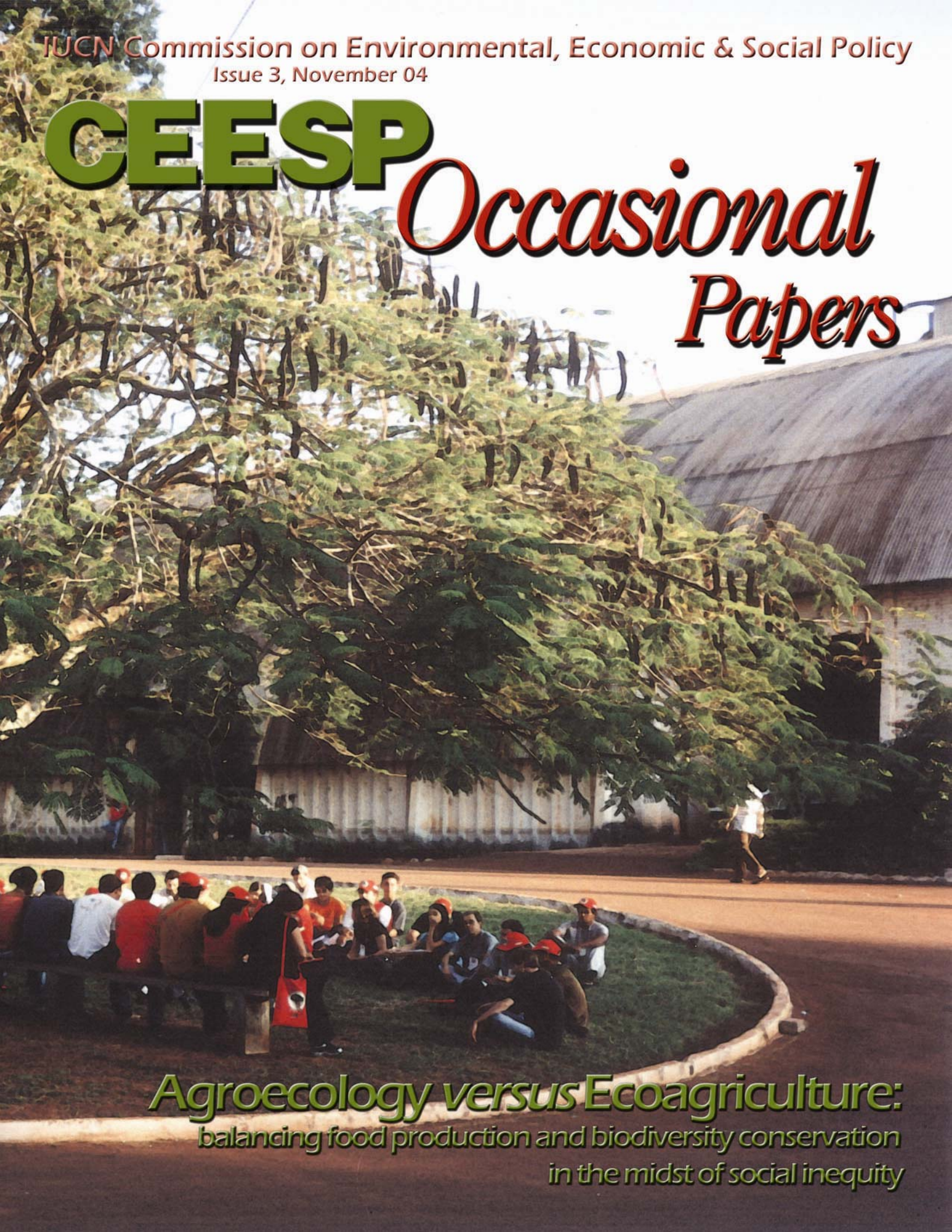


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Agroecology versus Ecoagriculture:
balancing food production and biodiversity conservation
in the midst of social inequity

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Miguel A. Altieri

IUCN
The World Conservation Union



Ecoagriculture: A Trojan horse for agricultural multinational corporations to enter IUCN?

M. Taghi Farvar, Chair

IUCN Commission on Environmental, Economic and Social Policy (CEESP)

For too long agriculture has been seen as a threat— in fact one of the main threats—to biodiversity conservation. However, with the increased appreciation for the livelihoods role of agriculture for local communities, as well as renewed interest in non-chemical agriculture, the conservation movement is starting to take a second look.

Agriculture is recognized as an extensive and necessary form of land use; conservation aims cannot be achieved at the expense of rural livelihoods. In 2002 IUCN launched the Ecoagriculture Partners, an initiative which has the involvement of powerful agricultural input companies with a history of controversy and conflict with farmers, such as Syngenta.

Conservation and development groups,

Who are the Ecoagriculture Partners?

Ecoagriculture is defined as sustainable agriculture and associated natural resource management that embrace and simultaneously enhance productivity, rural livelihoods, ecosystem services and (especially wild) biodiversity.

The “Ecoagriculture Partners” was formally established at the World Summit for Sustainable Development under the co-sponsorship of IUCN and the Future Harvest Foundation as a WSSD “Type II partnership”. One of the main outcomes of the Johannesburg Summit was the Type II partnerships, which can include the private sector and are meant to supplement— or supplant (depending on one’s perspective)— the commitments by governments to achieve sustainable development.

IUCN’s co-sponsor, The Future Harvest Foundation, was initiated by the Public Awareness and Resource Mobilisation Committee of CGIAR, the Consultative Group on International Agricultural Research, and is now registered as an NGO. Partners from the private sector include CropLife International, Sustainable Agriculture Initiative, Bayer CropScience AG as well as Syngenta Foundation for Sustainable Agriculture (an organisation established and funded by Syngenta).

IUCN included, recognise that business can be a power for good as well as for ill. Of course it is necessary for IUCN to engage in debate with the private sector— how else can we seek to influence them? But the terms of our dialogue and debates are of paramount importance. The mere engagement in dialogue with IUCN or other environmental groups can be used as a “greenwash” of corporate sector interests that have little to do with conserving biodiversity or ending poverty, rhetoric aside. There are two great attractions for IUCN in dealing with private corporations: The prospect of positively influencing the private sector. This is part of the mission of IUCN and any real chance to achieve this goal would be

extremely welcome;

The prospect of receiving funds from the private sector to support IUCN activities. This could be a lure, as the integrity of IUCN may be compromised by it. Money is never given without conditions or expectations, and even though these conditions may never be clearly mentioned, history shows that they eventually manifest themselves.

Importantly, the IUCN members have the right to expect that any such difficult and delicate dialogue is pursued under clear rules, guidelines and principles (such as the principle of the meaningful participation of rightsholders). IUCN needs to learn the lessons from its engagement with the mining sector, an engagement which was initially launched as a “partnership” but was then downgraded to a “dialogue” when IUCN members, Councillors, indigenous peoples and others raised strong objections to such a partnership. The industry agreed to the dialogue, but insisted that issues of human rights and equity would have to be excluded from the topics of discussion. This condition was unacceptable to the IUCN Council. This experience holds lessons for IUCN's growing engagement with agribusiness.

Agribusinesses are also accused by many of human rights abuses, such as the many deaths throughout the world caused by pesticide poisonings and the theft of genetic material from local communities, also known as bio-piracy. Agriculture is no less of a battleground for the rights of indigenous peoples and local communities— as well as consumers— than mining.

