Heterogeneity and Harmonisation in Layered Institutional Approaches to Global Common Issues –The Case of Pesticide Use in the South[1]

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Introduction and objective

The existence of negative consequences of pesticide use in the South from the local to the global level, as well as driving forces[2] for the problems and the involvement in governance efforts to address them at multiple levels makes it a complex cross level issue. It raises particular challenges for its governance.The use of pesticides in the South affects society and the environment at different scales; from the individual human health effects for an agricultural worker in the banana plantation in Costa Rica, to the biota in the lakes of Canada and northern Europe. The societal driving forces encouraging the use of pesticides are embedded in the global economic system where for example multinational companies market pesticides and importing countries' consumers and retailers desire certain quality of agricultural products. Responses from individuals and organizations aiming at reducing the negative effects or the risk for such effects include; policies of multinational companies who are promoting the safe use pesticides, governments engaging in negotiations of a global Convention to phase out certain persistent pesticides, governments' efforts to gain control of which pesticides are used in their countries and farmers who switch to alternative pest management methods to avoid damage to their crops from pesticides.

The particular case of pesticide use in the South is in the paper used as a window into the better understanding of complex, cross-level environmental issues and the potential for their governance. The study takes its departure in an empirical material and explores how elements of several theoretical frameworks, particularly that of common pool resource (CPR) management facilitate the analysis. Characterising words for the study are; explorative, theory generating and multidisciplinary. The larger study that this paper is based on does four things to explore some of the key features of multilevel complexity around the issue of pesticide use in the South:

1. First, it compares and analyses the way that stakeholders at the global, national and local governance levels structure the issue as a problem, including how the causative links are perceived.
2. Second, it compares and analyses what policies stakeholders formulate and/or apply to reduce the negative side-effects of pesticide use.

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[1] To be presented at the Eighth Biennial Conference of the International Association for the Study of Common Property:"Constituting the Commons: Crafting Sustainable Commons in the New Millenium" Bloomington, Indiana, 31 May – 4 June, 2000.

[2] Driving forces is here seen as human activities, processes and patterns that exert an impact and in many cases pressure on the environment (DPCSD, 1996).

3. Third, it looks at some parts of the process of decision-making for individuals and organisations in reaching their policies.
4. Fourth, it looks at some aspects of knowledge, institutions and values across levels that should be of special interest for multilayered governance of pesticide use in the South.

In this paper the first three objectives will be briefly covered while the fourth will be discussed in more detail.

Pesticide use in the South

A pesticide is defined as a chemical substance that kills a pest.[3] A pest can be any organisms that a farmer considers causes harm to his crop, like insects, fungi, or plants (in the latter case called weeds). The pesticides designed to kill these are then called insecticides, fungicides and herbicides respectively.[4] Pesticides also includes substances that are used to kill pest organisms that attack the crop after the harvest, in storage and transport. This study is confined to the use of pesticides in agriculture and excludes other uses, for example in vector control and on construction material.

The pesticide industry is a venture with estimated sales of around 30,000 million USD (1998) (Anonymous, 1999).[5] This is twice the value from 1985 when sales were at 15 900 million USD (WHO, 1990).[6] If Asia (excluding Japan), Africa and Latin America is merged as the South, then developing countries account for around 32 percent of the global market (Anonymous, 1999).[7] The use of pesticides in developing countries has been on the increase in the last decade and this trend is expected to continue (FAO, 1996). Agriculture can in developing countries generally be divided into three categories; plantations of export crops, smaller farmers growing export crops and subsistence farming. The level of pesticide use is usually highest in the first category and lowest in the last.

A percentage of the pesticides used extensively in the past, but to some degree also currently, belong to the group organochlorines. Some of these are categorised as persistent which cause concern because of their chemical stability, their long biological half-lives and the possibility of being recycled back to the base of the food chain (Bro-Rasmussen, 1996). The use of persistent pesticides in the South is increasingly seen as a global problem since a proportion of the persistent pesticides are believed to be further transported by atmosphere and oceans to the far northern and far southern part of the two hemispheres where they to some extent accumulate in biota. Several studies indicate that local contamination of toxic substances such as pesticides is low in tropical coastal environments explained by an accelerated contamination through the process of 'global distillation' with long-range atmospheric transport from tropical point sources towards the colder regions, see e.g. (SCOPE, 1989; Wania and Mackay, 1993). When the category of persistent pesticides was banned in the developing countries, largely in the 1980s and 1990s, it was substituted for other compounds

[3] Usually it is a synthesised chemical substance, if not specified pesticide will in this text signify a chemical pesticide. There are also biopesticides made directly from plant material.
[4] There are a few more types of pesticides such as nematicides (against nematodes), acaricides (against ticks) avaricides (against birds) etc.
[5] The source gives two slightly different figures of sales for 1998: 31,005 USD based on Wood Mackenzie data reported to the British Agrochemicals Association and 28,500 million USD based on figures from the German agrochemical industry association (IVA). Figures based on production, volume or weight, are rarely available. In 1985 the average price for pesticides was 5100 USD per ton which would have given a world production of 3,1 million tons in 1985 (WHO, 1990)
[6] The comparison has not taken inflation into account.
[7] Note should be taken that Mexico is here included in the NAFTA category, and in Asia there are a number of so called Newly Industrialised Countries.

such as organophosphates, carbamates and later pyrethroids.[8] Many of these compounds are much more acutely toxic for people than organochlorines, and it is assumed to have increased the number of human intoxications among farmers and workers in the South. The number of acute intoxications have been estimated as over 3 million each year with two thirds accounted for by suicides. Data is sparse and contested though and even more so data for possible less acute effects, for long term effects etc. (WHO, 1990).

