From Farming-System-Analysis to Land-Use-System-Analysis: How to integrate Eco-System-Services and Non-Farm Communities

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Abstract:
This paper deals with the idea to merge the concept of farming system analysis (FSA) and the concept of ecosystem services (ESS) at a landscape level. After the introduction we firstly make the reader acquainted with the discussion on ecosystem function (ESF) and - services (ESS) and inform them on deliberations currently popular in many upcoming research projects. Then secondly, we emphasize the landscape aspect of ESS and finally a possible response of a farming system analysis to the challenge of looking into ESS will be scrutinized. The main message is, that there is scope to get a new synthesis, which could be called landscape system analysis (LSA). An advanced LSA requires a modern integration of ESS aspects which regards to public management of ESS and the promotion of farm related ESS activities as well as coordination.

1 Introduction

Farming system analysis has been a popular concept over the last decades. It tires to integrate ecological, economic and social aspects into a holistic view of rural life. For the purpose of jointly analysing rural livelihoods and related challenges in rural areas as well as finding pathways to develop new options for rural populations, farming systems analysis was a considered a high-quality tool (Collinson, 2000). However, the concept has been shown also its limitations, especially with regards to an eventually too strong focus on farming and farms as the main organisational unit to be studied. We will argue that the study of community management of the underlying ecosystem is of equal important. As recent studies from different places in the world have shown, many times rural populations, and in particular the poorer segment of rural dwellers, heavily rely on common pool management and that they have found different institutions than farms, only, which enable them better to cope with degradation than being connected to singular farm activities (Perfecto et al. 2009) Especially if there is extraction of, for instance, soil fertility and deterioration of biodiversity farmers suffer. Additionally many rural inhabitants, for instance, rely no longer on food production for their livelihoods; rather other income or resource extraction options, remittances, payments for services, tourism, etc. have gained importance (Hebenick et al. 2001). Some scholars speak already about land-use-system-analysis (LSA: Veldkamp and Lampin 2001) modelling drivers of change, rather than farming-systems-analysis (FSA). Another major driving force behind the need to broaden the concept is the debate on eco-system services (ESS) and human well-being, as derived from ESS (MA, 2005). Most ESS are found at landscape level and are not only directly related to farm activities (see also TEEB, 2010). Furthermore, as the economic background is that ESSs are getting scarcer and are under threat due to common pool resource management problems (on deficits see Sandhu, et al. 2012), the public partly seeks to sponsor ESS through payments or through better governance (on call: Stallman, 2011).

In this regard it is the objective of the contribution to discuss consequences of the ESS concept for a broadening of the farming-system-analysis concept (eventually merging it into land-use-system concepts). We will discuss literature highlighting the logic for a conceptual amendment of

faming system to integrate ESS at landscape level in a first step. In a second step aspects of beneficiary recognition and institutional as well as organizational choices and consequences, needed to accommodate the creation of well-being from ESS valuation, will be put into perspective of land use offering a research agenda. We will focus on landscape elements and design which are important for ESS value generation. Both aspects, landscape design and elements as related to specific ESSs, will be highlighted and ESS similarities with farming activities to obtain the services will be outlined. Then from a modern perspective we not only can look at pure farm activities. Rather we have look into other well-beings generated from ESS, not coming directly through farming. For instance, tourism based on ESS is an important aspect for many areas with high nature value farming (Andersen et al, 2003) and this farming is strongly ESS dependent.

2 Eco-system Services

In principle, in farming system analysis, eco-system services (ESS) have played a strong role for a long time, though they may have not been named this way. Especially, since farmers used ESS as nature and resource goods, there was always an awareness that farming relies on ESS. The science based discussion on eco-system services was newly introduced in the nineties (Daily, 1997), apparently, because farmers started to have recently relied more on artificial inputs and tended to forget nature. From this angle one could think that there is a discontinuity between farming system analysis and the ecosystem service concept. But, one can see is also from the point of view a continuum. A crucial variable, in this regard, is the issue of landscape ecology and the scale of nature involvement in farming (Nelson, et al. 2009): is it individual or collective embracing a community. For example think about birds, who control insects and bees, who provide pollination? They do not live only on one farm rather their prevalence depends on habits within or between farms. As, in the traditional farming system analysis, the role of agro-ecology had been important, this has been further elaborated to the inclusion of the various services, like soil nutrition retention, pollination, organic pest control in farming. An issue is: is this for free?

