Summary of session 6

Divergent and convergent development models

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This summary of session 6 includes four main topics: i) the presentation by Dr Ivette Perfecto; ii) a summary of the presentation by Dr. Jeannine Cavender-Bares, iii) a summary of our presentation; and iv) comments to the question-answer session after the presentations.

1- The presentation by Dr. Ivette Perfecto. Dr. Perfecto presented the agricultural intensification/land sparing model, with food production given by intensification in some areas, and land sparing for conservation in others. The underlying assumption of this model is that intensive agriculture is the most efficient way to produce food, and consequently, biodiversity conservation will be enhanced because less land will be required to grow crops and, at the same time, deforestation will not be stimulated. The associated processes include the concentration of industries and work availability in cities. This process given intensification and spatial concentration of agricultural production is called the forest transition.

Afterwards, Dr. Perfecto showed that the assumptions underlying the agricultural intensification/landsparing model and the corresponding patterns and processes are not necessarily true in all conditions. In the case of Puerto Rico a recovery of forest cover from 1940 (when >10% of the landscape was covered by forests) to 2000 (when forest cover was 40%) did not ensure biodiversity conservation. Despite the rapid recovery of the forest, large-scale human disturbances have had a negative effect on the biotic communities that can last for centuries. The invasion of exotic species plays a central role in long-term ecological effects, such as the large-scale floristic homogenization (Grau *et al*., 2003).

As an alternative to the above model, Dr. Perfecto presented the quality matrix model - the nature's matrix (Perfecto & Vandermeer, 2010). Such a model is based on the fact that small-scale agricultural production can spatially coexist with a matrix of conserved forests, and simultaneously ensure food production and biodiversity conservation. Biodiversity can be maintained under such configuration through meta-population dynamics, where inter-fragment migration compensates for local extinction. On the other hand, food production can be sustained by small-scale farmers using agro-ecological methods that are more likely to promote a high quality matrix for biodiversity conservation.

2- The presentation by Dr. Jeannine Cavender-Bares. Dr. Cavender-Bares showed the contrast between the divergent development model (equivalent to the agricultural intensification/landsparing one presented above) and the convergent development model (equivalent to the agro-ecological matrix model developed above). The comparison of these two

contrasting developing models included the questioning of the need to balance human wellbeing with the maintenance of living support systems. These are clear trade-offs that have been largely been recognized; yet, how do the divergent and convergent models deal with these trade-offs?

Dr. Cavender-Bares used the work developed for the Willamette Basin in Oregon, USA (Polasky *et al.*, 2008) to explore how biodiversity conservation could be compatible with economic development. An analysis of the "efficiency frontier" has shown that biodiversity conservation (measured as expected number of species) and the value of economic activity (present value of land use activity) could be increased substantially under plausible land use configurations that do not intent to maximize either biodiversity or economic activity. This analysis provided a good framework to wonder whether convergent models were closer to the optimal point of the curve than divergent ones. Otherwise, convergent and divergent models could represent just different alternatives to deal with the trade-off between biodiversity conservation and economic activity.

3- CIEco, UNAM presentation. Our presentation was focused on addressing the three discussion topics chosen in collaboration with Dr. Cavender-Bares for the session.

A) How does discussion of convergent and divergent development models fit into the general framework of sustainability science? To establish this relationship we showed that the two development models seek the same goals presented by Clark and coworkers in the context of sustainability science (*in* Dasgupta *et al.*). These shared goals are: 1) the need to deal with sustaining the human system, and thus deal with poverty, inequality, and hunger, 2) the need to maintain the ecological system, thus dealing with biodiversity conservation, and 3) the interaction among these systems. Yet, we believe these two models deal with the same issues with very different visions. The divergent development model is based on satisfying human needs with spatial concentration and intensification of agricultural production, and sustaining ecological systems and biodiversity conservation with reserves, thus clearly separating land uses for each of the above goals. Instead, the convergent model is based on creating mosaics (matrix) with small units of production and natural areas, with a spatial coincidence of areas dedicated to fulfill the human and ecological system related goals.