A global common issue

The use of pesticides in the South is here analysed as a global common issue. The traditional way of defining an environmental issue as global is to look at the geographical scope of the effects, if they traverse enough state borders and afflict people and organisms across the globe. This criteria for making an issue global is relevant but there are other criteria according to which an environmental issue could be categorised as global. I argue that an environmental problem can be global for either, several or all of the following criteria:

- Culpability
- Suffering
- Concern

They can be global in culpability because driving forces are global, in suffering because people and/or ecosystems all over the world experience negative effects of environmental change, or in concern because of a widespread feeling on the part of global organisations or people in many countries that they are obliged to respond to the problem. Pesticide use can be analysed as a global issue according to all three of these definitions. If categorising an issue as global it could be looked at from the perspective of being a common affair for humanity, even as some kind of a global common. This perspective opens up the possibility to see how the theories on common property resources (CPRs) can increase the understanding of the local-global aspects of pesticide use in the South.

Both tragedies and successful management of resources have resulted from all types of property regimes; communal, private and government owned (Feeny, Berkes et al., 1990:12). For the case of resources that are neither private nor government owned there have been many examples around the world of both successes and tragedies in efforts to manage them as common property. The CPR concept was originally confined to local resources which are possible for a local community to manage. But the concept has also been applied to resources of significantly larger geographical scope, even encompassing the whole planet. These so called global commons can fall under three general types of governance; world government, extended national jurisdiction or restricted common property (Young, 1992). The classical notion of 'global commons' includes e.g. the oceans and seabeds beyond national jurisdiction, Antarctica, the atmosphere and outer space. All are 'resources' which are impractical for any one nation to lay claims on and can thus be seen as belonging to all nations in common. If they are not managed as commons the situation is one of open access and today problems of CO_2 accumulation and ozone depletion "are clearly global tragedies of the commons in the making" (Feeny, Berkes et al., 1990:14) Up till now the global commons have been seen as separate physical places or spaces with close connection to the issue of 'property' which implies an owner-property relationship. It is however argued that the definition should be widened from being confined to resources that can be delimited, so that we see the commons as a 'system' (Cleveland, 1993:10; Vogler, 1995:198) Even territorially confined environmental degradation can, in this respect, be an element of the global system of life

[8] In the last decades of the 20th century many active ingredients that did not belong to either of these major groups were manufactured. and some of these also available in the markets of the South.

support that the planet is providing us and all other species with. To reflect this changing perspective away from a pure property linked analysis, many analysts, including myself, prefer to use the term common pool resources (Oakerson, 1992; Ostrom, Burger et al., 1999) It should also be noted that the commons may not have the pure character of providing a flow of resources, but instead pose as a 'common sink' which still is characterised by public goods attributes as the benefits from unpolluted air and ocean are public goods (Vogler, 1995). When discussing commons in this wider sense, with the systems approach, it is less appropriate to talk about open or restricted access. An alternative concept revolve around the existence or absence of governance systems that influence the preservation or degradation of the system.

Although the emerging theory on collectively managed resources was originally developed for local CPRs, the insights gained have been transferred and applied to global commons and even further on cross scale/level situations (McGinnis and Ostrom, 1996; Gibson, Ostrom et al., 2000). Although some lessons from local systems can more easily be transferred for global systems, many new issues emerge in these because e.g. their extreme size and complexity (Ostrom, Burger et al., 1999). Also many resources that do not belong to either the local CPRs or the classical global commons, can be studied in the same theoretical mindset. In Karlsson(1997) the theoretical insights from studying the management of resources as common pool resources were applied on a wide set of disparate resources in global and local, urban and rural, Northern and Southern settings, and even on resources which until recently had not been viewed as resources.

In this paper I apply the concept of CPR and the adhering theoretical instruments to the issue of pesticide use in the South. This issue is neither a natural resource nor an environmental system but a human activity that has the potential to be a driving force for change in the environmental system. Such a common is not a common in the classical definition. Yet it fulfils, I argue, for other reasons the basic requirements of being a 'common'. No single entity, be it an individual, a state or a company, can exercise unchallenged sovereignty over this issue. Independent, unco-ordinated decisions would lead to suboptimal results, such as in the underprovision of a healthy global environment. This brings the issue back to the general theoretical framework where CPR theory principles origin. The management of resources as CPRs is a special case of collective action situation, or social dilemma, which occupy political scientists. It is an important area when looking at human dimensions of global environmental change (Gibson, Ostrom et al., 2000).

