

Synthesis of

State of Knowledge Review on the Interlinkages between Biodiversity and human Health

(basis for CBD COP12 decision 23 on Health & Biodiversity)

SCBD + WHO + international experts
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Introduction

Former initiatives on Biodiversity & Health:

One Health, ecoHealth of DIVERSITAS, COHAB, EcoHealth Alliance, Int. Assoc. for Ecology & Health,

! Center for Health and the Global Environment (U. of Harvard): 1st and top world teaching & research center on the issue.

→ concept of **various intrinsic links between biodiversity & health**

CBD:

- COP-7 (2004) and COP-8: decisions on **agricultural biodiversity** → *Cross-cutting initiative on biodiversity & health*, with **FAO**. (publications of FAO: Sustainable diets and Biodiversity; Diversifying Food & Diets)
- COP-11: → collaboration with **WHO: *Biodiversity and Community Health*** project
- WHO (+ CBD, CC, CCD, Rio + 20): *Our Planet, Our Health, Our Future*
- COP-12: decision 23 on **Biodiversity & Development**; sub-thematic = Biodiversity and Health → *State of Knowledge Review on the Interlinkages between Biodiversity and Human Health* → synthesis in next pages

Sub-thematics in Biodiv. & Health

Chapters of the State of Knowledge document:

Nutrition, Biodiversity & human Health

Agrobiodiversity & Food Security

Infectious diseases & Biodiversity

Environmental Microbial Biodiversity

Water, biodiversity & human health

Air quality, biodiversity & human health

Traditional medicines & Biodiversity

Biodiversity, health care & **new pharmaceuticals**

Nutrition, Biodiversity & human Health (1)

- **Agricultural production** is **able to feed world's** population (FAOSTAT 2014)
- Yet: **under-or malnutrition** is main contributor to global diseases

800 millions undernourished; 1, 2 billion overweight (also in developing countries) ; 2 billions micronutrient deficiencies (also in developed countries)

- **Causes:** programmes to eliminate hunger = ↑ energy supply (carbohydrates, fats) → intensive agriculture → **loss of agricultural biodiversity** & environmental degradation → escalating nutritional problems → pharma.supplements/fortificants → exacerbate nutritional problems (excess, unbalance, ...)
- **But:** insufficient data on food biodiversity & food composition → mainstream importance of biodiversity in nutrition, through studies on food and diets biodiversity composition and impacts

COP 7 & 8 CBD decisions : → **Cross-cutting initiative on Biodiversity for Food & Nutrition** (2004)
: → & : study on traditional biodiverse balanced diets (Bioversity International) ; data research and compilation on nutrients composition of food varieties (FAO).

International **Conferences on Sustainable Diets** (FAO) (2010: focus on Biodiversity; 2013: focus on livestock) → conclusion: influence policies to support agricultural biodiversity and local communities initiatives in that direction, including for wild relatives of crops and varieties or species in discrete ecological zones (role in balanced traditional food systems) → implies **sustainable use of biodiversity in sustainable environment.**

Nutrition, Biodiversity & human Health (2)

- main Outputs of **International Conferences on Sustainable Diets:**

1st (2010) :

▶ **definition** of sustainable diet: «low environmental impacts food and nutrition securityhealthy life ...present and future generations..... protective of biodiversity and ecosystems, culturally acceptable, accessible, economically fair and affordable; nutritionally adequate, safe.....”

▶ interlinkage **human & ecosystem healths** (interlinkage nutritional balance & agro-ecosystem biodiversity).

▶ development of **methods & indicators** (for nutritional diversity of cropping systems, agro-ecological zones for sustainable diets) (research partnerships)

2nd (2013):

▶ interdependancy between **livestock nutritional composition** and **biodiversity of pasture** (ex: horse breed in Mongolia have fatty acids composition \equiv marine species)

- **Food composition studies:**

FAO/INFOODS collect & compile data on nutrient composition of food varieties all over the world, accessible to everybody → nutrition **indicators** on food composition and food consumption.

Large intra-specific differences in nutrient content (ex. for protein content of rice, vit. A content of apricots, bananas) → potentially misguided nutrition interventions and guiding.