The next perception (assumption) is that farmers work with their voluntarily soil for the common goal, soil fertility, and design deliberately their environment (Perfecto et al. 2009); in particular research has stressed this linkage. Farmers know about it and may react by management, but not always. Issues such as crop rotation, nature elements in fields (hedges, stonewalls, ditches), terracing, crop livestock integration, choices of interaction with forest (even long run rotations which are part of shifting cultivation) as examples should be typical management instruments of farmers to improve nature which provides ESS. Hereby farmers seek to activate nature's propensity to recover nutrient, regenerate soils, and deliver materials.

Investigating the dependency of farming and faming systems on nature (in modern terms ESS), it has always been evident that the dependency is a matter of intensity of farming. In old times intensive caring about fertility of nature paid off. This is different between modern and traditional farming; especially in modern times in which the purchase of inputs and technologies has switched farming from a strong dependency on nature to a strong dependency on input markets, the importance of ESS seemed to diminish. Fossil energy is a basic external source. Hence, an immediate reaction would be to classify farming systems according the intensity of the use of external inputs and see modern farming systems as opposite to old relying on the use of ESS.

But this is not correct. From a more theoretical perspective it would imply that farming systems are characterized by the substitution of internal ESS and external inputs. But that would lead to a dead end. Going further the issue is whether substitution is possible or not. In case of an apparent substitution possibility one speaks of weak sustainability, if not strong sustainability. The ap-

proach of substitution has problems, especially with respect to ESS; nature dependency emerges as a problem either, if matching services can not be delivered by human inputs (Daily, 1997).

A special role and examples plays pollination. In case of this ESS one can nicely demonstrate the roles and problems of ESS notification in farming systems (FSA). As been highlighted (Winfree et al. 2011) in many studies, pollination counts up to 30 p.c. for the value added in fruit production. So it seems to be a valuable service. But where does it come from. To a certain extent honey bees as part of a farming system are private, but they are also public. Since the well-being of the specie is controlled by humans through the agricultural matrix (Jauker et al. 2009), the pollination service depends on bee keeping and natural habitat. Bee keeping is a characteristic of a human production system and ESS imbedded in nature. So what is the role of nature in insect pollination? Even if it would mean that without the service there is still a value creation of 70 p.c., we need nature. The same applies to the critical role of other ESSs: how much are they related to species, like ants (Dauber et al. 2008), and to landscapes; as well as what is the linkage between managerial elements (changeable by farmers in a FSA) in a landscape and the provision of ESS?

First of all, it is difficult to demarcate a border line between the farming system (FSA) and nature, distinguish ESS from inputs, separate them, and see agriculture as separate from nature (Stallman, 2011). For sure, honey bees thrive not only on human pastures; they live also from nectar from the wild. Second the joint management of nature and farming system is the important topic. From the need of joint management we should derive a special farming system oriented management for ESS and vice versa. The intermediary is the landscape. Then the management of landscapes for ecosystem service provision is done together by all farmers. This is not only an assumption for ESS provision, rather it is a prerequisite, if the landscape matter. Third, looking at the deficits in ecosystem management and requests for collective management (Stallman, 2011; Wossink and Swinton, 1997) the problem of jointness has to be appreciated in FSA. If we do not want to run the danger of reduced ESS because individual farmers defect, it is important to get a clear vision of ESS as regional ESS. For an integration it implies doing FSA at regional scale.