Study design

By analysing pesticide use as a global common issue, the objectives of the study are made more specific and it favours a more coherent approach to understand more of he issue's multilevel complexity and the implications for multilayered governance. This is achieved by identifying what facilitates successful management of CPRs. But the first quesiton is how do we define successful management of a CPR? The criteria according to which success is defined from a conservationist perspective can for example entail that the regime has "provided resources equitably, sustainably and at reasonable cost" (Gibbs and Bromley, 1989:23) When many stakeholder groups with potentially conflicting interests are involved it is no easy task to define success. At local level successful CPR arrangements has been achieved "through the persistent acceptance of rules which regulate individual behaviour in the continuing interest of the group as a whole" (Gibbs and Bromley, 1989:23). Ostrom (1992) has outlined some of the criteria that need to exist among decision-makers for the creation of an organisation of appropriators, and switching from independent to co-ordinated action for the local management of a resource as a CPR:

- Common understanding of the problem

- Common understanding of the alternatives for co-ordination
- Common perceptions that decision-making costs do not exceed benefits
- Common perception of mutual trust and reciprocity

The factors all circle on a degree of common understanding. For an issue with many different stakeholder groups involved, from the local to the global level, looking at the the degree of common understanding of the problems and alternatives for action should be a good first step in establishing the conditions for addressing the issue as a global common issue. The first two of these factors are reflected in the first two of the objectives of this study, whilst the last factors will only very indirectly surface in the analysis.

The first objective of this study was to learn of the problem structuring among stakeholders in pesticide use in the South across governance levels. This is linked to the first factor identified by Ostrom, the achievement of common understanding of the problem among the actors involved. Understanding of a problem can be rephrased as problem structuring. Problem structuring is made by stakeholders and determines what is defined as a 'problem' which is the prerequisite for eliciting discussion on a possible policy responses—including preserving status quo i.e. doing nothing. As the concept is used here it includes perceptions of both the problem, its character and magnitude, and why it occurs, that is the driving forces for the problem.

The second factor that Ostrom identified as essential among appropriators of a resource was common understanding of alternatives for co-ordination. The issue in focus here is not subject to direct possibilities for co-ordinated action between stakeholders across the local, national and global level but the action that each take will in the larger perspective be striving in one or more directions. I start at a more fundamental level and discuss common understanding for action, instead of co-ordination for action. Looking at the policies for reducing the risks with pesticide use in the South is the second objective of the study. It is reflected in the existing laws and other institutions, formal or informal, in approaches of aid projects, in the action of farmers etc. The focus is to identify the major strategies towards risk reduction and their underlying rationale, such as if the goal is to reduce the volume of pesticides applied by finding non-chemical pest control technologies, or to ensure continued or increased use but under safer conditions with less human exposure. The more detailed aspects of various pest technologies will not be analysed.

The decision-making of individuals and organizations is a key issue in collective action dilemmas, specially to what degree it is geared towards independent or co-ordinated action. Usually a mechanism of collective decision-making is a necessary part of a local and global commons regime (Vogler, 1995:36). In this study three governance levels are included and several stakeholder groups at each level. There is no forum for collective decision-making across levels. Situations of decision-making in pesticide management include choices of risk reduction strategies at each level, IGOs making risk assessments and global pesticide residue standards, national registration processes where some pesticides are allowed to be used in the country and others not, and farmers' decisions on if to use pesticides at all, which pesticides to use and how to use them.

Managers of classical local CPRs as well as global commons can seldom be confined to one specific level be it the local, national, regional or global. Also, for this non-classical 'commons' issue of pesticide use in the South which exhibit local-global linkages many stakeholder groups are involved at multiple levels of governance and the need for co-ordinated governance across levels should be evident. A higher degree of co-ordination in governance across levels I call multilayered governance. The fourth objective of the study is to

look at some aspects of knowledge, institutions and values that could be of particular relevance for establishing multilayered governance. The starting point for this discussion is the identification of 'mismatches' between levels in knowledge flows, institutions and values for governance. Aspects that emerge based on this analysis include; the tension between universal generalisations and local specificity in science and knowledge in decision-making and policy, according to which principles institutions should be assigned particular governance levels; and how more collective concerns could contribute to the reconciliation of conflicting goals.

Methodology

An empirically rich case study in three tiers was developed. The first tier of the case study is pesticide use in the South. The second tier of the case study is choosing specific countries, in this case Kenya and Costa Rica, to do the analysis at national level. And the third tier of the case study is to select a district in each of the two countries at the local level in which the same crop, coffee, is grown predominantly.

Pesticide use in the South exhibit a number of characteristics which makes it suitable to analyse as a global common across levels. The issue of pesticide use reveals a complex pattern of factors with the potential to influence the use of pesticides and its negative environmental (and other) effects. A number of stakeholder groups with often competing goals for the management of pesticides are involved. There is substantial uncertainty both in the characteristic of the problem itself and effects of various policy strategies (Finkelman, 1996). Policies are made to address the potential risks with pesticide use at various governance levels, and in different sectors. The case shows all the characteristics of what has been called an ill-structured policy problem (Mitroff and Emshoff, 1979). The use of pesticides is directly linked to at least two of the classical types of Global Environmental Change (GEC) issues[9]; ozone depletion in that one pesticide still used in a number of countries is Methyl Bromide, listed in the Montreal Protocol. Subsequently, pesticides can have negative effects on biodiversity. Pesticide use generally contributes to global toxic pollution. It is further intimately linked with a central human activity, agriculture, which is one of the foundations for human society and a dominating land use.

Both Kenya and Costa Rica were chosen as case countries partly due to their, on paper at least, rather advanced pesticide legislation compared to many other developing countries. In addition they had some research on pesticide pollution and health and/or environmental effects as well as alternative pest management technologies in the country. Both Kenya and Costa Rica are economically heavily dependent on agricultural export and have traditionally been dominated by very few cash crops (coffee and tea, and banana and coffee respectively) but in recent years non-traditional crops like pineapple, vegetables and ornamentals have expanded fast. The high proportion of export crops, the involvement of large businesses in their production and other factors have made the countries substantial users of agricultural pesticides.