IUCN is a nature conservation organisa-

tion with an equal concern for equity and social justice. Our own mission demands us to be extremely cautious when dealing with groups with a known history of exploiting and damaging nature and being careless about the concerns of local communities and indigenous peoples. Especially when the profits these companies stand to gain are so great that incentives for real change are greatly weakened, we need to consider options with wide open eyes and a background of principles and criteria as a guide. For instance, the following principles for engaging with the private sector would help to ensure that IUCN's integrity, values and reputation remain intact:

1. As a rule, IUCN should not accept any money from private sector companies whose actions and normal business contradict IUCN's vision and principles. Dialogue or even collaboration, but without taking money, will make IUCN a partner with integrity. Once we accept money from private corporations, there is a real risk of compromising our principles.
2. IUCN can be called an ethics-driven organization, but private sector companies clearly are not. Exactly because of that we should exercise double care to enter only into situations in which **we** set the rules, rather than the contrary. For instance, IUCN and other powerful bodies should not discuss issues or enter into agreements that affect third parties without those third parties being allowed to participate in the discussion. This becomes of utmost importance when these parties are among the weakest— such as indigenous peoples and local communities in many countries

of the South.

As mentioned above, lack of clear guidelines and principles can lead to co-option. With the involvement of companies such as Syngenta, a key area of concern is the role of biotechnology in ecoagriculture.

Ecoagriculture Partners has, to date, not identified any ecoagriculture systems using GMOs, but this does not necessarily mean that pro-biotech interests are not influencing their agenda. In a Strategic Planning Workshop of the

Ecoagriculture Partners held at IUCN Headquarters in 2003, partners concluded that they should support the "precautionary approach" in introducing new agricultural technologies. They also agreed that "where existing technologies and management systems have proven negative impacts on biodiversity, Ecoagriculture Partners will seek to transform them". Both of these arguments are trademarks of the pro-biotech industry lobby. On the other hand, environmental organizations argue that given the unpredictable consequences of genetic technology and the fact that any adverse consequences will only be evident in the long run the "precautionary principle" (not "approach") should be applied. IUCN has adopted a similar policy through Resolution 2.31 of the World Conservation Congress, which urges

Precautionary principle or precautionary approach?

The terms "precautionary principle" and "precautionary approach" are often used interchangeably, but there are important differences between the two.

According to the IUCN issues paper, *The Precautionary Principle in Biodiversity Conservation and Natural Resource Management*: "The precautionary principle' appears to mandate that risk be avoided or minimized, thereby automatically giving the environment the benefit of the doubt; while 'the precautionary approach' implies that it allows flexible operational measures which are context-sensitive and allow for the balancing of various objectives, including economic ones."

One of the most important ways in which the precautionary principle is given operational effect is the *burden of proof*.

Proponents of potentially harmful activities may be required to demonstrate that such activities are safe or acceptable, rather than those opposing the activities being required to argue that they are harmful."

IUCN members to "apply the *precautionary principle* in their respective regions regarding further releases of genetically modified organisms into the environment" including in the rationale that there is "widespread concern that genetically modified organisms (GMOs) could have potentially dangerous effects on living organisms and their ecosystems"¹. By agreeing to conclusions that are *weaker* than existing IUCN policy, the Ecoagriculture Partners seem to reveal the influence of pro-biotech interests on their agenda.

There is growing concern, particularly among NGOs and social movements, with the influence of agribusinesses on the agendas of public and inter-governmental organizations. The corporate takeover of public agricultural research

¹ The Resolution was adopted, but with a formal objection from the delegation of Canada to an amendment changing the words "precautionary approach" to "precautionary principle".

and policy-making over the past several years is striking. Currently CGIAR, one of the Ecoagriculture Partners (both through its Future Harvest Foundation as well as four of its 16 Future Harvest Centres), is at the centre of many of the controversies.

CGIAR is the largest publicly funded international institution working on agricultural research. Even more importantly, the CGIAR holds in public trust the world's largest collection of plant genetic resources. The CGIAR established its NGO Committee (NGOC) in 1995 to strengthen its partnerships with NGOs. Yet at the CGIAR Annual General Meeting in 2002, the NGO Committee "froze" its relations with the CGIAR. The NGOC cited the adoption by CGIAR of a corporate agenda for agricultural research and development as the main reason behind this move.

But the reach of the biotech corporations seems to have spread even further to the FAO itself, an inter-governmental organization mandated with addressing food security. In 2004 FAO published a report (*Biotechnology: Meeting the needs of the poor?*) which many civil society organizations, including CEESP, denounced for its biased pro-biotechnology stand. Over 650 civil society organizations signed a protest letter against the report, an unprecedented global mobilization against a report by a UN agency. They asserted that the report "has been used in a politically-motivated public relations exercise to support the biotechnology industry. The way in which the report has been prepared and released to the media, sadly, raises serious questions about the independence

and intellectual integrity of an important United Nations agency."

The lesson for IUCN is clear: not only must we be cautious in dealing with the private sector, but on issues where the private sector has gained influence in public institutions— such as agriculture— IUCN must be even more cautious, applying the same principles to its dealings with these public institutions as it would to the private sector.

Finally, it may be necessary to reiterate that we support the engagement of IUCN with the private sector, as long as concerns such as those addressed in this article are dealt with. If they are not addressed, there would be no choice but to avoid a direct or formal engagement with the private sector and resort to challenging them through other means. Organizations, movements, activists and scientists who refuse a direct engagement with the private sector are sometimes characterised as merely screaming from the sidelines; too afraid, too apathetic, too irresponsible or simply too ill-informed to engage in a direct dialogue with their adversaries. Yet, more often than not, this characterisation is a tactic used to discredit the legitimate voices of dissent in the face of powerful interests. The experience of the NGO Committee of the CGIAR is a case in point. The members of the Committee had made the decision to engage CGIAR directly in debate by sitting on the Committee since 1995. As the CGIAR began to deviate from its mandate their concerns grew and finally began to gradually boil over. Even prior to the freeze in relations announced at the 2002 AGM, a

number of the NGOC members had resigned. In May 2003, the last member announced his resignation. In 2004 as the situation has continued to deteriorate, NGOs and Civil Society Organisations—including some former members of the NGOC—have started calling for the CGIAR to be shut down completely.

While it has been necessary to examine in detail the relationship of IUCN with agribusiness in the context of the Ecoagriculture Partners, it is also necessary to take a closer look at the substance of the ecoagriculture approach. For this, Miguel Altieri's contribution is essential reading for any of us who thought that ecoagriculture and agroecology were synonymous. We are happy to produce it in CEESP's Occasional Paper series as this will surely contribute to the intensification of dialogue and debate.

Altieri articulates important differences between ecoagriculture and agroecology, both in terms of conservation and poverty. He makes a strong case that agroecology works to conserve biodiversity and improve livelihoods by building on traditional agriculture and indigenous knowledge and by addressing the root causes of poverty and inequality, such as lack of access to productive resources, including land and water. The latter, an approach known as "food sovereignty" contrasts "food security"—an approach that often perpetuates dependence of the hungry and the poor on the goodwill of the "haves". Ecoagriculture, on the other hand,

seems to ignore the importance of customary institutions. For example, in reading *Ecoagriculture* by McNeely and Scherr,²— a valuable work that treats many technical problems and solutions—one cannot help but notice that a great deal of the solutions discussed by the authors have been in practice by customary institutions of indigenous peoples and traditional communities for millennia. This begs the question, "Why are these being dismantled today and why are we not trying to re-institute the good practices by strengthening, rather than ignoring and weakening, the customary institutions that have possessed the knowledge of sustainable agriculture and pastoralism *with* the conservation of biodiversity? To do so would be no less practical than some of the— seemingly unlikely— measures proposed in the book.