Consecutive questions are: though provision and regulatory services are many times already part of the farming system (and FSA), where is a good entrance point for inference in nature and farming in terms of physical management? What obligations go beyond farms and where is the trigger for ESS promotion in landscape to be designed for a community of farmers? How can common property be managed (organized)? Do farmers have recognition of community level services at all? And is “nature” cultivation already in their mind? Many questions appear as concepts of eco-system services go beyond farm and are normally embedded in landscape ecology.

3 Landscape ecology as perceived by the economics of ESS

Landscapes are an intermediary between ecosystems and human systems. Starting from this premise it is evident to ask what are tools which direct ESS in landscapes? And how can a landscape system analysis (LSA as extension of farming system) help? Perhaps it may be good at the beginning to look at experiences. The idea of ESS is not new, though it requires a modern perspective. Facts and lessons learnt form the past are: Farmers under serve scarcity of ESS which are primarily related to soil fertility, pest pressures, and adverse natural conditions have, at many places in the world, started to manipulate their environment at a large, landscape, scale (Grigg, 1974). However, it is not clear whether this is done deliberately or by chance and by collective will. A position of trial and error may also suit, because we do not know, to a large extent, how specific management tools came about at landscape level. I.e. we do not know the process

of institution generation. An interesting invention to generate ESS and soil fertility at landscape level was the introduction of the three field system in the middle age (Baker and Butin, 1973).

However, the interesting topic is the introduction of a crop rotation and at community, landscape, level within that system. It meant also that field strips and boundaries as sub-organisations of the landscape emerged which fitted in a community of farmers who rotated their fields according to statutory regulations. This shaped the landscape and we still have a clue about it when we compare old and new landscape appearances. As can be seen in Fig 1 the conflict is between traditional landscapes and modern land use. Particularly field edges, re-combinations of small fields, room for hedges, etc are important (Dauber et al, 2003). Additionally in extended systems, which included secondary forest for firewood and are based on leaves and straw from wilderness, farmers started to appreciate deliveries of ESS (incl. food) from outside of farms. From a modern perspective one has tried to add field margins (Wossink et al. 1998), and create a nature matrix.