B) How does the perspective of the developing world differ from the developed world in preferences for contrasting development models? The group discussed that preferences are more related to the social organization (government vs. community perspective) than the developed vs. developing worlds. We showed that in general federal level country policies as well as global policies tend to favor the divergent models. For instance, even in Latin-American countries, and particularly in Mexico, there has been an emphasis on agricultural intensification. On the other hand, local communities and several peasant organizations and ethnic groups, favor more frequently convergent models. These groups are aware of their dependence on wild plants and animals for their well-being, they are the owners of the land an the resources, and thus they could prefer the spatial convergence of food production and biodiversity conservation.

C) What is the evidence that convergent models are more sustainable than divergent models? We presented evidences that support that convergent model can be more sustainable

than the convergent one for the case of Mexico. Our first line of arguments was the critique to the forest transition model as a consequence of the divergent model. In the case of Mexico, the forest transition model did not behave as expected (García-Barrrios *et al.,* 2009) mainly due to political and social factors like: 1) weakness of local rural institutions that lead to uncontrolled forest exploitation, 2) remittances that stabilize rural economy, permitting people to invest on their lands, 3) differential support and thus abandonment of land conservation, fire control practices, increasing the use of herbicides and other inputs., and 4) other options to abandonment like expansion of livestock and grassland.

We presented the work "Biodiversity conservation in traditional coffee systems of Mexico" (Moguel & Toledo, 1999) showing some trends that supported the idea that the convergent models of coffee plantations are more sustainable. Three of the five trends showing high yields but high environmental impacts reached their maximum values for the most intensive agriculture production (unshaded monoculture), while carbon sequestration and biodiversity levels were highest for the most diverse and traditional systems (rustic and shaded polyculture). The question here is for how long the high production can be maintained under intensive agriculture production where high levels of erosion and chemicals are present.

4- Discussion. Various key questions were posed and addressed. We have organized them by themes below.

a) How comparable are the two models in terms of biodiversity and food production?

There is a need to have quantitative information to compare the relative performance of the two development models, both in terms of their performance in some study cases, as well as their potential contribution to global food production and global biodiversity conservation.

b) When and where is each of the two models more adequate?

It was discussed that both the divergent and the convergent models have been shown to be successful in different areas of the world. A key question would be to explore which social and ecological conditions have favored each of the models. Past history, policies and the ecological context can all contribute to the differential suitability of the two models in different parts of the world. A simple replacement of one development model by the other is not plausible.

It is important to consider the environmental, social, economic, political, historical and cultural context of the specific regions, as well as the perspectives of the different local stakeholders, to explore the viability of each of the development models. It is also important to explore the differences in perspective that arise from bottom-up approaches, based on local with proactive communities considering local knowledge, perceptions and needs, from those given by top-down approaches that would emphasize global perspectives and global demands.

It was questioned whether divergent models are better options for the developed world while convergent models are more adequate for the developing world. Further evidences are needed to document the performance of each of these two models in a range of conditions throughout the

world. There are, for instance, examples of local farms and local markets in some areas of the USA that could approach more the convergent than the divergent model. Modeling exercises could then be used to explore which combinations of which models could address the global demands for food production and biodiversity conservation.

In any case, the current practices of the divergent model and intensive agriculture have had enormous ecological consequences, thus questioning its sustainability on the long term.

c) The ecological drivers underpinning the convergent model

Meta-population dynamics is a key argument to support the convergent model. Natural protected areas are needed to protect a fraction of the world's biodiversity, but not all biodiversity can be conserved there. Increased evidence has been showing the importance of anthropogenic landscapes in the maintenance of biodiversity.

d) The role of urban areas

Under the divergent development models urban areas are only food consumers. Yet, under the convergent model, urban areas produce at least part of the food they consume. Actions towards the second trend have been taken into various cities in the world (e.g. Cuba). It is important to explore whether agricultural areas will be enough to support the growing demand of food from cities, given both by increased population and increased per capita food consumption, without compromising the sustainability of the food production systems. Changes in consumption patterns and reducing demand for input material and resources will certainly be needed.

Literature cited

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