Perhaps there is only a communication problem between some in the conservation community and the majority of those committed to equity and social justice. But IUCN, which combines both of these two fundamental concerns, needs to make concrete efforts at bridging this gap— which amounts to nothing less than remaining true to its own mission.

² McNeely, J.A. and S.J. Scherr. *Ecoagriculture: strategies to feed the world and save wild biodiversity*. Future Harvest and IUCN. Washington, Island Press, 2003.

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Agroecology versus Ecoagriculture: balancing food production and biodiversity conserva- tion in the midst of social inequity

Miguel A. Altieri
University of California, Berkeley

At first glance, everybody would agree that the concept of **Ecoagriculture** (ECOAG) is a good one. Who could oppose the idea of transforming agricultural systems so that they support healthy populations of wild species while simultaneously improving productivity and reducing poverty? There is an urgent need to conserve biodiversity and if this can be achieved through agricultural intensification, which many argue is needed to meet growing food demands in the developing world, there is no question that this is a win-win situation. Ecoagriculture advocates argue that their approach is particularly important in the biodiversity hotspots of the developing world where most of the poor concentrate and have little choice but to exploit wild habitats for survival.

Ecoagriculture promoters claim that the best way to reduce the impact of agricultural modernization on ecosystem integrity is to intensify production in order to increase yields per hectare, and in this way spare natural forests and other wildlife habitats from further agricultural expansion. They argue that feeding a growing world population without further endangering the natural environment and its biodiversity requires

an evaluation of the role that emerging technologies may play in helping meet food needs at a reasonable environmental and social cost. Although they embrace alternative, low input agricultural systems, ECOAG practitioners do not discount chemically-based, high-yielding, intensive agricultural systems, including transgenic crops, as part of their strategy for protecting wildlife while feeding the

world's population. While they do not directly recommend agro-chemically based systems, they do so indirectly by promoting intensification of crop production as the only way to spare forests from the advancing agricultural frontier. By doing so, ECOAG supporters adhere to two pervasive assumptions:

(a) that alternatives to a chemically-based crop production system necessarily require more land to produce the same amount of output and (b) that the adverse ecological and health consequences of industrial farm-

Although they embrace alternative, low input agricultural systems, Ecoagriculture practitioners do not discount chemically-based, high-yielding, intensive agricultural systems, including transgenic crops, as part of their strategy for protecting wildlife while feeding the world's population. While they do not directly recommend agro-chemically based systems, they do so indirectly by promoting intensification of agricultural production.

ing are minor in comparison to those that would be wrought by expansion of land extensive production systems.

But the ecological and health impacts of industrial farming are not easily discounted. In his global analysis of the impacts of agricultural intensification on biodiversity, Donald (2004) found that massive increases in production of five major commodities (soybean, rice, cacao, coffee and oil palm) were achieved by increases in both the area planted and in the yield achieved per unit area. Both strategies led to environmental degradation and negative impacts on biodiversity via massive loss of natural habitats but more importantly through pollution linked to heavy use of agrochemicals. Monoculture systems, lacking in functional biodiversity and self regulatory mechanisms, are genetically homogeneous and species poor systems that are very vulnerable to diseases and pest outbreaks. Due to this increased vulnerability, more than 500 million kg of active ingredient of pesticides are applied annually on the world's genetically homogeneous agroecosystems (91% of the 1.5 billion hectares of arable lands are under monocultures of grain) to suppress insect pests, diseases and weeds. The environmental impacts on wildlife (pollinators, natural enemies, fisheries, etc) and social costs (human poisonings and illnesses) of pesticide use reach about \$8 billion each year in the USA alone. Such costs are much higher in the developing world where banned pesticides imported from the North are still being used at large.



Figure 1. Seeds are carefully gathered and grown in Salvador de Bahia, Brazil for home consumption (Courtesy Grazia Borrini-Feyerabend)

Despite such costs the chemical warfare against pests is futile as more than 450 species of arthropods are resistant to various insecticides and today yield losses to pests reach 30%, the same as 50 years ago.

And while it is well known that widespread adoption of chemically-based, land intensive crop production systems have negative impacts on biodiversity, less known is the fact that such production models actually hinder attempts to provide adequate food for a growing world population. Increasing production does not necessarily reduce hunger. The real causes of hunger are poverty, inequality and lack of access to food and land. In many parts of the world famines occur during periods of high agricultural output, not food shortages. When the true root cause of hunger is inequality, then as most methods of production intensification deepen inequalities, they fail to reduce hunger.

Large scale plantations and transgenic crops: can they advance the goals of ecoagriculture?

Large scale plantations and transgenic crops are among the tools of the Ecoagriculture arsenal to reach the twin goals of meeting future global food needs and conserving biodiversity. In *Ecoagriculture: strategies to feed the world and save wild biodiversity*, McNeely and Scherr (2003) provide many examples of interventions that, according to them, can simultaneously reach the objectives of conservation and food production. Among the examples, they cite a large (3,300 has) corporate Costa Rican orange plantation that belongs to Del Oro Company. Large patches of dry tropical forest are left within or adjacent to the farm, benefiting biodiversity while bringing substantial economic gains to Del Oro (the crops are grown with cheap labor and marketed with a focus on the product that benefits biodiversity, a message that is seductive for Northern consumers). Given that one of the main problems for poor farmers in most of the developing world is access to productive land, it may be argued that it is precisely those very large biodiversity-friendly

Breaking up large plantations into a patchwork of thousands of small farms which make up highly heterogeneous landscapes is key to promoting rich biodiversity.

plantations such as Del Oro that need to undergo a process of land reform to reduce social inequities, an important component of any meaningful conservation effort. It is difficult to understand how a conservation strat-

egy for large mammals and birds that require extended territories for effective reproduction can be compatible with an agricultural development agenda focused on small farmers that barely have small plots of land to grow their crops?

In fact, breaking up large plantations into a patchwork of thousands of small farms which make up highly heterogeneous landscapes is key to promoting rich biodiversity. In Mexico, half of the humid tropics are utilized by indigenous communities and "ejidos" (a form of communal land tenure still present in



Figure 2. A rustic shade coffee system that harbors biodiversity but also provides ecological services to the coffee system for optimal crop protection, nutrient cycling and productivity (Courtesy Miguel Altieri)

Mexico) featuring integrated agriculture-forestry systems aimed at subsistence and local-regional markets. Recent research confirms that such systems like cacao and coffee-based agroforestry managed with low inputs by smallholders harbor significant biodiversity, including a substantial number of plant, insect, bird, bat and various mammal

species. Biodiversity is highest in the more rustic tree diverse and multistrata systems interspersed in a matrix of tropical forests (Perfecto *et al.* 1996).