In each country I selected a coffee growing area in the higher altitudes where *Coffea arabica*, highland coffee is grown. In the case of Kenya the choice fell upon Meru which is a district in the Eastern Province, located on the slopes of Mount Kenya where coffee has been grown as a cash crop since the 1950s by the indigenous farmers. In Costa Rica the work was carried out in Naranjo, in the province of Alajuela in the Central Valley, a district completely dominated by coffee growers since many decades.

[9] To these one usually include climate change, ozone depletion, acid rain, loss of biodiversity.

There were various stakeholder groups at each level for the issue in question. (Grimble and Chan, 1995:114) define stakeholders as "all those who affect, and/or are affected by, the policies, decisions and actions of the system". I divide the groups of stakeholders into three major categories; organisations (government and IGOs), civil society (NGOs, private companies, academia) and individuals (farmers and workers). Although striving to include representatives from all stakeholder groups at each level, there were practical limitations to achieve this and priorities were given to those who were considered most important in efforts of governance to reduce the risks from pesticide use. This led to an emphasis on IGOs at global level and on farmers at local level.

Several methods were combined to solicit stakeholders' problem structuring, policies and decision-making processes; interviews with stakeholders, studying policy documents, and to a lesser extent direct observation. The main approach was semistructured qualitative interviews with stakeholders at each level. Interviews were made the core of the methodological approach as I wanted primarily to learn of stakeholders' own structuring of the whole issue and the current decision-making processes. Interviews were further chosen as I wanted to be able to compare answers to similar questions between a great variety of stakeholders that would not be disclosed in documents. Semistructured open-ended interviews were necessary as I wanted to understand how respondents comprehended and approached the issue and to avoid imposing too much of my perspectives on theirs (Patton, 1990; Rubin and Rubin, 1995). I was striving to understand a complex issue as pesticide use in the South in a holistic context. Over 200 interviews were carried out during 8,5 months of field work.

Common understanding of the problem?

The unwanted side-effects with the use of pesticides in agriculture in developing countries that emerged among stakeholders across governance levels have in this study been categorised as belonging to either of these five areas: economic, production, human health, trade and environment. Based on a FAO questionnaire among developing countries their problems with pesticides was summarised as follows:

> "Many countries shared common problems, such as inferior quality products, inappropriate labelling and advertising practices, availability of highly toxic products, residues on food and export crops, and human environmental poisoning" (FAO, 1993:5).

This quote gives examples of four of the five problem categories. Farmers who are anxious to protect their crops from pest attack may have economical difficulties in purchasing pesticides. When pesticides of inferior quality are used it can be detrimental to the agricultural production, pest attacks are not abated adequately. Highly toxic products can lead to human health problems. Pesticide residues on export crops can, if exceeding importing countries' allowed levels, cause serious trade problems. And lastly, the environment with its ecosystems and organisms, including humans, can be negatively affected. This categorisation is not clear cut since several of the areas are closely interrelated. The categories were still seen to be the most appropriate sorting instrument for the empirical data.

At global level, there were several ways in which pesticide use in the South was structured as a problem in IGOs. It was seen as a health issue, specially for the poor and uneducated farmers and workers who spray pesticides. The risk of acute intoxications came in the forefront. Concern with consumption of pesticide residues over extended periods of time indirectly accounted for pesticide use turning up as an important trade issue. That the general environment, and then indirectly the human population as well, is exposed to pesticides which are transported over vast distances, has induced the use of certain persistent categories of pesticides to emerge as an environmental issue in multilateral negotiations, in the framework

of the Persistent Organic Pollutants (POPs) Convention.[10] There was little mention of potential local and regional environmental effects in the areas of the South where the pesticides are used. The effectiveness of pesticides to save agricultural production from pests, was not an issue substantially raised in IGOs.

At the national level in Kenya and Costa Rica stakeholders either saw negative health and environment effects of the whole category of pesticides or did not see evidence for substantive negative effects. The government in Kenya tilted towards the second position while various environmental NGOs referred to much problems. In Costa Rica there was more thorough statistics on acute intoxications from pesticides and more references to the existence of environmental effects. At the national level transboundary effects did not in either country seem to be known or considered except in the implications that residue levels have for export crops. The issue of residues as a problem for trade was definitely high on the agenda, but largely it was referred to as a problem of the past, before measures had been taken.