- **Wild food:**

important source of **cheap, diverse,** and **nutritionnally rich** food in **developing countries**, + income (by sale)

(50 % population eat wild food, mainly during periods of poverty of agricultural products)

Ex. vegetable: baobab fruit (*novel food* in the EU in 2008): ~ 6 x vit C of orange; amaranthe: 10 x Fe of cabbage

Ex. animals: insects, snails, vertebrates (bushmeat prominent in HIV affected zones: loss of agri. labor and knowledge)

Ex. ♂ anemia in Madagascar in children deprived of bushmeat without substitution

Large **biodiversity** in **traditional food** systems (x 100 items). But ↓ abundance of indigenous fruit trees (and pollinators) through land use changes.

CONCLUSION:

→ **Include biodiversity for food & nutrition in post-2015 development agenda.**

Agricultural biodiversity = best guarantee for global **food security** and **nutritional health.**

Need for cross-sectorial collaborations, for generation & dissemination of nutrient composition data , and for characterization of food systems and ecosystems able to provide sustainable diets.

Agrobiodiversity & Food Security (1)

Between 1980 → 2001, through **intensive agriculture**:

- ▶ ↗ ~ 35 % cereal production, nitrogen use, areas under permanent crop
- ▶ additional 4 billions people fed ; ↓ 33 to 18 % hungry people
- ▶ but : **major driver of biodiversity loss, water usage, land use change**

Agricultural biodiversity benefits :

Productivity, stability of production, control of pests and diseases, resilience, regulating and provisioning of ecosystem services, food cultures and well-being.

Agricultural biodiversity use:

7000 plant species used through agricultural history

Presently: 82 crop species provide 90 % energy (3 of them 40 %)

40 livestock species used (5 species provide 95 %)

230 aquatic species used (31 species provide 95 %)

Ancestors or wild relatives of major livestock species extinct or highly endangered (hunting, habitat loss, cross-breeding)

38 % terrestrial **landscape converted for agriculture**, 26 % for livestock production → **loss of forests, wetlands,...**
→ **change in supporting & regulating ecosystem services**, ↓ wild species, ↓ medicinal plants, ↓ carbon sinks,
↓ water quality & quantity, non food material ecosystem's products, ↓ ecosystem services useful for agriculture
(↓ natural pest control, ↓ pollination, ↓ soil health & nutrient cycling, ↓ water regulation, ↗ soil erosion) ,
↗ interaction with disease hosts, vectors, reservoirs.

Agrobiodiversity and Food Security (2)

→ Chemical additives to intensify agriculture & compensate loss of biodiversity & its ecosystem services

95 % **pesticides** not totally specific →

- ▶ ↓ soil biota & ↓ water retention → ↓ nutrient cycling → negative feed-back loops
 - ▶ pollinators death & disorders → ↓ production of very nutrient plants (35 % crops dpd on pollinators) and of honey production (→ socio-economic consequences for producers)
- ↗ Pest resistance to pesticides → **ecological imbalance**. Agroecosystem less resilient, more fluctuant.

Human health effects of pesticides:

- ▶ **acute poisoning** (C-phosphates): 25 millions agricultural workers per year in developing countries
- ▶ **chronic effects** (C- chlorides): reproductive, teratogenic, mutagenic, oncogenic, neurotoxic, immunosuppressive

Fertilisers effects (> 1960 : N x 2 , P x 3 . But only 40 % taken by crops) :

- ▶ on human health: **methemoglobinuremia** (↓ O₂ in tissues) + **carcinogenic** nitrosamines
- ▶ water **eutrophisation** → toxic phytoplankton → ↓ vertebrate life in waters
- ▶ large fossil fuel exploitation ; 60 % global N₂O emissions

Agrobiodiversity & Food Security (3)

Non-food crops:

- ▶ coffee, tea, cacao, palm trees: expansion **at expense of local biodiversity**; little benefit to human health & calories & nutrients.
- ▶ biofuels: x 450 % between 2000 & 2010
 - additional negative effects on human health: intense production techniques, forest burning, suppression of food production areas.