Arguments in favor of consolidating land holdings to take advantage of greater productivity and efficiency, as well as biodiversity conservation potential, have no scientific basis. The actual data shows the opposite: small farms produce far more per acre or hectare than large farms. These arguments persist, however, based on the false concept of efficiency (measuring yields per acre as the key indicator of performance) and based on the fact that large farms produce high amounts of one product but in fact the total output of small farms is much higher because they produce a great diversity of crops using resources more efficiently. The relationship between farm size and total production for fifteen countries in the developing world shows in all cases that relatively smaller farm sizes are much more productive per unit area – 200 to 1,000 percent more productive – than larger ones. In the United States the smallest farms, those of 27 acres or less, have more than ten times greater dollar output per acre than larger farms. While in the U.S. this is largely because smaller farms tend to specialize in high value crops like vegetables and flowers, it also reflects relatively more attention devoted to the farm, and more diverse farming systems (Rosset 2002). Recent evidence from agroecological surveys of small scale coffee producers in Chiapas, Mexico, reveals an important relationship between farm size, technology used and production. Conventional coffee producers had larger landholdings aver-

aging 7 hectares, devoting most of their land to coffee production. Since their systems used shade trees, they conserved some biodiversity but their dependence on external markets for cash, food and inputs was very high, making such farmers very vulnerable to the vagaries of an economic system out of their control. Large farms used fertilizers and pesticides and had a higher level of dependence on external inputs. Conversely the average farm size for small organic producers was 4 hectares. These farms exhibited the highest average coffee yields and did not make use of fertilizers and pesticides. In addition, they devoted about 30-50% of their land to maize and beans for food security, pasture for animals and forest reserve. Given the heterogeneous patchy nature of such farming systems, their contribution to biodiversity was significant but important to note is that this was achieved without sacrificing farmers' autonomy and food security (Martinez-Torres 2003).

Reflecting the views of the Future Harvest Foundation, Syngenta, other donors and the CGIAR, Ecoagriculture advocates argue that biotechnology is biodiversity friend-

Reflecting the views of the Future Harvest Foundation, Syngenta, other donors and the CGIAR, Ecoagriculture advocates argue that biotechnology is biodiversity friendly because planting engineered high-yield crops will avoid advancing the agricultural frontier. This view is flawed as it ignores other more powerful forces that drive deforestation and also assumes that GMOs increase yields when data shows that for example RR ready soybean yields 6% less than conventional varieties.

yield crops will avoid advancing the agricultural frontier (McNeely and Scherr, 2003). This view is a legacy of the Green Revolution, which assumed that progress in traditional agriculture systems inevitably required the replacement of local crop varieties with improved ones. This led to the disruption of traditional biodiverse agricultural patterns and the erosion of landraces and wild relatives along with indigenous knowledge. Large scale adoption of transgenic varieties will lead to the erosion of traditional varieties in the same way as the adoption of modern varieties of the Green Revolution. The rapid spread of transgenic crops threatens crop diversity by promoting large monocultures on a rapidly expanding scale leading to further environmental simplifi-

cation and genetic homogeneity.

Worldwide, the areas planted with transgenic crops

jumped more than thirty-fold in the past seven years, from 3 million hectares in 1996 to nearly 58.7 million hectares in 2002 (James 2002), an

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unprecedented move towards increased agricultural uniformity (Jordan, 2001).

These crops are being grown on land that was being cultivated with other crop species and varieties. In Argentina the rise of Round up ready soybean (a crop for animal feed) occurred at the expense of more than 300 thousand

hectares of food crops and it was partly responsible for the hunger that prevailed in that country after the recent economic crisis. Such simplification and the associated environmental impacts of transgenic crops can lead to reductions in agroecosystem biodiversity (Altieri 2004).

Biodiversity brings direct benefits for agriculture through a range of environmental services such as nutrient cycling, pest regulation and productivity. Disruptions in biodiversity levels prompted by transgenic crops are bound to affect such services and thus affect agroecosystem function. Small farmers grow crops in polycultures which enhance populations of natural enemies of insect pests. If these are wiped out through monocultures then they



Figure 3. Small holders cooperate in rice husking in North Cameroon (Courtesy Grazia Borrini-Feyerabend)



Figure 4. Farmers in India are recovering their lost local varieties for planting and sharing, such as at this fair in Jardhar, India (Courtesy Ashish Kothari)

will have to use expensive and toxic chemicals to kill the pests, before naturally controlled by biodiversity. For example it is known that polyphagous natural enemies of insect pests that move between crop cultures frequently encounter Bt (*Bacillus thuringiensis*, a toxin-producing bacterium) containing non-target herbivorous prey in more than one crop during the entire season. According to Groot and Dicke (2002) natural enemies may come into contact more often with Bt toxins via non-target herbivores, because the toxins do not

bind to receptors on the midgut membrane in the non-target herbivores. These findings are problematic for small farmers in developing countries who rely on the rich complex of predators and parasites associated with their mixed cropping systems for insect pest control (Altieri 1995). Research results showing that natural enemies can be affected directly through inter-trophic level effects of the toxin present in Bt crops raise serious concerns about the potential disruption of natural pest control, as polyphagous predators that move within and between crop cultivars will encounter Bt-containing, non-target prey throughout the crop season. Put simply, elimination of beneficial insects will cause pests to thrive and lead to the well known pesticide treadmill. Disrupted biocontrol mechanisms will likely result in increased crop losses due to pests or to increased use of pesticides by farmers with consequent health and environmental hazards.

In fact, there are studies that show that certain beneficial species can be negatively affected by transgenic crops. Recent studies conducted in the UK showed that herbicide resistant transgenic led to a reduction of weed biomass and flowering and seeding of plants within and in margins of beet and spring oilseed rape, which involved changes on resource availability with knock-on effects on higher trophic levels reducing abundance of relatively sedentary herbivores including Heteroptera, butterflies and bees. Counts of birds and predaceous carabid beetles that feed on weed seeds were also lower in transgenic fields (Hawes *et al.* 2003).

Another key problem with introduction of transgenic crops in biodiversity regions is that the spread of characteristics of genetically altered grain to local varieties could dilute the natural sustainability of these races (including fitness and adaptability). Thus, traits important to indigenous farmers (resistance to drought, food or fodder quality, competitive ability, performance on intercrops, storage quality, taste or cooking properties, compatibility with household labor conditions, etc) could be traded for transgenic qualities (i.e. herbicide resistance) which surely are not important to farmers (Altieri 2003). Local varieties subjected to genetic pollution could pay a metabolic cost by expressing the characteristics of the transgenic variety at the expense of a trait key for farmers' survival (i.e. drought resistance, nutritional quality, etc). Under this scenario farmers will lose their ability to adapt to changing biophysical environments and to produce relatively stable yields with a minimum of external inputs while supporting their communities' food security. The risks they face will increase. The social and environmental impacts of local crop shortfalls resulting from such uniformity, or changes in the genetic integrity of local varieties due to genetic pollution, can be considerable in the margins of the developing world. In the extreme periphery, crop losses often mean ongoing ecological degradation, poverty, hunger and even famine. It is under these conditions of marginality that traditional skills and resources associated with biological and cultural diversity should be available to rural populations to maintain or recover their production processes.

The agroecology and ecoagriculture divide

Agroecology is a scientific discipline that addresses agricultural systems from an ecological and socioeconomic perspective. Agroecology provides the scientific basis and methodology to design biodiverse agroecosystems capable of sponsoring their own function. On the contrary, ECOAG advocates say little about agricultural biodiversity and its ecological role in farm systems— choosing instead to focus

on wild biodiversity. Agroecologists recognize agricultural biodiversity not only as a key source of genetic resources, but also as the source of important environmental services key to the performance of agroecosystems such as biological pest control and nutrient cycling.

Environmentalists should no longer ignore issues relating to land distribution, indigenous peoples' and farmers' rights, and the impacts of globalization on food security and of biotechnology on traditional agriculture. It is crucial to transcend the Malthusian view that blames the poor for environmental degradation.

In fact their impact on nature is low compared to the damaging effects of the economic activities of large landowners, mining and timber companies.