At the local level in both Meru and Naranjo coffee farmers complained that the pesticides were too expensive and that coffee prices were low. Farmers in Meru experienced the additional problem that they received payments for their coffee very late, up until a year after the harvest and other expenses took precedence over agricultural inputs. In Meru many farmers had stopped spraying, solely attributed to the inability to purchase the products, whereas in Naranjo there seemed little indication that farmers had even reduced the number of sprayings for economical reasons. Meru coffee farmers were in general strongly convinced that if they could afford spraying pesticides, there would be no problem with pests. Only few incidences of pests that had not succumbed to the products applied were related. Effective products were always available. In Naranjo there were similar sentiments on the general effectiveness of the products only with one major exception; it was hard to control the fungal disease iron rust. Up until the beginning of the 1990s they had had a very good product, lead arsenate, to control iron rust but it had been forbidden by the Ministry of Agriculture. The problem dimension that emerged almost exclusively in Naranjo was the existence of negative side-effects on the coffee plant and its production from certain pesticides. Herbicides took the heaviest toil in this criticism towards pesticides, they were claimed to have various bad effects on the soil, killing beneficial organisms in it and damaging the roots of the coffee plant. Also other products could become toxic to the plants if they were not applied correctly. The experience of health symptoms from using pesticides varied a lot between individuals in both areas. There were those who suffered problems such as dizziness, nausea, headache, skin problems, eye problems, fever etc.[11] and there were those who never had any problem. More severe intoxications were primarily mentioned in Naranjo, where the victims were brought to hospital. In Meru on the other hand, such cases were hardly mentioned. There was hardly any reference from farmers or workers in Meru to the possibility of more long term health effects. In Naranjo, on the contrary, references to cancer and other effects that could emerge after a long time were not uncommon among pesticide users. Comments on this specially emerged in connection with the rationale for the government to prohibit the use of lead arsenate. The general environment was practically absent as a possible victim for negative effects from pesticides during the interviews in Meru, whilst it was more present and quite prone to be a victim according to some of the respondents in Naranjo. These latter ones raised the general contamination of water and the environment and the loss of different categories of species as negative effects.

[10] There are ongoing negotiations carried out by the Intergovernmental Negotiation Committee for an International Legally Binding Instrument for Implementing International Action on Certain Persistent Organic Pollutants. They are scheduled to finish in the year 2000 (UNEP, 1999).

[11] These were the symptoms that were mentioned in both districts.

The problems perceived, specially health and environmental problems, among stakeholders across all three governance levels were attributed primarily; to farmers who were not enough aware of the risks or for other reasons did not follow the precautionary measures, to the Industry that was too aggressive in marketing pesticides or to states who were not able to regulate and implement regulation on labelling, not able to provide training programmes for farmers and not able to gather data on the potential risks by monitoring food and the environment for pesticide residues. At one end, national governments, adhering to the Industry view point, and supporting modern pest technology affirmed that use *per se* was no risk, as long as the mode of use was appropriate. At the other end the organic movement and others stressed that all pesticides per definition constitute harm and they will all eventually end up in the environment. IGOs were mostly found in between these two extremes and took action focusing on helping countries with identifying and eliminating those individual pesticides which were too toxic to be used safely.

The degree of common understanding of the problems from pesticide use within and across governance levels was thus rather low. But there was some limited consensus, if the farmers and extension officers in Meru and some pesticide companies are excluded, that there were negative effects from the use of pesticides in the South in general and in the two countries in question. However, the magnitude and type of problems and who was to blame for them was not included in this picture of consensus. The situation with varying problem structuring, in how the magnitude and type of problems from pesticide use and driving forces causing them, is by no means surprising. It is not surprising neither within each level among various stakeholder groups, nor across levels. It reflects differences in knowledge and value judgements, for example in what is known about the consequences of pesticide use and which priorities or values that stakeholders have in weighing the benefits and costs of using pesticides.

Common understanding of alternatives for action?

When identifying alternatives for action in the policies of individuals and organisations, the study focuses on those policies and strategies that aim to reduce mainly the health and environmental risks from pesticide use. Implicitly, however, such measures can be of relevance for reducing trade, production and economic problems, and measures taken to address these may have positive effects on health and environment as well.

At global level IGOs were engaged in a range of aid activities that aimed to assist developing countries to regulate and control the use of pesticides. Such activities included; help with development of national legislation, capacity building in chemical management, supplying information and risk assessments and provision of technical guidelines. IGOs were also the administrators and fora for the negotiations of several Conventions as well as non-legally binding instruments to address problems from pesticides and other chemicals. In many of these activities there was a strong strategy of strengthening the national regulatory framework to have the information and resources to decide which pesticides should be used in the country and to promote safe handling and use of pesticides in all stages of their life-cycle, which included a number of precautionary measures that should be adopted during transport, handling and application of pesticides. These strategies assumed a continued use of pesticides and aimed to reduce their negative side-effects by eliminating or restricting the worst pesticides and establishing an infrastructure for the safe use of the rest. Other strategies were more directed at the farmers' production methods. IGOs no longer openly supported increased use of pesticides in grassroot projects. The IPM concept has been present in IGOs discussions for many decades but had in the 1990s emerged as a favourite policy for pest management. And this time the concept of IPM used in many of the activities included more than the definition of rational use to get pests below economic thresholds, which was the definition endorsed in the International Code of Conduct on the Distribution and Use of Pesticides

(FAO, 1990). The newer IPM concept involved the approach with Farmer Field Schools, see for example (FAO/World Bank/UNDP/UNEP, 1996; FAO, 1998). This is a resource intensive approach which focus on educating farmers over an extended period of time in population biology and the methods of experimental science and through this assist the farmer to learn more about alternative pest management methods. Organic farming is another strategy to reduce the risks from pesticides, plainly by eliminating their use but this had hardly emerged on the agenda of IGOs.

At national level Kenya and Costa Rica have developed extensive laws and regulations on pesticides, and the core of these was the process for registration of pesticide products. A number of primarily organochlorine pesticides had been banned over the last two decades. Pesticides were registered for use only on specified crops. Regulations also covered the facilities of pesticide retailers and training of their personal. Safe use training was involving not only the industry association but also governmental agencies in both countries. In Costa Rica training was also geared at school children. In Kenya there were small efforts of establishing IPM as a national policy but less implementation. On a small scale there were nation wide NGOs in both countries that worked to promote organic farming and in Costa Rica organic farming was also supported by an office in the Ministry of Agriculture.