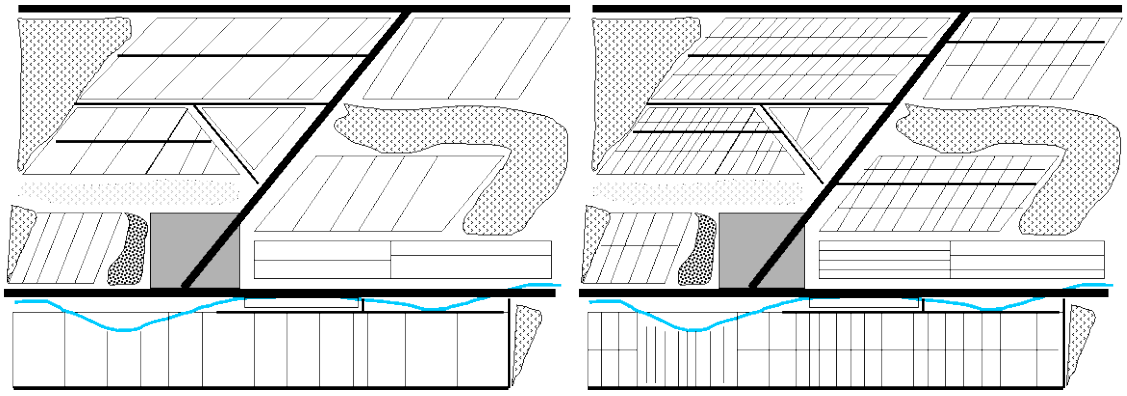

Fig. 1a: Modern land use structure **Fig. 1b: Traditional land use structure**

Actually the boundaries between what is farmed and what is landscape or wilderness are normally not exact. But ESS deliveries can be integrated indirectly focusing on landscape design. Especially in systems which need melioration, control of contours, protection against wind erosion, etc., the decision making of farmers on their field design and decisions how to organize a landscape, i.e. field structures, provision of nature elements, eventually terraces, field-pasture-forest connectivity, etc., are interwoven (Veldkamp, 2011). From an institutional point landscape design, individual farmers decisions on field outlay and community decisions as well as governance matters Decisions on managing the common, mostly made by communities, but also in hierarchical modes by landlords and their dependent peasants in cont(r)acts, seem to have served the conservation and restoration of resource; we need to identify their ESS aspects from a modern perspective. Aspects of ESS and generation of well being, such as accessibility to nature by farmers, and promotion of the use of provision goods based on ESS, such as fruits and meat from the wilderness, should matter with respect to the decision making and design of landscapes.

In farm economics, mostly the appearances of landscapes and ESS are investigated at a rather individualised scale, but this is wrong. It seems that organic processes of evolutionary character have shaped landscapes and their management, but only because of collective action.

However, there are also some generalised aspects which are now discussed at landscape scale:

(1) The issue of a need for ESS is even more important at landscape than individual farm level.

(2) An improved understanding of the link between farm productivity and ESS must be accomplished.

(3) The capacity to manage ESS plays a major role. Are there tools which make ESS visible to farmers and technically feasible for integration in farming practice and analysis?

(4) Alternatives (opportunity costs) in terms of modern technology options, which otherwise do not force farmers to recognise ESS, are a matter of concern and to be investigated.

To start with (1):

The ecological background for a proper functioning of processes which are described as eco-system function ESF which, in fact, underlie ESS and the provision of those eco-system services (ESS) which are the noticeable part of ecology, primarily in semi-natural area, is different in different environments and landscapes. There are quite easily treatable areas, mostly called fertile areas, in which farmers normally can not make things wrong. For example, in areas which have soils of high field moisture capacity, minor active organic mater management is needed. It implies that the ecology is comparable resistant to interventions. In contract some landscapes and their ecologies show limited resistant to the introduction of specific farming systems. For example, areas of sandy soils need not only farmers recognition of organic matter, but also public awareness.

Hence the farming systems have to be adapted to ESF and ESS conditions, not vice versa. In modern farming the tendency is the opposite (Nuppenau, 2002): the industrial package tends to evens natural differences. ESS are substituted, For example, nitrogen recycling and nitrogen fixing by bacterial, losses importance and nitrogen comes from buying bags. In contrast, in well adapted farming systems, one finds a greater recognition for the needs of a specific eco-system to assure a “good balance” between nature and human systems. This starts as example with moisture management for bacterial life. We need wetlands and organism that stop loosing nitrogen.

However, what does this observation mean for the design of landscape system analysis? First of all, in precarious cases i.e. in which ESSs need a careful management much farm labour must be devoted to caring for ESS. Most of this labour is community work. Eventually there are also strong needs of supplementary work as observable in case of the construction of supportive elements for ESSs. Examples are terraces and other measures to stabilize landscapes in fragile areas (Ruben et al, 2006). In this regard it is sometime naive that ecologists consider ESS only as natural. Many farming communities have developed schemes that give scope for supportive ESSs, especially in conjunction with supportive measures. Traditional examples are also earth worms and micro-organisms caring in soils. Soil recovery depends in functioning, to a large extent, on a good mixture of organic matter for rotting and nitrogen as well as soil moisture. Regulatory and supportive ESSs require special soil management practices at large scale and in areas of poor soils conditions can be only improved if farmers fix resources, for example through hedges, etc. Another advantage of hedges is that they provide habitats for birds which feed on insects. If there is a great need for pest control the importance of hedges increases in landscapes.

