standing crop but represent more comprehensive biological index of the environmental conditions. Phytoplankton, which include blue green algae, green algae, diatoms, desmids, euglenoides, etc. are important among aquatic flora and are ecologically significant as they form the basic link in the food chain of aquatic animals (Kortnicker & Shon 1971), serves as ecological indicators (Puri et al. 1964), and act as secondary host for a number of fish parasites (Hoffman 1967). The abundance of rotifera may be attributed to its dependence on phytoplankton and detritus matter as food (Pandey et al. 2004). This finding is in accordance with the findings of Pennak (1944), Michel (1968), Saha et al. (1971) and Sarwar & Parveen (1995). The rotifer communities were reported to have some association with water quality and any variation in suspended solids, dissolved solids, organic matter, etc. in the water should immediately affect their distribution (Holland et al. 1983).

The river still has undisturbed habitat for endangered and threatened fish species viz., *Tor putitora, Tor tor, Acrossocheilus hexagonelips, Labeo pungusia, Labeo dyocheilus, Cirrhinus mrigala, Ctenophyryngodon idellus* and *Cyprinus carpio* are not indigenous species but somehow they are being released from the culture fisheries (particularly during the flood) into the river system. Some air breathing fishes like *Channa barca, Heteropneustes fossilis, Clarias batrachus, Anabas testudineus,* etc. were not present in the river though they are abundant in the nearby lentic water bodies (swamps, wetlands, seasonal ponds, etc.) of the Subansiri drainage system. The floodplain ecosystems have jeopardized the flora and fauna of these habitats (Biswas et al. 1998). The river floodplain includes river channels, oxbows, relict channels, floodplain pools and seasonally inundated areas of the terrestrial environment. The seasonal inundation of the floodplain that is associated with monsoon rains determines the magnitude and extent of land water interactions and allochthonous inputs in the river (Welcomme 1979, Junk et al. 1989, Sedell et al. 1989). The wetlands or flood plain lakes of the river have the potentialities of well developed fishery and in fact, most fish production in the large river is derived from floodplain habitat (Welcome 1979, Junk et al. 1989). The migratory fishes *Hilsa hilsa* is migrated through the river Brahmaputra and reached the Subansiri river.

CONCLUSION

The NHPC violating all rules by continuing blasting operation for road construction accompanied by extensive muck and debris disposition in the river has badly affected the breeding ground of Mahasheer, the endangered fish *Tor tor* and *Tor putitora*. The deforestation for construction of residential colony and also for fuel wood by labourers at construction site will changes total ecology of the river ecosystem. If the project work continues in this manner, serious ecological problems in the downstream will come very shortly. Moreover, when the river will be regulated by the dam, the entire downstream river ecosystem may be altered.

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ENVIRONMENTAL NEWS

Rising Methane Level

National Institute of Water and Environment, New Zeland (NIWA) has reported that levels of the climate warming methane gas have begun to rise again in the Southern Hemisphere as measured at Wellington's Baring Head. NIWA said that atmospheric methane increased by 0.7 percent over the two-year period 2007-08, a change it called globally significant.

NIWA Principal Scientist Dr Keith Lessey said, "The evidence we have shows that methane in the atmosphere is now more than double what it ever was during the 800,000 years before 1700 AD". The US National Oceanic and Atmospheric Administration (NOAA) also reports that global methane concentrations rose in both 2007 and 2008 after a ten-year lull.

Methane is the second most important contributor to global warming after carbon dioxide, though its abundance in the atmosphere is far lower. The global growth in commercial livestock farming, mining of fossil fuels, leaks from urban gas networks, and continued burn-offs of tropical rainforest are also to be blamed for this.

NIWA, December 22, 2009

Ship Pollution is Greater

Large shipping vessels have become commonplace in today's global market place. Fred Pearce, a science writer and environmental consultant for New Scientist, has been studying the shipping industry for quite some time. He has focused particularly on their use of filthy, toxic fuel that is polluting the air at a staggering pace.

Though cheaper filthy fuel would never be permitted for use on the mainland, but is tolerated on international waters. The chemicals found in the smoke trials of this "bunker fuel" are known to cause severe inflammation, cancer, breathing problems and heart disease. The reason why reckless ship pollution is allowed to continue is due to the International Maritime Organization's (IMO) policy that permits bunker fuel containing up to 4.5 percent sulfur to be used in international waters.

The IMO has reluctantly agreed to reduce the sulfur limits to 3.5 percent by 2012 and eventually to 0.5 percent. The biggest barrier to enacting stricter pollution guidelines is the increased cost of cleaner fuel. Bunker fuel is inexpensive and plentiful, allowing shippers to make use of the leftover by products of clean fuel production.

Natural News, December 26, 2009