At local level many coffee farmers in the study areas of both countries said no, there were no alternatives to pesticides. Pesticides were used in the coffee groves by every farmer in Meru who could afford it, and by virtually everyone in Naranjo. In Meru a few raised the mechanical killing of stemborers, pruning or mulching as non-chemical methods to combat pests, and it was not uncommon to address weeds by hand. And one farmer in Kenya, and some of his friends, used a home made biopesticide. In Naranjo the number of pest management methods not involving pesticides mentioned were significantly higher and included general soil conservation measures, shade trees which shed organic matter, fertilisation, clearing weeds with a bushwhacker and even allowing weeds to grow. The extension agents here heavily emphasised an integrated control specially for iron rust, nematodes and weeds, where there were either no effective pesticides, or the pesticides brought negative side-effects. In Meru the extension system had provided a coffee variety that was resistant to the two most prominent fungal pests, that would reduce the need for spraying with fungicides to a minimum, but these integrated measures were not applied to address either health or environment problems.

In Meru, strategies to reduce the health problems from using pesticides, either were unknown, involved the drinking of milk after spraying or hiring someone else to spray. Naranjo farmers also drank milk, with the additional option of lemon juice or clay water after spraying but it seemed to be geared more at very acute signs of intoxication. And if they got sick they went to a doctor or the hospital, something which was practically unheard of in Meru. In Naranjo they also had the option of avoiding to spray themselves, and some individuals who had become intoxicated had been forbidden by the doctors to continue to handle pesticides. Some farmers in both Naranjo and Meru who were aware of the risks, or who had experienced health problems, did not put themselves subject to it but used their economic resources to hire others to spray. This was not a strategy open for farmers who depended only on their coffee for their income, neither was it a strategy for casual or permanent workers.

The Industry sponsored Safe Use Project was present in Meru. Over 20 000 farmers had been trained in the first half of the 1990s (which is still a small part of the agricultural population in the district), but neglected groups seemed to be women, casual and permanent workers. The latter category should be the category most heavily exposed to pesticides. Also in Naranjo the training of protective measures had been present for a number of years, though not in the form of an explicit safe use project, but incorporated in the general extension message at field days.

In common for appliers in both districts was the low level of adoption of the safe use message, specifically the part of using protective clothes. In Meru, although a few used improvised protective clothing or a partial cover, most neither owned nor had access to prtoective garments. People said they were too expensive. In Naranjo access was generally not a problem. However, for reasons of discomfort etc. also there did few farmers use them, or they used them only in the early mornings before it got too hot.

In Meru many coffee groves were in fact organic since farmers could not afford to spray pesticides and applied manure instead of fertilisers. But since there were no market infrastructure e.g. with organic certification. none of these got any premium price for this. In Naranjo some farmers were aware that one could receive a significant premium price for growing certified organic coffee but growing organic was not something many had thought about and only one farmer had switched to this system. The organic coffee factory did not really promote it as an option for active farmers, they favoured it more for those farms that had been abandoned. However, organic coffee growing was increasing around the country.

The risk reduction measures and strategies outlined above could be categorised as primarily addressing one of these three factors that can be seen as contributing to the risk from pesticides:

$$\text{risk} = f\,(\text{use})(\text{type})(\text{mode})$$

Risk is considered a funtion of toxicity of a chemical and the exposure. In this case both the use, the quantity of pesticides, and the mode factor, how it is used together establishes the degree of exposure. The type factor refers to the toxicity or ecotoxicity of the pesticide. The strategies and activities can be geared to reducing risk by ensuring proper mode of use, by reducing all use or reduce the use or improve the handling of some specific categories of pesticides that are more toxic. To the first category of risk reduction strategy I have included IPM and organic farming, to the second category various efforts at regulating pesticides according to individual characteristics such as risk assessment, registration systems, banning of individual substances and to the third efforts to ensure safe use by training etc.

The degree of common understanding of alternatives for action was moderate. Most risk reduction efforts by governments and Industry belong to the type and mode category although the IPM efforts are increasingly encouraged specifically from IGOs. On the margin some NGOs and farmers also address the use factor by efforts at organic farming. The discrepancies can also in this case be attributed to varying knowledge and/or value judgements on what are the major contributing factors to risks, what is the acceptable level of risk, what are the inherent toxic properties of pesticides, the exposure patterns under conditions of use and who, at what level of governance, should be responsible to address the risks.

Decision-making

Three questions surrounding pesticide use in the South emerged as central in the analysis of decision-making. The first is *if* pesticides should be used or not. The second is *which* pesticides should be used. And the third question is *how* they should be used. These are directly linked to risk equation elaborated in the previous section.

At global level, in many of the IGO offices that were involved in evaluating pesticides or setting standards for them, decision-making was on which pesticides to evaluate, what magnitude of risk they posed and for which active ingredients standards should be developed. In other offices the decision-making was on how to address pesticide use in general, or how to help countries in their regulation of pesticides at national level. The risk assessments and standards were often explicitly or implicitly referred to as providing decision-makers with

objective information on the potential risks from each substance. Science was preferably pictured as flawless, universally valid and objective as long as qualified scientists were involved. The assessments or suggestions for standards made by IGOs then fed into various political decision-making processes at global and national level. In the array of activities of prioritising certain pesticides for management and risk reduction efforts, the criteria primarily put emphasis on substances which were both toxic and persistent, thus having the potential for building up in the human body over long periods of time.