→ CONCLUSIONS:

Wish of simplification & globalization for intensification of agriculture led to negative health, cultural, and ecosystem effects

→→→ **Alternative production pathways:** **agroecology**, conservation agriculture (maintain natural ecosystem services in agricultural production rather than replacing them with external inputs), ecoagriculture, sustainable intensification, integrated pest management, integrated plant nutrition systems

Encourage **home gardens** (for food security and proximity), and productive **agroforestry** & **aquatic agro-ecosystems**

Infectious diseases & Biodiversity — Complexity of impacts

~ 1 billion sick people/year > infectious diseases (x x millions deaths/year)
2/3 > animals (= zoonoses), mostly wildlife recently

Ecological approach of role of disease:

Disease **maintains genetic diversity** (and thus adaptability) within populations: disease selects, **removes**, the more **homozygotic**, disease **susceptible individuals and their genes** (disease pre-select animals for predation) (Trypanosomiasis case: antigenic profile evolution inside the host → regular challenge to immune system → favor heterozygosity of parasite & human populations for mutual adaptation) → evolution favors symbiosis between bacteria & man.

Infectious disease complex ecology:

Land use change (deforestation, urbanization, extractive industries, agriculture, drainage) → **zoonoses change**

- + : drainage of wetland & swamps for agriculture → ↓ malaria
- : deforestation → ↑ malaria, Ebola, leishmaniasis, yellow fever, Chagas disease

Review ≠ land use changes → > 50 % : ↑ pathogen transmission

10 % : ↓ « «

30 % : variable pathogen responses

2,5 % : no change

Influence of biodiversity:

Sometimes: « **dilution effect** » of vertebrates biodiversity loss → ↑ human zoonose (ex.: Lyme disease) (man = unique pest host)

Sometimes: « **amplification effect** » : high mammalian diversity = many pathogens species able to affect man

Importance of community structure and interaction changes & not just of biodiversity change through landscape perturbations;

Ability of pathogens to infect humans differ between taxa.

→ → **Need for more research on land use disturbance/disease relationship and on ecology/evolution of host and pathogen biodiversity**

Infectious diseases and Biodiversity — Drivers of change

Food production:

~30 % terrestrial land area used for livestock grazing & feed crops; **accelerated land use change** with ↗ demography

Wildlife ↔ livestock contact at periphery of forests

Intensification of poorly biodiverse animal density production → easy contamination & amplification of pathogens to entire livestock & eventually to humans .

Excess **antimicrobial use** → ↗ pathogen resistance

Poor surveillance of wildlife disease.

Wildlife trade:

x x billions animals/year (> 300 billions US dollars/year): traditional **medecines, bushmeat, trophies, live exotic pests**

Illegal trade (c/CITES): 60-70 % of species decline

x x billions non CITES animals largely unassessed

Bushmeat → HIV & Ebola; exotic pets trade → Monkeypox virus; China markets → SARS

→ → human & animal disease risks + economic & agricultural risks

Challenge: **Gaps between various ministries involved in regulation of wildlife trade.**

Specific market value chain types require targeted evaluation & tailored interventions

Climate Change:

Important driver of disease emergence worldwide if **pathogen & host/vector** can **move** through climate change

Infectious diseases & Biodiversity — Drivers of Change

Invasive Alien Species: Environmental, health, economic, socio-cultural risks

IAS can be microbial **pathogens** causing pandemics

IAS can act as **vectors** or **reservoirs** for pathogens (ex: tiger mosquito: vector of > 20 diseases : yellow fever, chikungunya)

IAS can make local **conditions** more favorable for pathogens (ex: zebra mussel → toxic cyanobacteria; water hyacinth: host mosquitoes, snails → malaria & schistosomiasis)

Human population Urbanization :

2000 → 2030 : X 3 Urban landscape (5 billions urban inhabitants in 2030)

Dense population, ~ few biodiversity → ? dilution effect ? → ↗ **contamination**

> 800 millions in **urban slums** → lack of hygiene → **disease amplify poverty cycle**

Plant diseases – Monocultures

Monocultures **less resilient** facing changes & threats – « dilution » and « amplification » effects here also (ends of a continuum)

Land use changes → **changes** of community structures and **interactions** of plants, microbes, arthropods

Little knowledge on native non pathogenic and pathogenic **microbes** of **plants** and their **interactions** → **research need**

Marine infectious diseases

Difficult to study impacts of disease on biodiversity & transmission dynamics in marine ecosystems

Stressors: climate change, t° , pH, salinity

Infectious diseases & Biodiversity – Challenges

CONCLUSIONS:

- Overlapping drivers of biodiversity perturbations & infectious disease
- Increasing drivers (population, land-use changes, climate)
- ▶ Need for more research in One health approach
- ▶ EIA must incorporate health - Health management programmes must incorporate biodiversity
- ▶ Need to move from response to preventing measures
- ▶ Need for integrated surveillance of human, wildlife, livestock disease & pathogens
- Economic & health arguments for tackling root cause of disease emergence may serve to protect biodiversity

