Q&A sheet of synecoculture project with respect to the criteria of 3rd Science Forum for biodiversity, CBD COP13

Q. How is or could this work (case, tool, Approach, etc) contribute to mainstreaming biodiversity? What could decision-makers learn from this experience?

A. Synecoculture project tackles extreme experiments of mainstreaming biodiversity in smallholder farming. By augmenting the biodiversity with edible species beyond the natural state, it takes the self-organized relationship between biodiversity and ecosystem functions as the foundation of productivity in order to yield multiple ecosystem services in a sustainable manner. It does not rely on conventional resource input such as tillage, fertilizer, and chemicals, instead we create management tools with the use of information and communication technologies (ICT).

Q. What do you think are/were the factors for success?

A. Synecoculture is theoretically constructed on scientific facts of synecology (community ecology), on the basis of general relationship between environmental condition, biodiversity, and productivity. It has therefore quit wide range of application and tailor-made adaptability. As synecoculture can introduce huge diversity of products in wider environmental condition, it excels especially in harsh environment such as arid tropics where conventional agriculture is difficult to introduce.

Q. What were the challenges and what could be the strategies to overcome it?

A. The challenge lies how to harness the huge complexity of biodiversity and obtain constant yield. The solution is the combination of efficient vegetation portfolio strategy that facilitates the management and that is suitable for constant harvest by thinning out of dense mixed plant communities. ICT could greatly help the management in this strategy.

Q. Any ideas or recommendations for work ahead, open questions, or need for further research or empirical work ?

A. Synecoculture could be widely introduced in any arable condition without much cost. It increases crop diversity, construct local ecosystems to the degree that can even utilized to desert revegetation, create on-farm employment, conserve natural resources and plant genetic resources. This project is based on open source principle and we are seeking for collaborators to collect open data all over the world. Collaboration with gene bank would be substantial advancement for the optimization of global vegetation portfolio including neglected and under-utilized species.

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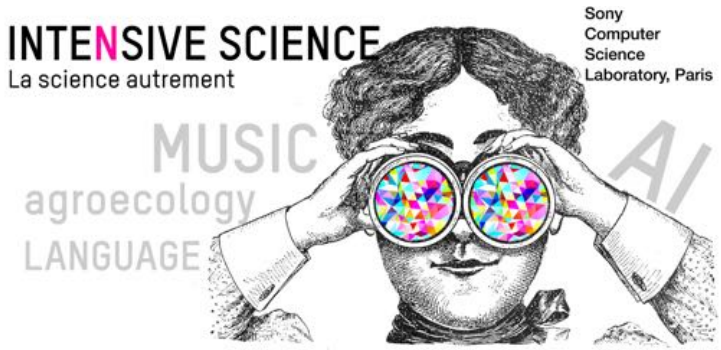
SYNECOCULTURE

–HUMAN AUGMENTATION OF ECOSYSTEMS



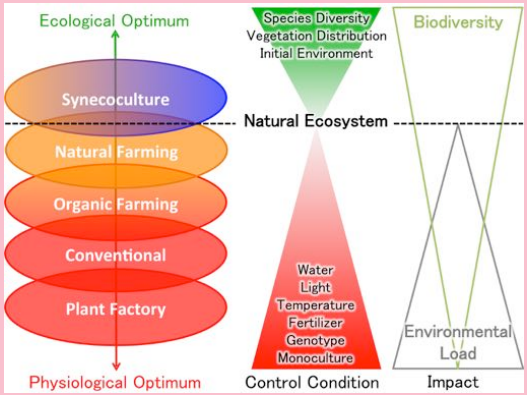
1 Concept

Humans have engaged in agriculture for over 10,000 years since the dawn of history, but that history has been inevitably based on the trade-off between agricultural production and environmental degradation. Modern agriculture is still situated along the same line, further loading the environment to realize physiological optimum in large-scale monoculture. On the other hand, plants have been one of the main agents that transformed terrestrial environment through surprisingly intelligent adaptation and coevolution. Ecosystems have evolved by developing complex networks containing both competitions and symbiotic relations as a result of ecological optimum, which formed today's biosphere we live in.

Synecoculture aims to yield the potentials of self-organizing nature of ecosystems, and to develop long tail, parallelly distributed frameworks of primary industries beginning with agriculture.