As proposed by many

Agroecology advocates, "greening" the green revolution will not be sufficient to reduce hunger and poverty and conserve biodiversity. If the root causes of hunger, poverty and inequity are not confronted head-on, tensions between socially equitable development and ecologically sound conservation are bound to accentuate. Organic farming systems that do not challenge the monocultural nature of plantations and rely on external inputs as well as foreign and expen-



Figure 5. A vineyard with an island of flowers at the center that serves as a habitat for beneficial biodiversity (insects, birds, etc.) from which predators disperse into the vineyard for pest control (Courtesy Miguel Altieri)

sive certification seals, IPM systems that only reduce insecticide use while leaving the rest of the agrochemical package untouched, or fair-trade coffee systems destined only for agro-export, may in some cases benefit biodiversity, but in general offer very little to small farmers that become dependent on external inputs and foreign and volatile markets. Fine-tuning of input use does little to move farmers towards the productive redesign of agroecosystems which would move them away from dependence on external inputs, be they conventional or organic, and keeps them dependent on an input substitution approach. Niche markets for the rich in the North, in addition to exhibiting the same problems of any agro-export scheme which does not prioritize food security, create stratification within rural communities as only a few members can capture the benefits from markets, limited by the demand for gourmet products by the northern elite.

Deep differences on the above issues define the divide between Agroecology (a truly pro-poor farmers science) and Ecoagriculture. Ecoagriculture cares little if the land is devoted to plantations or to agroexport crops as long as the strategy saves wildlife. It also presumes that the economic and technological integration of traditional farming systems into the global system is a positive step that enables increased production, income and community well being (McNeely and Scherr, 2003). But for agroecologists, environmentalists should no longer ignore issues relating to land distribution, indigenous peoples' and farmers' rights, and the impacts of globalization on food security and of biotechnology on traditional agriculture. It is crucial to transcend the Malthusian view that blames the poor for environmental degradation. In fact their impact on nature is low compared to the damaging effects of the economic activities of large landowners, mining and timber companies. Social processes such as poverty and inequity in the distribution of land and other resources push the poor to become agents of environmental transformation, and as long as such processes are not dealt with prospects for an ecoagriculture approach are limited.

If the root causes of hunger, poverty and inequity are not confronted head-on, tensions between socially equitable development and ecologically sound conservation are bound to accentuate.

It is also important for ecoagriculturalists to understand and respect the fact that values of indigenous peoples may be different from those of the global conservation community, although

species and habitats valued by local people have global significance. Much of the concern of the global community is the alarming loss of biodiversity and associated environmental services. While for local communities such issues may also be important, their real concerns, needs and perceptions usually remain hidden to outsiders who, despite their good intentions, can at times embrace an eco-imperialist perception of conservation. Therefore the voices of the people that live in these lands and that biodiversity is part of their ecological patrimony must be included in a meaningful way, recognizing that this may open the conservation movement to criticism.

The agroecological approach to conservation

Aware of this reality, a key challenge for agroecologists is to translate general ecological principles and natural resource management concepts into practical advice directly relevant to the needs and circumstances of smallholders. The strategy must be applicable under the highly heterogeneous and diverse conditions in which smallholders

live, it must be environmentally sustainable and based on the use of local resources and indigenous knowledge. The emphasis should be on optimizing the productivity of complex systems at the field or watershed level, rather than the yield of specific commodities.

The enhancement of biodiversity is key and at the heart of the agroecology strategy is the idea that agroecosystems should mimic the biodiversity levels and functioning of local ecosystems. Such agricultural mimics, like their natural models, can be productive, pest resistant and conservative of nutrients. This ecosystem-analog approach uses biodiversity to enhance agroecosystem function, allowing farms to sponsor their own soil fertility, plant

health and sustained yields, therefore totally eliminating the need for external agrochemical inputs or transgenic technologies. As a result of the diverse designs (such as polycultures,

A key challenge for agroecologists is to translate general ecological principles and natural resource management concepts into practical advice directly relevant to the needs and circumstances of smallholders.

agroforestry systems, crop-livestock mixed systems, etc.) and absence of toxics, non-functional biodiversity (wildlife species of interest to EACOAG) thrives in such systems. In such biodiverse farms free of agrochemicals and transgenic crops, the opportunities for wildlife species to thrive are much greater than in "green" monocultures managed with input substitution. Thus in agroecological systems conservation is a product of the assemblage of productive



Figure 6. Indigenous communities grow quinoa in Ecuador (Courtesy Grazia Borrini-Feyerabend)

agroecosystems rich in functional biodiversity (the collection of organisms that play key ecological roles), and not as in

ecoagriculture the result of deliberate attempts to improve wildlife habitat within agricultural areas. Systems that are rich in wildlife but poor in functional biodiversity do not necessarily meet the needs of small farmers for food diversity, productive self sufficiency, low inputs, etc.

At the heart of the agroecology strategy is the idea that agroecosystems should mimic the biodiversity levels and functioning of local ecosystems. Such agricultural mimics, like their natural models, can be productive, pest resistant and conservative of nutrients. This ecosystem-analog approach uses biodiversity to enhance agroecosystem function, allowing farms to sponsor their own soil fertility, plant health and sustained yields, therefore totally eliminating the need for external agrochemical inputs or transgenic technologies.

Benefits of agroecologically designed integrated farming systems extend beyond conserving biodiversity by producing far more per unit area than monocultures (see Box 1). Though the yield per unit area of one crop – corn for example – may be lower on a small farm than on a large monoculture farm, the total production per unit area, often composed of more than a dozen crops, trees and various animal products, can be far higher. Usually complex polycultures overyield monocultures and this is estimated by an index called the land equivalent ratio which estimates the efficiency of resource use by a

combination of crops versus monoculture. Critics tend to point to lower crop yields forgetting that the yield is a measure of the performance of a single crop. In fact, there is greater per unit area productivity in complex, integrated agroecological systems that feature many crop varieties together with animals and trees than in industrial monocultures. In most multiple cropping systems developed by smallholders, productivity in terms of harvestable products per unit area is higher than under sole cropping with the same level of management. Yield advantages can range from 20 to 60% and accrue due to reduction of pest incidence and more efficient use of nutrients, water and solar radiation. And all this happens while conserving native crop genetic resources and overall biodiversity. There are also cases where even yields of single crops are higher in agroecological systems that have undergone the full conversion process.



Figure 7. An integrated farm which produces fish, crops, cattle, firewood and where outputs of one subsystem serve as inputs in another thus creating a closed ecological system (Courtesy Miguel Altieri)

Box 1. Applying agroecology to enhance the productivity of peasant farming systems in Latin America (adapted from Altieri, 1999)

Most research conducted on traditional and peasant agriculture in Latin America suggests that small holder systems are sustainably productive, biologically regenerative, and energy-efficient, and also tend to be equity enhancing, participative, and socially just. In general, traditional agriculturalists have met the environmental requirements of their food-producing systems by relying on local resources plus human and animal energy, thereby using low levels of input technology.



Figure 8. Alyssum flower strips within organic vegetable crops as a habitat diversification strategy to enhance beneficial biota (Courtesy Miguel Altieri)

While it may be argued that peasant agriculture generally lacks the potential of producing meaningful marketable surplus, it does ensure food security. Many scientists wrongly believe that traditional systems do not produce more because hand tools and draft animals put a ceiling on productivity. Productivity may be low but the causes appear to be more social, not technical. When the subsistence farmer succeeds in providing food, there is no pressure to innovate or to enhance yields. Nevertheless, agroecological field projects show that traditional crop and animal combinations can often be adapted to increase productivity when the biological structuring of the farm is improved and labor and local resources are efficiently used (see Table 1; Altieri, 1995). In fact, most agroecological technologies promoted by NGOs can improve traditional agricultural yields

increasing output per area of marginal land from 400–600 to 2000–2500 kg ha⁻¹ enhancing also the general agrodiversity and its associated positive effects on food security and environmental integrity. Some projects emphasizing green manures and other organic management techniques can increase maize yields from 1–1.5 t ha⁻¹ (a typical highland peasant yield) to 3–4 t ha⁻¹. Polycultures produce more combined yield in a given area than could be obtained from monocultures of the component species. Most traditional or NGO promoted polycultures exhibit LER values greater than 1.5. Moreover, yield variability of cereal/legume polycultures are much lower than for monocultures of the components (Table 2).