Where to start with limited resources:

First monitor & manage risks of pathogens families known to be highly pathogenic to humans & other species

Measures to take presently:

- Avoid high-density monocultures & high human settlement near highly biodiverse ecosystems
- ↗ biodiverse agriculture & food systems. But avoid species risky for men (ex: primates)
- ↗ judicious use of antibiotics
- Careful management of greening cities (avoid habitat for risky peri-domestic wildlife & vectors)
- ↗ control of wildlife trade (to avoid disease transmission & threat to population species)
- ↗ research on pathogen « species jumping » and evolution
- Tourism management in biodiverse areas
- Integrated Risk Assessment & Analysis (USAID Emerging Pandemic Threats Programme: pathogen surveillance in wildlife in 20 countries) → Integrated policies and implementation in One Health approach

Environmental Microbial Biodiversity = Ecosystem Service essential for human Health

In high-income countries, large \nearrow inflammatory disorders (allergies, autoimmune diseases, inflammatory bowel diseases) > disorders of immunoregulation (> 1980)

→→→ « Hygiene hypothesis » → « Biodiversity Hypothesis » or « Old Friends mechanism »

Categories of microorganisms (following this hypothesis)

- 1) **Old infections:** co-evolved with humans, without killing the host. Progressively eliminated by modern medicine (ex.: *Helicobacter pylori*, helminths). Regulate immune system: **temperate IS responses** by negative feedbacks (acting as **adjuvants of T lymphocytes regulatory cells**)
- 2) **Commensal microbiota:** co-evolved with humans, in symbiosis (protect c/pathogens by field occupation). Loss in modern urban settings, uniform asptic diets, lack of breast feeding, delivery by caesarian, antibiotics. **Drive development of immune system.**
- 3) **Supplements to commensal microbiota:** > natural environment (soil, *Lactobacilli*,) → colonize gut.
- 4) **Crowd infections:** need large population to spread and persist (kill + than « old infections ») → aquired after neolithic revolution (agriculture → larger populations settlements). Did not evolve as down-regulators of IS; rather **trigger allergies or auto-immunity.**

Envir. Microb.biodiv. = ES for human Health (probes)

Immunoregulatory effects of Old infections & Commensal Microbiota (and Supplements to these):

- a) Argentinian multiple sclerosis patients infected by helminths → disease progress stops (helminths ↗ T regulatory cells)
- b) Idem: *Bacterioides fragilis* (commun in human guts), *Lactobacilli* ↗ T reg. Cells
- c) Skin microbiota with reduced biodiversity → inflammatory disorders like eczema, psoriasis
- d) Gut microbiota with limited biodiversity is associated with obesity, inflammatory bowel disease, ↗ inflammatory markers (IL-6)

More on Gut Microbiota effects:

- ▶ Different gut microbiota can induce tendency to leanness or obesity with same diet (NB: exist link between obesity & inflammatory state of adipose tissue)
- ▶ Western fast food diet → low T reg Cells in adipose tissue
- ▶ *Lactobacillus reuteri* can oppose adipogenic & inflammatory effect of Western fast food diet
- ▶ Colitis, diarrhoea are associated with perturbed microbiota & can be treated by administration of fecal organisms of sain donors
- ▶ Pigs raised in fields → gut microbiota rich in *Lactobacilli*; pigs raised indoor with same diet → few *Lactobacilli* in gut microbiota, ↓ T reg. Cells, ↑ inflammatory genes expressed in gut
- ▶ In animal models (mice), inflammatory signals from gut microbiota can trigger mammary, colorectal, prostate cancers

Envir. Microb.biodiv. = ES for human Health (probes)

- ▶ In \neq animal models of mamary carcinogenesis induction, carcinogenesis is inhibited by exposure to *Lactobacilli reuteri*
- ▶ In animal models, microbiota influence development of brain, gut, bones, energy retrieval from food, obesity, diabete 2, cardiovascular diseases.
- ▶ In man experiment, gut microbiota influence “ aspects of cognition involved in human emotion & sensation”
- ▶ NB: Chronically raised blood levels of inflammatory mediators are routinely associated with risk of depression and reduced stress resilience in high income countries.