(2) To understand the link between farm productivity and integration of ESS at landscape level requires knowledge which can be gained from experience, traditions, experiments and even exposure to soft scientific. The situation on knowledge is quite complicated. A general view is that ESS have been only recently discovered. In some case this might be right. However, as can be observed from publication (Swinton et al, 2007) ecological knowledge might increase and farmers are put more and more under pressure to recognize nature in landscapes. But it is not only science. The tricky issue is that traditionally knowledge was available (especially on soil formation

see Uekötter, 2010), thought it was not recognized. Science based production knowledge has substituted this knowledge to a large extent. Especially since modern farming systems are based on external inputs, additional activities (related to ESS) normally not directly paying off. They become neglected. Hereby ESS are frequently linked to traditional knowledge though not recognized as such. In this regards, they are integrated again in types of farming practice which work with traditional modes to optimize soil nutrient recycling and nutrient uptake by plants. Under scarcity of ESSs and a great need for natural recycling of nutrients (see 1) farmers, for example in Africa, can even rely on termites (Barrios, 2007) and termites are living in mounds being part of a landscape as well as they feed on organic crop residues. So a question is to tolerate nature (termites) or not? If termites enable recycling of nutrients, farmers have to compromise, though they might see some nature elements as enemy. Hereby knowledge is confined to tolerating.

Ecologists like this perspective where eventually human interference in eco-systems is minimized. But management can be active, not just tolerating. For example, the delivery of organics under conditions of shortages is a practice. It attracts organism which produce colloids at large scale because nutrients and humus is transported. This knowledge, to the author's opinion, of ESS in practice is mainly gained by experimenting in landscapes at large scale by communities.

(3) The capacity to manage

Limited capacities to manage the natural environment for ESS provision are sometimes a great hindrance in the adoption of ESS management at landscape level. Indeed to a certain degree this capacity is linked to the knowledge of farmers and rural population. But knowledge is not the only facet. The capacity to manage ESS depends on bio-physical conditions. ESS and the underlying ESF are normally not directly accessible and in the mind of farmers. They are field oriented. Actually a typical feature of farming is that farmers like controlling media which are directly responsive; whereas nature is considered uncontrolled. A typical example is livestock rearing with domestic animals as opposed to semi-natural hunting. The provision type of ESS matters as a definition. ESS is considered natural as is normally fairly uncontrolled and additionally control is faced by competition from natural food webs (Zhang et al, 2007). To rely on ESS provision only is fairly dangerous because nature is uncertain in delivering its service. It is a long lasting wisdom of farmer not to depend too much on notoriously fragile nature. A solution is to take hybrid practices and focus on managerial options. Examples for hybrid practices can be found, for instance, in livestock rearing. Farmers differently care on livestock health and the ESS obtained from pasture. They know that grazing should be limited. The answer is migration to new pasture (ESS). But the capacity is limited to care about ESS from natural pastures and we see degradation. A term which was coined in this context is that of a "high reliability strategy" (Richert 1994) which is based on the recognition of complexity of land use systems, including ESS and domestic animals. Another frequently mentioned example is riparian river management and selection of arable land in fragmented field structures where only spots are farmed whereas the landscape remains intact.

(4) This aspect is most tricky, since it is working with opportunities and their costs. Opportunities are virtual features and shape decisions because decisions are made on alternatives (opportunities). In this context, especially in the modern context of seemingly having the alternative to live without ESS, modern farmers (not traditional peasants) have developed a mentality that ESS can fully be substituted. In a modern landscape we see the regime of opportunity costs strongly working. For example, the agro-industry offers many solutions to pest control, soil fertility and regional management of resources. The decisive topic is that the technologies, offered as substitutes for ESS (at least as partial substitutes), come with economies of scale and farms and fields increase.

However one can not speak about a full substitution since soil fertility and water retention still dependent on ESS which are related to nature in farming. Such issues are linked to the notion of providing a matrix (Vandermeer and Wright, 2009); it means that farming is coupled with nature since it is imbedded in a matrix of various interactions having a spatial dimension.