Table 1. Extent and impacts of agroecological technologies and practices implemented by NGOs in peasant farming throughout Latin America

Country	Organization involved	Agroecological Intervention	No. of farmers or farming units affected	No. of hectares affected	Dominant crops	Dominant Yielding crops
Brazil	EPAGRI AS-PTA	Green manures, cover crops	38 000 families	1 330 000	Maize, wheat	198–246%
Guatemala	Altertec and others	Soil conservation, green manures, organic farming	17 000 units	17 000	Maize	250%

Honduras	CIDDICO COSECHA	Soil conservation, green manures	27 000 units	42 000	Maize	250%
EL Salvador	COAGRES	Rotations, green manures, compost, botanical pesticides	> 200 farmers	no data	Cereals	40–60%
Mexico	Oaxacan Cooperatives	Compost, terracing, contour planting	3000 families	23 500	Coffee	140%
Peru	PRAVTIR CIED	Rehabilitation of ancient terraces	> 1250 families	> 1000	Andean crops	141–165%
	PIWA-CIED	Raised fields	no data	250	Andean crops	333%
	CIED	Watershed agricul- tural rehabilitation	> 100 families	N/A	Andean crops	30–50%
Dominican Republic	IDEAS	Intercropping, agro- forestry, composting	12 families	25	Several crops	20%
	Plan Sierra Swedforest- Fudeco	Soil conservation, dry forest manage- ment, silvopastoral systems				
Chile	CET	Integrated farms, organic farming	> 1000 families	> 2250	Several crops	> 50%
Cuba	ACAO	Integrated farms	4 cooperatives	250	Several crops	50-70%

Table 2. Coefficient of variability of yields registered in different cropping systems during 3 years in Costa Rica

Cropping system	Monoculture (mean of sole crops)	Polyculture
Cassava/bean	33.04	27.54
Cassava/maize	28.76	18.09
Cassava/sweet potato	23.87	13.42
Cassava/maize/sweet potato	31.05	21.44
Cassava/maize/bean	25.04	14.95

In general, data shows that over time agroecological systems exhibit more stable levels of total production per unit area than high-input systems; produce economically favorable rates of return; provide a return to labor and other inputs sufficient for a livelihood acceptable to small farmers and their families; and ensure soil protection and conservation as well as enhance biodiversity.

For a region like Latin America which is considered to be 52.2% self-reliant on major food crops as it produces enough food to satisfy the needs of its population, agroecological approaches that can double yields of the existing 16 million peasant units can safely increase the output of peasant agriculture for domestic consumption to acceptable levels well into the future.

It is not a matter of romanticizing traditional agriculture or considering development *per se* as detrimental, but if the interest lies in “improving” local agriculture, researchers must first understand and build on the existing agricultural system, rather than simply replacing it. It is important to highlight the role of traditional agriculture as a source of agrobiodiversity and regenerative farming techniques which constitute the very foundation of any sustainable rural development strategy directed at resource-poor farmers. Moreover diverse agricultural systems that confer high levels of resilience to changing socio-economic and environmental conditions are extremely valuable to poor farmers as they buffer against natural or human-induced variations in production conditions.

A case study: harmonizing biodiversity conservation and cacao production

This project was implemented by the Centro Tropical de Investigacion y Ensenanza (CATIE) in Talamanca, an indigenous cocoa growing region of Costa Rica. The main goal of the 3-year project that ended earlier this year was congruent with ECOAG goals: to improve the sustainable production of cacao while conserving biodiversity in

small organic cacao farms managed by indigenous peoples in Talamanca, Costa Rica. The project’s main strategy was to find ways of simultaneously enhancing cacao production in a sustainable manner while conserving biodiversity. The focus on cacao is justified by the fact that in addition to being culturally and economically important to local indigenous groups of the area, it is well known that highly diverse and multistrata cacao agroforestry systems (CAFS) support higher levels of biological diversity than most tropical crops (Rice and Greenberg 2000). A key problem is that the permanence of these systems is threatened by low yields and low prices of cacao. By improving the productivity of cacao, the project sought to increase farmers’ income and in this way avoid the shift of farmers to other less biodiversity conserving crops such as banana (Somarriba *et al.* 2003).

After training a number of local farmers to monitor CAFS, researchers confirmed that CAFS harbor significant biodiversity, including 55 families, 132 genera and 185 species of plants, as well as a substantial number of insect, bird (190), bat (36) and various mammal species, some of which seem to be declining. Biodiversity is highest in the more rustic tree diverse and multistrata systems

(about 55-60% shade cover) and lowest in CAFS with simple strata (maximum two shade tree species with 35-40 % shade).

CATIE researchers proposed a number of interventions aimed at improving cacao production (pruning, introduction of clones, enrichment with fruit trees, shade management, etc) while at the same time preserving biodiversity. After three years of project interventions there was no evidence that newly designed CAFS conserved or enhanced biodiversity. Apparently, biodiversity declines as plant diversity and structural complexity of cacaotales (cocoa agroforestry systems) decrease, although lower diversity in cacaotales may be more desirable from an agronomic point of view. Productivity in rustic systems (traditional biodiverse agroforests) is lower than in the less diverse CAFS, suggesting a negative relationship between conservation and production and presenting a major challenge to researchers and managers because as

By only focusing on production enhancement and wildlife diversity, researchers fail to consider a key relationship in peasant agriculture: the relationship between farm size, diversity levels and productivity.

cacaotales are renewed or interventions made to enhance production (especially through pruning, elimination of shade trees and genetic homogenization with clones), biodiversity levels apparently may be sacrificed. When replacing existing trees with new timber or fruit species or reducing shade through pruning or thinning, it is important to consider that such practices can reduce habitat complexity for wildlife. Likewise enrichment

with forest or fruit trees must be done considering the potential competition pressures that these plants may exert on existing cacao trees, and the possibility that some trees may be sources of insect pests or diseases (i.e. viruses).

By only focusing on production enhancement and wildlife diversity, researchers failed to consider in their surveys a key relationship in peasant agriculture: the relationship between farm size, diversity levels and productivity. Smaller cacaotales (<1 ha) were more biodiverse and also seemed more productive than larger ones, indicating that given labor and cash constraints there may be an optimal size for efficient production (in terms of labor allocation and returns per unit of labor).

In situations such as this, agroecologists would recommend harmonizing conservation and production in cacaotales over 1 ha in size by intensifying management to enhance production (pruning, grafting, etc) in a small optimal area of each cacaotal (0.5-0.7 has), leaving the rest of the area of the cacaotal under low input management, with high levels of plant diversity and multistrata designs for conservation of existing biodiversity. In a well-managed 0.5 ha cacaotal, farmers may be able to obtain higher productivity per unit of labor than in a badly managed cacaotal of 1- 1.5 has. In this way a mixed strategy featuring intensification of production and conservation enhancement may be reached.