→→→ **Positive effect of:**

Geophagy by children, farming environment, green spaces in cities > exposure to environmental microbiota → protect c/ allergic & other inflammatory disorders

NB: Gut microbiota = 100 x genes cpred to human genome

30 % small blood molecules > microbial DNA

Some anti-inflammatory microbiota effects = inhibition of histone deacetylase

→ **epigenetic effect → inheritance**

Envir. Microb. Biodiv. = ES for human Health

CONCLUSIONS:

- Avoid excess hygiene (targeted hygiene)
- Avoid antibiotics use or abuse, especially during infancy; antibiotic remediation of waste water
- Avoid pesticides (kill part of soil & environmental microbes)
- Greening cities (? Large parks vs small high quality green spaces ?)
- Open windows (or air conditioning spreading *good* microbes)
- Preserve reservoirs of human-associated microbes in hunter-gatherers communities (= microbial heritage that co-evolved with our species)

RESEARCH needed on:

- Ideal composition of our microbiota. ? ≠ if ≠ genetics & ≠ diets ?
- Nature of ≠ beneficial microorganisms from natural environment
- Environmental microbial composition (maps) compared to disease epidemiology (maps)
- Microbial air diversity outdoor, at home, in public places
- Microbial content on ≠ trees, flowers, grasses
- Microbial content of food in traditional farmers markets vs modern supermarkets
- Microbial content comparison on ≠ different varieties of same species of fruits, vegetables, ..

Water, biodiversity & human health (1)

Without water, no life, no human civilisation: necessary for consumption & agriculture

- > ½ mankind still rely on freshwater from mountain highlands
- But in water also live pathogens; ~ 1 billion humans do not have access to safe water
- Modern industry & agriculture consume & pollute waters a lot
- **Forests, wetlands, biodiversity** (some plants, algae, animals) **purify water** (correlation between species diversity & ability of water ecosystems to filter pollutants); forests also ↓ reduce soil erosion by water
- 33 of 105 world's largest cities source clean water from protected areas (ex: Catskills Mountains, forest reserve created in 1885, provides pure unfiltered water to 9 millions people daily in New York → **costs saving**)

→→ **Deforestations** all over the planet and **wetlands lost** (95 % in some regions), **habitats degradation** & fragmentation (2/3 world's largest rivers are fragmented by dams & reservoirs), **threat water ecosystems and human health**, and can result in **high economic costs** to avoid high health problems.

Drinking unsafe water → ~ 90 % diarrhoeal diseases worldwide (1, 5 million deaths: year)
5 millions killed/year > water diseases (cholera, diarrhoea, malaria, schistosomiasis)

~ **50 % world lakes are eutrophized** (**excess nutrients** in water > fertilizers, urban sewage, industrial waste water) → excess development of often toxic phytoplacton (like some cyanobacteria), ↓ O₂ for vertebrates life in water → ecosystem inbalance & human health and well-being threat (by **toxic effect** and by **lack of food**)

Water, biodiversity & human health (2)

Agriculture:

1/3 renewable freshwater on earth consumed for agricultural, industrial & domestic use

→ ↓ drained wetlands, ↓ water tables, ↓ water in key rivers

2/3 water withdrawal = for agriculture → ↓ quantity & quality of available drinking water (accumulation of nitrates, phosphates, sedimentation loading, pesticides)

→ importance of **non-crop vegetation** as **buffers around fields** (remove part of nutrients)

Medicines:

Accumulation of sex hormones (contraception), growth hormones (livestock) in water

→ **endocrine** & reproductive **disturbances**

Aquatic IAS:

Melting arctic sea ice → release of unknown pathogens locked in ice for xx 1000 years

Microplastics can be vectors of microbial communities

↓ local species for food (ex: Nile perch)

Water, biodiversity & human health (3)

Climate change:

↓ water O₂, northern migration of species including vectors and IAS

CONCLUSIONS & Future considerations:

Stop forests, wetlands (! Ramsar Convention), water ecosystems degradation !
Stop water pollution !