The opportunity cost aspect has created many problems in land use systems. An interesting topic in this regard is the modern institutional setting of rights to shape landscapes according to the will of farmers which is expressed as their interest to make profits and profits increase with the use of chemicals. The case of maize intensification is a good example: A recent attempt to qualify on such things as conversion of grassland into cropping areas for maize and production of biogas (Landwirtschaftskammer Niedersachsen, 2012) has raised the topic of individual and collection decision making and in particular thresholds and upper limits of industrial (maize) farming. The discussion on opportunity costs for ESS and decision making to substitute has to be supplemented with an investigations into the rights structure which prevails in the decision making process.

4 Managing ESS in Landscapes

By the last remarks on decision making in favour of (or against) ESS cognition in landscapes, which has been based on the opportunity cost issue and believes of farmers, we enter into a new sphere of analysis for land use and ESS. Our analysis has to go beyond an incomplete farming system analysis which is primarily set up in agronomy, only, and looks at the topic of individual decision making. In landscapes, decision making has features which can either been portrayed as the simple aggregation of individual decisions (then decisions are aggregated as in summing up in modelling) or it contains a component of collective decision making (then decisions are about the outlay of the landscape and ESS integration). In science on land use system analysis (LSA) algorithms of participative decision are needed (Strassert and Prato, 2002). They shall depict the preferences of communities for ESS, rather than of individuals. The aspect of an interwoven situation of individual and collective decision in land use and LSA (as the academic aspect of institutions and their economics) should portray also the collective decision. However, we have reached a scale where ESSs are becoming an important element of public management decision.

The immediate question is: how and at what entity can ESS be managed in landscapes to the benefit of farmers and nature in terms of more sustainable conditions? For sure, landscape ecologists have made many contributions on how they perceive an ecologically well managed landscape and how it should look like and what are interventions or regulations how to treat nature. But the integration in decision making is weak. There are different overall concepts for development “Leitbilder” (Söderbaum, 2007) which are sometimes conflicting within the farmers because priorities are to a certain extent subjective and not only objectively determined. In other words there are degrees of freedom, which and how to promote ESS. A route to is to minimize pressure on most important ESF and ESS (Kumar, 2019), For integration of ESS in decision making it means that the long term costs of not recognizing should be made transparent. This is best done in terms of seeing ESS as natural capital (Kareiva, 2011) and conserving it.

The concept for a landscape management should include a capital approach on ESS. Further on, in conflicts with farmers’ valuation, the long term user perceptions of ESS should be put at priority, if natural capital conservation matters. It is here where four aspects come in consideration. (1) What are relevant ESSs indicators and valuation techniques (Kumar and Wood, 2010) which guarantee capital maintenance? (2) Can they be agreed with users? (3) To what extend are they to be based on monetary valuation? I.e. are there criteria which, for instance, invoke safe

minimum standards and this standards matter more that capital and substitution (Randell, 2011). And (4) Is nature responding, at what time scale, to what extent, and what are the uncertainty?

These questions must be intensively discussed. In a recent contribution Kumar (2010) focuses on "pressure" on eco-system functions and says that services can be an operational indicator level. Pressure is understood in such terms as land use change, habitat degradation, disruption of food webs in ecology, etc. Working with the term "pressure" apparently means working with those who are initiating and putting the pressure on ESS, and who are farmers. For integration pressure indicators are ones to be addressed directly by management. To put it into a language of economist: the pressure should be minimized and the declining capital aspects should be made clear! For example the discussion on eco-nets as capital and nature matrix (see above), would nicely fit in the paradigm, since it enables reducing the pressure and provides land for habitats.