As farmers become aware of biodiversity components they should also learn to distinguish between the various types and functional groups of biodiversity and

the roles they play in the CAFS:

1. ecologically functional groups that mediate important processes such as biological control, pollination or organic matter decomposition;
2. conservation functional groups that protect soil and water;
3. livelihood functional groups that produce timber, fruit, cash, etc.;
4. destructive biota that reduce production and other processes; and,
5. non functional biodiversity (wildlife species, etc).

In this way farmers could target specific biodiversity groups according to the functions they wanted to emphasize in order to maintain healthy and productive CAFS.

The question that remains is, what mechanisms are in place to compensate farmers for the environmental services of interest to ECOAG advocates (non-functional biodiversity)? Many farmers may be trained to monitor biodiversity, and although they would appreciate new knowledge and skills which would also help to raise conservation consciousness in the communities, most farmers would doubt whether non-functional biodiversity conservation would bring them direct economic benefits

Finally, an approach directed at increasing cacao production while conserving biodiversity must transcend the cacaotal and embrace the total farming system. Most farms in the hillside areas have an average size of 42 hectares where cacao

occupies about 1.6 ha, the rest being devoted to forest, fallow, pasture and annual crops. In such areas, farm designs should be directed at maintaining or enriching the surrounding environment conducive to biodiversity conservation (forest patches, etc), enhancing food security (re-introduction of the practice of growing beans, rice, corn, cassava, etc), and promoting other productive activities to generate income (honey, fish, wood for crafts, medicinal plants, etc), including ecotourism under local control. Farm designs should promote integration among sub-systems so that outputs from one subsystem become inputs into the other, creating efficient bio-resource flows, as well as synergies that may aid in sponsoring the soil fertility, plant protection and productivity of cacao and the other



Figure 9. Corridor of plants that connect to a riparian forest for the circulation of beneficial biota from forest to vineyard (Courtesy Miguel Altieri)

crops of the entire farm.

Spreading the agroecological approach

In order for agroecological approaches that lead to food security and biodiversity conservation to spread, major changes are needed in policies, institutions, and research development.

Policy changes necessary to achieve the potential of agroecology include land reform, protection of prices for food crops, appropriate and equitable market opportunities, and equitable partnerships between local governments, NGOs and farmers with participatory technology development and farmer-to-farmer research and extension replacing top-down transfer of technology models.

Agroecological interventions must truly benefit small farmers by providing them with access to land and other resources, equitable markets, alternative technologies, but more importantly by empowering them to become actors of their own development. It is clear that

macro-economic reform and sectoral policies promoted by trade liberalization have not generated a supportive environment for small and poor farmers. In most cases agricultural growth was concentrated in the commercial sector and did not trickle down. Trade liberalization reduced protection at a time when commodity prices were at historic lows, leaving small farmers incapable of competing in domestic markets. The drop in price of many crops, the lack of credit, as well as the long distances from markets are all factors that have led to increased pauperization of the small farm sector. Moreover, government programs and subsidies have concentrated on medium and large commercial farmers and small farmers have remained

limited in their access to services, infrastructure and markets. Such negative trends must be halted so that they do not continue drastically impacting the viability of peasant and family agriculture.

Despite such anti-peasant biased scenarios, the evidence shows that sustainable agricultural systems can be economically, environmentally and socially viable, and can contribute positively to local livelihoods as well as biodiversity conservation goals (Uphoff 2002). But without appropriate policy support, they are likely to remain localized in extent. Therefore, a major challenge for the future entails promoting institutional and policy changes to realize the potential of agroecological approaches. Necessary changes include land reform, protection of prices for food crops, appropriate and equitable market opportunities, and equitable partnerships between local governments, NGOs and farmers with participatory technology development and farmer-to-farmer research and extension replacing top-down transfer of technology models.

Agroecology has already made some inroads, particularly among peasants' movements and NGOs, but also among some governments. In Latin America

Alternatives to both chemical-intensive, high-yield agriculture and to land extensive sustainable agriculture can be expected to result from scientific endeavors dedicated to their discovery and development. However, only a fraction of the billions of research dollars spent over the last fifty years has been devoted to increasing the productivity of sustainable and/or organic production systems and current funding is being threatened by proposed federal budget cuts.

agroecology is strongly supported by the social movements that promote food sovereignty and oppose globalization and GMOs. Via Campesina, a global peasants' movement, MST – The Landless Peasants Movement – in Brazil, and other social rural movements have also declared agroecology as the key production strategy to reach food security and natural resource conservation. In addition, the NGO/CSO Forum for Food Sovereignty in 2002, attended by more than 600 NGO/CBO and social movements, included agroecology as one of the 4 main pillars of food sovereignty

(the others were the right to food, access, management and control of local resources, and trade and food sovereignty). Finally, countries such as Cuba, Brazil and Venezuela have policies either at the national or regional level that advocate for an agroecological approach. The approach is also spreading beyond Latin America: FAO is working with civil society (through the International Planning Committee for Food Sovereignty) and governments to develop and implement agroecology projects in all continents.

Box 2. What is food sovereignty?

Agroecology and food sovereignty go hand in hand. Social movements and NGOs who support the food sovereignty approach recognize agroecology as one of the key strategies for its achievement. These approaches share similar concerns over access to productive resources, the dangers of transgenic crops and respect for biodiversity and indigenous knowledge.

According to Via Campesina "Food sovereignty is the right of peoples to define their own agriculture and food policies, to protect and regulate domestic agricultural production and trade in order to achieve sustainable development objectives, to determine the extent to which they want



Figure 10. Youth present their declaration to the 4th Conference of Via Campesina under the rallying cry "Organizing the struggle: Land, Food, Dignity and Life!" (Courtesy G.R. Riffer)

to be self reliant, and to restrict the dumping of products in their markets. Food sovereignty does not negate trade, but rather, it promotes the formulation of trade policies and practices that serve the rights of peoples to safe, healthy and ecologically sustainable production."

Food sovereignty has been gaining in support and interest. In 2002 the World Food Summit +5 took place in parallel to the NGO/CSO Forum for Food Sovereignty, an event organized by social movements, NGOs and CSOs. The success of this event led to an agreement to work with the FAO on food sovereignty issues. And more recently the UN Special Rapporteur on the right to food recommended that "Food sovereignty be considered as an alternative model for agri-

culture and agricultural trade, in order to meet State obligations to respect, protect and fulfill the right to food" (UN Economic and Social Council document E/CN.4/2004/10).

Table 3. Dominant model versus food sovereignty model (taken from Rosset, 2003)

Issue	Dominant model	Food Sovereignty model
Trade	Free trade is everything	Food and agriculture exempt from trade agreements
Production priority	Agroexports	Food for local markets
Crop prices	"What the market dictates" (leave intact mechanisms that enforce low prices)	Fair prices that cover the costs of production and allow farmers and farmworkers a life with dignity
Market access	Access to foreign markets	Access to local markets; an end to the displacement of farmers from their own markets by agribusiness
Subsidies	While prohibited in the Third World, many subsidies are allowed in the US and Europe—but are paid only to the largest farmers	Subsidies that do not damage other countries (via dumping) are okay; i.e., grant subsidies only to family farmers, for direct marketing, price/income support, soil conservation, conversion to sustainable farming, research, etc.
Food	Chiefly a commodity; in practice, this means processed, contaminated food that is full of fat, sugar, high fructose corn syrup, and toxic residues	A human right: specifically, should be healthy, nutritious, affordable, culturally appropriate, and locally produced
Being able to produce	An option for the economically efficient	A right for rural peoples
Hunger	Due to low productivity	A problem of access and distribution; due to poverty and inequality
Food security	Achieved by importing food from where it is the cheapest	Greatest when the food production is in the hands of the hungry; or when food is produced locally