European Marine Board recently published: « *Linking Ocean & Human Health: Strategic Research Priority for UE* » : highlights complex marine environment & human health & well-being

Air quality, biodiversity & human health (1)

7 millions deaths /year > **air pollution** (= 1/8 global deaths → **most important environmental risk**)

(cardiovascular diseases, various cancers immune disorders, eye-ear –nose –throat disorders)

Exposure to some pollutants in childhood → ↗ risk of health problems later in life

50 % deaths among children under 5 years > air pollution

Pollutants also damage trees and other plants

Origin of pollution: combustion of fossil fuels, industrial processes (smelting, oil refining, ...), ecosystem degradation (outdoor origin, but also indoor inadequate ventilation)

Nature of pollutants: CO, NO_x, SO₂, particulate matters, volatile organic compounds, O₃ .

Role of trees biodiversity in regulating air quality: + & - effects

General effects of trees :

Shadow , t° reduction > leaf transpiration → positive in summer; negative in winter

Reduce wind speed → negative in summer, positive in winter

Pollution removal = positive effect

Trees & plants themselves emit volatile compounds attracting pollinators or repelling predators.

Oxydation of these compounds → CO, O₃ ↔ counterbalanced by pollution removal by trees

Air quality, biodiversity and human health

(2)

Importance of trees biodiversity

- Trees remove pollutants mostly by stomata (transpiration, gases exchange holes) of their leafs, and leaf surface (for particulate matters removal) → **pollution removal dpd on leaf area & shape** (www.itreetools.org)
- Removal of pollutants depd **on vegetation configuration**: tree large canopies can prevent a) pollution in upper atmosphere from reaching ground-level air; b) dispersion of ground-level pollutants → choice of trees shape to improve air quality depend on situation
- Emissions of **volatile compounds** by trees **vary by species**, like pollutants removal & is t° dependant
→ more studies needed to know best tree species to place in urban areas following situations

Also think to maintenance need and longevity of species (to ↓ fossil energy use and pollution)

More research needed to relate vegetation composition impacts to pollution concentration and human health impacts

Bioindicators & human health (air quality)

Lichen & bryophytes species richness, relative abundance, dominance, are common indicators of N & S pollutants.

Radionuclides, POPs, PAHs, PCBs, dioxins, heavy metals, accumulate in lichens & bryophytes (but without specificity related effects)

However, those **bioindicators are seldom used in health studies related to environmental pollution**

(? cause: need to assemble **interdisciplinary research** team with very various skills ? : biologists, ecologists, analytical chemists, epidemiologists, toxicologists, public health specialists, socioeconomists,).

Yet, bioindicators are living organisms and thus biologically reflect the environment where they are living and its level of adequacy for life

Traditional medicines & Biodiversity (1)

Interlinked nature of the « **biodiversity conservation** », « **sustainable use of biodiversity** » and « **health development** » issues → need for integrated approaches between biodiversity & health

Moreover, need for integration between traditional medicine and modern medicine: patients embrace benefits of Western medicine, while traditional medicine is maintained in people's culture, and fills a gap in access to modern health care in developing countries → **complementary** aspect of **traditional & modern medicine; vital importance of traditional knowledge**

Traditional medicines are **unique by biodiversity & cultural practices** of specific socio-economic regions → no universal way for integrated approaches (NB: traditional healers experience new remedies and are responsive to international health trends. Ex.: look for remedies c/ HIV)

60.000 plant species used for medicinal, nutritional, aromatic properties (non clear distinction between medicinal & nutritional use. Ex: « tonic » plants)

2,5 billion US dollars plants trade for medicinal purpose

Medicinal herbs are traditionally **wild-collected**

Traditional medicines & Biodiversity (2)

Demand for traditional herbs ↗ while threat ↗ of overharvest, climate change, habitat destruction
→ **threat on traditional medicines material & knowledge** → need for **development** of programs for cultivation as complementary approach; creation of **databases** of local pharmacopoeia
Develop **local enterprise** & trade for local income generation

Demand ↗ for **cost-efficacy & safety** (demand in urban areas → alienation from natural environment & demand for universal standards) → **need for engineering process**
(Safety : DNA bar-coding before sale of wild-collected)
→ need for clinical studies, statistical analysis of efficacy, with **methods of conventional medicine**
But traditional formulations may require testing within **traditional epistemologies** & methods

! ? **Intellectual property rights** ? → Nagoya Protocol.