2 Theory

Figure: Relational classification of farming methods based on Integrated model of physiological and ecological optima(IMPEO). Existing farming methods, conventional, organic, and natural farming try to control the growth condition of crop to achieve closer condition to physiological optimum in trade-off with environmental conservation effort. Plant factory represents the extreme control in confined environment. Production at physiological optimum range turns out to cope with competition-dominant interaction when associated with other vegetation of concurrent physiological property. Synecoculture targets the mixed cultivation of both competition-dominant and symbiosis-dominant niches under fluctuating environment, by controlling plant species diversity and its distribution.



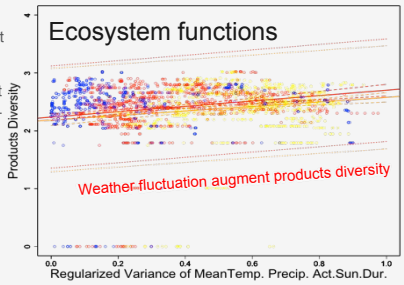
3 Results

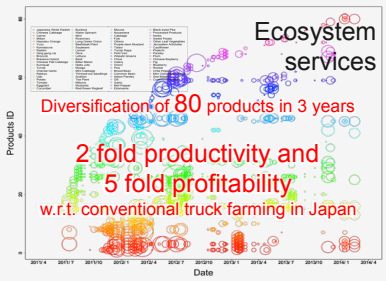
We experimented a novel system of small-scale truck farming, namely synecoculture, in temperate zone of Japan and semi-arid tropic in Burkina Faso. Synecoculture is based on highly biodiverse mixed polyculture of crops, including underutilized and neglected species, on the basis of no-till, no-fertilizer, and no-chemical practices. Spontaneous organization of ecosystem functions in response to the diversity of plant community is a major hypothesis that was expected to be compatible with productivity and various regulation services.

We monitored between 2010-2016 on 3000㎡ in Japan, and 2015-2016 on 500㎡ in Burkina Faso, a mixture of 150-300 species in each plot. The productivity as measured by sold benefit after cost deduction rose to 5 fold in Japan with respect to conventional monoculture systems. Field ecosystems also augmented spontaneous biodiversity. The component analyses of products revealed increased expression of plant secondary metabolites and increased concentration of minerals, which contributed to enrich nutrition profile. The experiment in Burkina Faso recovered a sane functioning of ecosystem exposed to desertification, and marked more than 30% increase for major 10 crops compared to traditional farming methods. The total profit of products resulted in about 20 times superior to the Gross National Income per capita (GNI) of Burkina Faso (World Bank 2015), and 50 fold of absolute monetary poverty threshold in the capital city (INSD 2014).

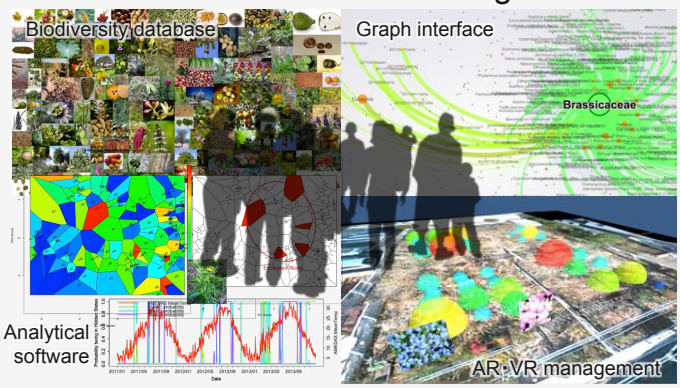
These results are important in recovering biodiversity in both environment and food products lost by excessive exploitation of conventional agriculture. Wider introduction of synecoculture could be expected to support sustainable food production, especially in arid tropics where desertification of arable land, poverty and malnutrition of smallholders form a vicious cycle upon conventional methodology.

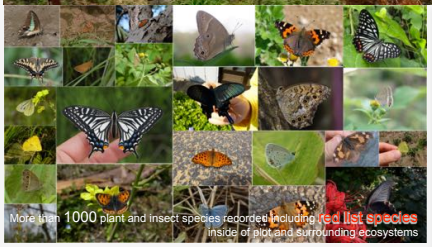
Adaptive diversification of plant community in changing environment





Human augmentation × Augmentation of ecosystems





In order to manage the complex vegetation, we developed an open-source management support system with the use of information and communication technology. We aim to convert agriculture from resource-consuming type to sustainable information industry that support the augmentation of ecosystem.

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