Control over productive resources (land, water, forests)	Privatized	Local; community controlled
Access to land	Via the market	Via genuine agrarian reform; without access to land, the rest is meaningless
Seeds	A patentable commodity	A common heritage of humanity, held in trust by rural communities and cultures; "no patents on life"
Rural credit and investment	From private banks and corporations	From the public sector; designed to support family agriculture
Dumping	Not an issue	Must be prohibited
Monopoly	Not an issue	The root of most problems; monopolies must be broken up
Overproduction	No such thing, by definition	Drives prices down and farmers into poverty; we need supply management policies for US and EU
Genetically modified organisms (GMOs)	The wave of the future	Bad for health and the environment; an unnecessary technology
Farming technology	Industrial, monoculture, chemical-intensive; uses GMOs	Agroecological, sustainable farming methods, no GMOs
Farmers	Anachronisms; the inefficient will disappear	Guardians of culture and crop germplasm; stewards of productive resources; repositories of knowledge; internal market and building block of broad-based, inclusive economic development
Urban consumers	Workers to be paid as little as possible	Need living wages
Another world (alternatives)	Not possible/ not of interest	Possible and amply demonstrated

Conclusion

There is no question that small farmers located in biodiversity hotspots throughout the developing world can produce much of their needed food in ways that are compatible with conservation goals.

The evidence is conclusive: new approaches and technologies spearheaded by farmers, NGOs and some local governments around the world are already making a sufficient contribution to food security at the household,

national, and regional levels. A variety of agroecological and participatory approaches in many countries show production increases through diversification, improvement in diet and income, contributions to national food security and even to exports, and also conservation of the natural resource base including biodiversity (Uphoff and Altieri 1999).

There are many opportunities to create linkages and synergies to solve the dilemma of conserving while producing. Exclusive attention to meeting food needs can exert a very high toll on the environment, undermining possibilities of meeting food needs in the future. But a sole focus on preserving the natural resource base could condemn millions to hunger and poverty. Feeding a growing world population without further endangering the natural environment depends upon public support for high-yield, sustainable agriculture research, education and extension. Alternatives to both chemical-intensive, high-yield agriculture and to land extensive sustainable agriculture can be expected to result from scientific endeavors dedicated to their discovery and development. However, only a fraction of the billions of research dollars spent over the last fifty years (mostly in the United States of America) has been devoted to increasing the productivity of sustainable and/or organic production systems and current funding is being threatened by proposed federal budget cuts (Hewitt and Smith 1995).

Demands to dramatically increase food production in the next century may require a re-evaluation of ideas and positions by proponents on both sides of the debate, but it is also possible that the debate will remain polarized. Social movements (such as MST and hundreds of anti-globalization indigenous and grassroots movements) will most likely determine the outcome of this debate.

What is important to realize is that if governments, universities, CGIAR and organizations like IUCN fail to support the scaling up of agroecological approaches, rural and social movements will do so whatever the cost.

They articulate the views of small farmers and many consumers and researchers in support of sustainable agriculture who do not see the need to evaluate the role of emerging technologies (precision farming and biotechnology) in helping meet food needs due to their unreasonable environmental and social costs. On the other side of the debate, proponents of high-yield agricul-



Figure 11. Members of the Landless Peasants Movement (MST) occupy land in the massive plantations of Brazil (Courtesy Maryam Rahmanian)

ture will need to embrace the precautionary principle. In addition, they must recognize that scientifically valid alternatives to chemically-based agriculture exist and can and should play a vital role in developing the production systems of the twenty-first century. What is important to realize is that if governments, universities, CGIAR and organizations like IUCN fail to support the scaling up of agroecological approaches, rural and social movements will do so whatever the cost.

References

- Altieri, M.A. "Agroecology: the science of natural resource management for poor farmers in marginal environments" *Agriculture, Ecosystems and Environment*, 93: 1-24, 2002.
- Altieri, M.A. "The sociocultural and food security impacts of genetic pollution via transgenic crops of traditional varieties in Latin American centers of peasant agriculture" *Bulletin of Science Technology and Society*, 23: 1-19, 2003.
- Altieri, M.A. and C.I. Nicholls *Biodiversity and pest management in agroecosystems*, Haworth Press (New York), 2004.
- Altieri, M.A. "Agroecology: the science of natural resource management for poor farmers in marginal environments" *Agriculture, Ecosystems and Environment*, 93: 1-24, 2002.
- Altieri, M.A. "Applying agroecology to enhance the productivity of peasant farming systems in Latin America" *Environment, Development and Sustainability*, 1: 197-217, 1999.
- Altieri, M.A. Genetic engineering in agriculture: the myths, environmental risks and alternatives. 2nd Ed. Food First Books. Oakland, CA 2004
- Donald, P.F. "Biodiversity impacts of some agricultural commodity production systems" *Conservation Biology*, 18: 1-29, 2004.
- Gliessman, S.R. *Agroecology: ecological processes in sustainable agriculture*, Ann Arbor Press (MI), 1998.
- Hawes, C. *et al.* "Responses of plants and invertebrate trophic groups to contrasting herbicide regimes in the farm scale evaluations of genetically modified herbicide-tolerant crops" *Philosophical Transactions of the Royal Society B: Biological Sciences*, 358: 1899-1913, 2003.
- Hewitt T.I. and K.R. Smith *Intensive agriculture and environmental quality: examining the newest agricultural myth* Henry Wallace Institute for Alternative Agriculture, Greenbelt MD, 1995.
- James, C. Global review of commercialized transgenic crops: 2000 *International Service for the Acquisition of Agri-Biotech Application*, ISAAA Briefs No. 23-2001, Ithaca, 2001.
- Jordan, C.F. "Genetic engineering, the farm crisis and world hunger" *BioScience* 52: 523-529, 2001.
- Lappe, F.M., J. Collines and P. Rosset *World Hunger: twelve myths* Grove Press (New York), 1998.
- Martinez-Torres, M.E. *Sustainable development, campesino organizations, and technological change among small coffee producers in Chiapas, Mexico*. Ph.D. Dissertation, University of California, Berkeley, 2003.
- McNeely, J.A. and S.R. Scherr *Ecoagriculture: strategies to feed the world and save wild biodiversity* Island Press (Washington D.C.), 2003.
- Perfecto, I., R. A. Rice, R. Greenberg, & M.E. van der Voort "Shade coffee: a disappearing refuge for biodiversity" *BioScience*, 46: 598-608, 1996.
- Rice, R.A. and R. Greenberg "Cacao cultivation and the conservation of biological diversity" *AMBIO A Journal of the Human Environment*, 29: 167-173, 2000.
- Rosset, P. *On the Benefits of Small Farms* Food First-Background. Oakland, CA, 2002.
- Rosset, P. "Food sovereignty: Global Rallying Cry of Farmer Movements" *Food First Background*, Vol. 9, 2003.
- Somarriba, E. *et al.* II informe tecnico-financiero "Proyecto Biodiversity conservation and sustainable production in small, indigenous organic cacao farms in the Talamanca-Caribbean Corridor, Costa Rica" CATIE, Turrialba, 2003.
- Uphoff, N. *Agroecological innovations: increasing food production with participatory development*, Earthscan (London), 2002.
- Uphoff, N and M.A. Altieri "Alternatives to conventional agriculture for meeting world food needs in the next century" Report of a conference on Sustainable agriculture: evaluation of new paradigms and old practices. Cornell International Institute for Food, Agriculture and Development. Ithaca, NY. 1999.
- Wojtkowski, P.A. *Landscape agroecology* Haworth Press (New York), 2004.