Traditional knowledge often oral

Demands for re-patriate traditional knowledge in local language and establish in situ collections

→→ **Need for fair initiatives & partnerships**

Traditional medicines & Biodiversity (3)

Initiatives & Partnerships:

- FRLHT (Foundation for Revitalization of Local Health Traditions), in India, since 1993
- PROMETRA (Promotion of Traditional Medicines), NGO, since 1971, worldwide
- MUTHI: Multidisciplinary University Traditional Health Initiatives: research partnership financed by EU (Framework 7 Program) between institutions in Africa & in Europe (Norway, NL & UK)
- Fair Wild Standard: (merger of IUCN medicinal plants specialists group, WWF Germany, German Agency for Nature Conservation): best practices guidelines for sustainable use & trade of medicinal plants)
- RITAM (Research Initiative on Traditional Antimalarial Methods): 200 international researchers in 30 countries, since 2001 (Cohort study approach → positive results in herbal prep.)
- Biodiversity & Community health Initiative (> COP11 of CBD, 2012)

→→→ **Need to ↗ partnerships between conservationists & health care sector (**integrate biodiversity conservation priorities in health system planning**)**

Document better efficacy of traditional medicines in a culturally sensitive way

? Recognize **locations of important medicinal plants as **biodiversity heritage sites** ?**

Biodiversity, health care, & new pharmaceuticals

Positive impact of biodiversity for health care

50 % new drugs approved by USDA between 1980 & 2010 > natural origin

75 % antibiotics approved by USDA between 1980 & 2010 > natural origin

9/13 major classes of antibiotics > microorganisms

→→ Biodiversity to preserve as **source for new drugs**:

Microbial & marine living world almost unknown for their therapeutic potentialities.

Yet, new drugs in development from fixed marine organisms (sponges, corals,), drogs, snakes, leeches, (anticancerous, antibiotics, antipain, anticoagulant, neurotopics, ...)

Biodiversity to preserve as **tools and inspiration for fundamental biology and physiological research** ex: bears for kidney function; Aplysia (small mollusc) for memory study; Thermus aquaticus bacterium for PCR (polymerase chain reaction)

!!! Species dissappear 1000 x faster than before humanity development

Biodiversity, health care & new drugs

Potential negative impacts of health care for biodiversity

General impacts of hospitals on environment & living organisms: **energy** use, **water** use , **waste** production, ↓ air quality (incinerators)

Antibiotic use :

- disrupt relationship between hosts & symbiotic microbes
- favors selection of resistant pathogens

Active Pharmaceutical Ingredients (APIs) (for humans or livestock) released in the environment:

Hormones, antibiotics, NS antiinflammatory, anti-depressants, antifungal, detected all over in rivers
→ **non target organisms (humans & animals) exposed**, over long periods if APIs persistent;
possible additive or synergistic effects →→→

▶ intersex characteristics in fishes, molluscs, (? Men ?) exposed to **endocrine-disrupting compounds** (contraceptive pill used by 100 millions people worldwide)

▶ **anti-depressants** affect behaviour of animals. Ex: Small crustacean (amphipode) swim closer to water surface → ↑ preyed by birds

▶ Pesticides, parasitides, in farmland → ↓ preys available for surrounding wild life (**ecological imbalance**)

▶ case of Vulturs in Asia : 95 % decline in the 1990 ↔ diclofenac sodium, used in many analgesic, anti-rheumatismal, anti-microbial prep. → Vultures died from visceral & kidney problems → threat of rabies & other zoonoses (NB: Vulturs clean carcasses of dead animals)

Biodiversity, health care & new drugs

Conclusions:

Need to preserve **biodiversity** as inestimable **source for new drugs**

Need for **Risk Assessment** of **sub-lethal effects of Active Pharmaceutical Ingredients** on wildlife ;

Need for research on ways of entrance in nature and persistence of APIs

Need to **regulate more** effectively use and disposal of **APIs**

→→→→ **Biodiversity scientists, environmental chemists, practitioners, policy makers**
have to engage **more closely with health sector**

General CONCLUSIONS

- Many similar drivers of biodiversity & health evolution
- Many cross-cutting issues between sub-thematics of biodiversity & health (nutrition & biodiversity, agricultural biodiversity, infectious diseases & biodiversity, microbiodiversity & health, water & air quality & health, biodiversity & pharmaceuticals)
- Need for more **research**.
- But **actions** already possible.
- Need for collaboration/**integration** between concerned **sectors** and **actors**: environment, health, agriculture, land management, water management, air and climate management,
- Need for **collaboration** between **developed and developing countries** and taking into account of B & H in Dev. Coop. projects
- Need to **include Biodiversity & Health in post-2015 Development agenda**