At national level in the governments of Kenya and Costa Rica most decision-making concerned the question which pesticides to use. This was reflected in the importance attributed to the registration process, the banning of certain pesticides and the efforts to prevent smuggling of illegal pesticides from neighbouring countries. The registration processes depended exclusively on data on toxic and ecotoxic characteristics of the substances provided by Industry and IGOs while their efficacy to address pests was tested in the country. The strict adherence to science and validated data was given high significance, as was the fact that the registration process demanded as much data from the companies as systems in countries in North America and Europe. Yet after the banning of the most notorious organochlorines and a few other substances in the 1980s and 1990s it appears as if few pesticides were refused registration. In Kenya the registration decisions were made by a committee which included representatives from various ministries, scientific disciplines and civil society. In Costa Rica the Ministry of Health and the Ministry of Agriculture were the only ones formally involved in the decision-making process, except for the most hotly debated pesticides where a multistakeholder commission was called in. In the instructions put on the labels was also decided how the pesticides should be used by those who apply them.

The decision-making on if to spray pesticides at all occurred in different frameworks in Meru and Naranjo. For Meru, coffee was a largely modern crop, not indigenous to the area, there were no cultural or traditional pest control methods to fall back on. Pesticides were a modernity that was readily adopted and transformed into the normal part of life, to an item farmers could not do without. In Naranjo on the other hand, pesticides had been introduced long after the coffee plant itself, but through the modernisation of the coffee production in the country, the character of the coffee farms had changed significantly. They had been highly technified and the dependence on both fertilisers and pesticides was almost total. With the presence of a system in Costa Rica for certifying organic coffee farmers and exporting their coffee, there was, for a few farmers who were aware and positive towards this, at least a theoretical option to decide to switch to organic farming. But there were many obstacles raised that made them decide against it. In Meru, where many farmers did not spray at all, they had no alternative pest management methods to chose between, it was basically pesticides or nothing. The organic coffee farmers in Costa Rica worked intensely to get their soil and whole farm in balance so as to reduce to a minimum the pest attacks.

Meru farmers who still sprayed, and a majority of Naranjo farmers were then primarily faced, not with the option whether to spray or not but rather which products to apply. And in both cases they put their confidence in the expertise of the agronomists from the government extension or the co-operative societies. It was the agronomists' decision-making that was decisive. And the agronomists in turn got the recommendations from the central coffee research institutions. Private companies were pictured to have a lower profile, at least in terms of direct contact with the farmers, the clear exception being their presence on the extension days organised by the Ministry of Agriculture in each district. Instead, companies seemed to have closer contact with the extension system and the retailers directly.

How to spray was the farmers' and workers' decision but it was influenced by the access to training in safe use measures, access to protective garments, type of spraying equipment, the feeling of discomfort while using protection etc.

Multilevel complexity

When pesticides are not functioning, are not solving farmers' pest problems to a degree they find satisfactory it is a problem that affect the farmers economically. The trade problems affect developing countries economically in cases of returned shipments where pesticide residues are too high and in difficulties to export an agricultural product that has been sprayed with a pesticide and for which crop-pesticide combination no Maximum Residue Limits (MRLs) exist.[12] Environmental side-effects may occur both locally, in the soil of the farm, in nearby creeks and streams, regionally along coast lines, and globally from accumulation in biota from pole to pole. Acute health effects pose the greatest risk of occurring among the sprayers of pesticides, farmers and workers, and families and others who are close to the substances in the farming environment. Lower exposure may afflict both domestic consumers of agricultural products that have been sprayed and consumers in importing countries. And for persistent pesticides primarily, their presence in the general environment, in water, in organisms, can expose human beings via secondary sources.

Driving forces for the negative effects of pesticide use originate from the local to the global level. If the use of pesticides by itself is seen as the problem then the driving forces constitute the companies selling the products, the quality demands of northern consumers of blemish free products, the culture of pest control dependent on pesticides in national and local communities and the lack of alternative pest technologies. If it is the type of pesticides used that are seen as the problem both the companies who do not develop better pesticides, or governments who do not ban or refuse registration for the most toxic pesticides, would be part of the driving forces. If the mode of using pesticides is seen as the major problem, by its consequences of negative health and environmental effects, then the farmers' lack of education, the extension systems or companies inability to provide appropriate training or the farmers' unwillingness to follow label instructions or advice received in training, would be major driving forces.

Responses specifically addressing the negative health and environmental effects range; from farmers whose only measure to reduce the health symptoms he suffers is to drink milk after spraying, national extension systems and industry associations holding field days of training for farmers in safe use of pesticides, national NGOs and private organic product retailers giving courses in alternative pest control technologies and providing a market for products not sprayed by pesticides. Responses are also taken by a range of IGOs on everything from information dissemination on the toxic and ecotoxic characteristics of individual pesticides, setting of international trade standards of pesticide residues and promoting IPM as the new policy for pest management in the South.