The second question is more complicated. Agreements with users, mostly farmers but also hunters, tourist operators etc. on ESS and amenities are normally based on compensation and income level maintenance for farmers. However, ESS quantification might offer good chances to get money from outside beneficiaries. This is also related to natural capital. There is conservation version, in which the status quo or deconstructions of such things as positive melioration may become financed, and farmers opt for it if they are compensated. If many farmers may refuse because they think that the interference means they are betrayed for their future, a solution would be to introduce discussions on dynamics aspects of loosing capital. Then farmers become open for conservation using dynamic compensations. Different modes of compensation could be tested; for example, gradual land use change and regional planning may be accepted. Seeing a danger of land price increases, otherwise, due to land scarcity this might have an impact on reducing land prices which is beneficiary for those farmers who need to expand. A way for reducing land use pressure seems to be controlling land prices. This needs investigation. At least the current mobilization of German Farmer Union against eco-nets and greening is a hint in the direction of not accepting regulations on eco-nets which run the danger for rapid land price increases.

A third subject is the techniques of "monetary evaluation and providing an inventory on regional accounting of ESS". This must be seen as an attempt to create a better ESS value recognition by land users. Its aim is to redirect behaviour towards minimization of interference in the natural capital represented by ESS. A crucial issue is that the valuation itself comes from the managers who are supposed to direct behaviour towards ESS, which may create suspicion. To rationalize discussions, the divergence between the assessment of conservation priorities of managers and current users must be look tat. A joint value inventory obtained by scientific investigation and farmers' valuation is needs to pin-point on hidden values and problems. For example regulatory services, which are normally not in the immediate recognition of users, could be hidden, and science make them transparent. However, valuation of ESSs (as in TEEB, 2010) can contribute to a map of values and knowledge representation in a landscape. The decisive thing is: can these values impact on decisions to conserve and restore ESS? In that regard land use decisions can be separated in two aspects: (1) Is there scope for extensive farming and in particular things like the introduction of eco-nets and high nature value farming, eco-friendly landscapes, etc. (UK-NEA, 2011)? (2) Is there any value recognition in daily operation? Value recognition in daily operation means that farmers, for instance, make assessment on combination of input purchases and ESS as compared to repairing machinery (capital maintenance). Can capital aspects of nature be transferred to decisions on ESS use or conservation? The question at hand is: is there recognition of ESSs to the extent that ESSs are considered inputs that should be maintained, repaired, etc.; i. e. not substituted by newly purchased inputs? As it can be expected that farmers making efforts in investing in ESSs based on valuation, if it pays off, the input aspect should have

a priority in terms of labouring for ESS. Then nature as capital can be established. Good examples are the maintenance of hedges, offering habitats for birds preying on insects, offering nitrogen for soil organisms, etc. A major question is can one call it a farming (system) with nature?

In regards to finding values for farming with nature and ESS as well as making values of ESS appreciable by land users (farmers and other users at landscape level), the response issue of nature is an important topic. Eco-farming (as agricultural matrix) is depending to a larger extent on ESSs which should be matured. This is not always given since we degraded landscapes. ESS valuation is confronted with the question how to get a more or less stable and certain delivery of the service. The problem is: if you compare the use of a bag of nitrogen with that of ESS, the bag gives immediate, visible results. ESS require landscape design, adjusted farming and one has to wait until organism eventually show reactions to landscape design (elements because of thresholds). Then there are conflicts because some organisms are not only beneficiary but have also problematic aspects such as birds which browse on crops, etc. In principle, tolerating nature reduces pressure on habitats etc., but it seems not to pay off immediately in straight monetary terms. Especially risk and uncertainty are there and also have to be translated into values judgments. There is a tendency that the uncertainties of receiving ESS benefits are upgraded and ESS are down graded because the alternatives (farming with chemicals) are considered more “reliable”.

5 Implications for Farming System as Landscape System Analysis

Having reviewed several aspects of ESS recognition in landscapes and their connectivity with faming system, it is now up to the author to draw some conclusions and give some recommendations. I am of the opinion synthesizing farming system analysis and ESSs into a landscape approach needs to address ESS at the user (farmer) and landscape (design). But how will this synthesis look like and what is the contribution for the economic profession? I see a core element in the finding and assessment of management options of ESS at landscape level rather than ecosystem level. Two distinct perceptions seem to prevail. On the one side ecologist seem to think that a minimum intervention (pressure) will enable ESSs fully to flower and land users do the best if they restrain from habitat modification. In their opinion, to a certain extent, harvesting ESS depends on doing nothing at all and restoration is the mere subject. In contrast I believe that nature, eco-system functions, preliminary ESSs and goods form ESSs need human intervention. So what is right? Maybe the contrasting is too general, and the answer is it “depends” on the situation. However, the ESS could be broadened so what we see a more active role of humans in landscape design and management. This may better constitute the Ecosystem Functions (ESF) to work at their maximum capacity for ESS? Again, the problem is that we are not dealing with wilderness as the references (at least in Europe), where, for sure, ESF could be given a simple recognition of existence. The tricky problem is to venture into deficits in ESSs under human intervention which can not be avoided through proper landscape design. For example, eco-nets could be designed as provisioning units of ESSs but at the same time eco-nets are conflicting with needs of farmers for land. The interesting topic, in this case, is to venture into the design options first and look at land reallocation to farmers, later, i.e. secondly. As been mentioned in the beginning in traditional system the issue was addressed by collective action, for example as crop rotation between summer, winter and fallow crops. This seems to be impossible in modern times of fragmented ownership. But it is unalterable. At landscape level and in farm communities we see renting out of land and renting in of land. So can’t we have land exchange? The question is: what could be done to strengthen the role of public management if interferes in land allocation for the sake of ESS are needed? I my opinion ESS provision should be linked to regulations on land use.

I believe we have to rethink the power of institutions of landscape management directed towards the goal of ESS provision. Minimizing the economic costs of ESS provision (similar to Wossink et al. 1998) is part of the story, but not the full story. An important tool is the exchange of land parcels between providers of the ESS, who may own parcels of land which become element of the eco-net, and the beneficiaries (users) who are also landowners, but who may not be affected. By assignment of parcels for ESS (eco-net), agreements can emerge. This process could be determined by a novel job description of a reeve who is a custodian of ESS in a landscape on behalf of a team of farmers, not on behalf of a superior land lord, as in historical times. This job description, as part of landscape system management, should entail a land exchange program which is based on participation and a team work approach. We might see team work as a basis, but also the reeve devices landscape elements and we have to investigate the role of statutory regulation on land use.

On such a basis regulations could be that those farmers who loose land from field (buffer) strips in the eco-net are compensated with land which is adjacent to their land and has been in the hand of neighbours. In contrast, by the logic of property rights, one would expect that the neighbouring farming would not concede valuable land. Is that right? For that we could assume that in total perhaps 15 p.c. of the area should be under the eco-net and this land is no longer available for farming at all. Then automatically all right are reduced. The challenge is: can we create a pool of land which is coming from a joint effort of the community to buy out land from farms for eco-net land which operate at lowest profitability. Here a cap and trade scheme is possible. In the scheme a mechanism shall equalize land losses? In the first case the community has to pool money which is used for compensating others. In that case we have to specify the team approach as contribution of money which comes of the benefits derived from ESS. The management task, such extended landscape management system, is a new job description beyond the pure farm management. It means to determine the rates of contribution of land or money, to negotiate the compensations of the farmers who leave, and then distribute land to whose farmers who loose land. This job could make farmers accept the eco-net design and concede rights. However, the underlying plan should be made transparent to community members.

The second version is that land is exchanged without monetary compensation voluntarily and with the still existing number of farmers and rights. It means that in principle everybody has to contribute the same amount (for instance 15%) but then we need an exchange mechanism on the basis of quality categories. It should enable an “internal pricing” of land categories. In this case the land allocation of the eco-net needs a compensatory mechanism agreed by the community.

Finally, I would like to stress that especially the issue of who “owns” the natural capital which is associated with ESS provision in landscapes will be an important topic for landscape (extended farming) system analysis from an economic point of view. So far, to my knowledge ownership is a concept which is primarily applied to individual farms. With farming which is oriented towards landscapes and ESS the question of collective ownership remerges.

7 References:

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