This picture of a complex issue has been painted with the brush of perceptions, policies and decision-making processes by stakeholders across levels who have varying professions and socio-economic, cultural and institutional environments. By no means is the picture complete. Layers of interlocking driving forces could have been added, had one for example gone more into the private stakeholder, such as the multinational and the whole agricultural sector, more nuances of effects had been added by including stakeholder groups such as northern and southern consumers and those working with producing or reformulating the active ingredients

[12] Maximum Residue Limits represent the maximum concentrations of a pesticide residue (expressed as mg/kg) that the Codex Alimentarius Commission recommends be legally permitted in food commodities and animal feed (WHO, 1997).

of the pesticide products in factories. Additional risk reduction activities would perhaps have emerged had it been possible to dig deeper in the government agencies' regulations. The picture also shows a different resolution and representativeness at the various levels. At the local level interviews with many farmers, but they were also representing a much larger diversity of local realities. Local settings in the whole region defined as the South include a range of diverse crops cultivated, climates, ecosystems, cultural and socio-economic conditions. At the global level the diversity of work in IGOs addressing pesticides in one way or another allows only a scratching of the surface on what is done and why. However, I hope the picture relates enough about the multilevel complexity that pesticide use in the South exhibits and has given a backdrop for looking at the implications for multilayered governance of such an issue.

Multilayered governance of multilevel complexity

The above description of the multilevel complexity of the issue raises the question on the need for considering complexity in a multilevel or even multilayered system of governance. The turn has now come to look closer at some aspects the multilevel links in knowledge, institutions and values. There are mismatches in the knowledge flows for decision-making on pesticide risks, in institutions' mode of addressing the problems and in what goals or values are pursued, between stakeholders at various levels. I will discuss these mismatches in knowledge, institutions and values across levels. And with this as background I outline some strategies in policies and action to address such mismatches, based partly on the empirical data, that is which strategies are being used, but adding a theoretical layer of possible strategies in the analysis.

Mismatch in knowledge flows

For knowledge on pesticides the IGOs have largely assumed the role of assembling and evaluating toxic and ecotoxic data on pesticides and other chemicals within themselves. The inflow of information to these organisations primarily come from the national level (research/government agencies) or multinational companies, all located in the North (OECD countries).[13] Information is then processed through scientific peer review, to assemble the latest state of the art of science. In addition IGOs have a role in the encouragement of data collection around the globe, specially in developing countries. They provide the format for the data (in the case of acute intoxication of pesticides) and the priorities for it (in the case of monitoring of substances in food). The risk assessments are disseminated across the world and fed into global decision-making processes such as standard settings (for example MRLs) and Convention negotiations. But IGOs have few resources to substantially influence either the monitoring or the research that is made in the South. IGOs only collect the information and data that is available. They have no major influence on the data production itself, whether within Industry or the research community. Industry, the multinational companies manufacturing the active ingredients of pesticides, is practically the sole producer of primary data on toxic and ecotoxic characteristics of the substances and other parameters for the calculation of risks. A recurrent theme in IGOs was the lack of proper data describing the character and specifically the quantity of effects, both for human health and the environment in the South. Although most risk assessments and standards were primarily used in the South, the inflow of data for those assessments from those regions was largely absent.

At the national level in Kenya and Costa Rica, for the decision-making on which pesticides should be registered in the country or not the companies had to provide the agency with data on e.g. physical and chemical characteristics, toxic and ecotoxicological properties, data of the same type that OECD countries require. The companies had to generate, or pay for, studies of the product's efficacy in the country. In Costa Rica those local studies, apart from efficacy

[13] Some of these have territories in the sub-tropics.

data, also included data on residue levels. Although there was some collection of data on acute intoxications from pesticides by the government in both countries, with more solid statistics in Costa Rica, this data did not seem to feed into decision-making on pesticides in the registration agency. These agencies also put a strong emphasis on the information that they received from IGOs for example through the Prior Informed Consent procedure, with little or no comments on the need to adapt it to national circumstances.

The knowledge that came from outside their local environment in the form of pest management advice and pesticide technology was readily adapted by farmers in both countries. There were standard pest control packages, determined doses of pesticide applications and often recommendations of preventative calendar spraying on the coffee trees (against fungi). It seems that the process of knowledge and technology transfer, was from higher levels down, with little local adaptation, experimentation or reflection on pest control technologies. The two most vivid exceptions of from this adoption of knowledge from the extension system was first the farmer in Meru who made his own biopesticide. He claimed he had developed this himself. The other example was one of the organic farmers in Costa Rica. His source of knowledge was his own farm, books, and the Internet through which he has established links with other countries.[14]

In Meru there was virtually no awareness of the possibility for pesticides to cause environmental damage, damage to the coffee production or long term health effects. There was little or no knowledge on these issues reaching farmers and workers, or if it did, it was not made part of their associations to pesticides. In Naranjo more knowledge reached the farmers on side-effects of pesticides, for example through widely publicised cases of long term health effects in the media, and information on why lead arsenate had been forbidden. There was a parallel pattern in the sources and flows of information on risk reduction measures for farmers, in that label instructions and safe use projects came from national institutions such as the registration regulations, the agricultural extension system and the pesticide Industry.

Due to this heavy bias in knowledge production in the North, on both pest control technologies and their negative effects, developing countries in the southern hemisphere experience a negative bias in the level of uncertainty of the negative health and environmental effects from the use of pesticides. Ecotoxicological data is essential in chemical risk assessment. There is very limited research not only on ecotoxicological principles in the tropics, but also on ecological and environmental conditions in general as compared with non-tropical regions. By far most research in the relevant fields is done in the North.[15] There is a parallel in the situation of limited data on human exposure levels and intoxication data in the South.

Governance strategies for knowledge

Three broader strategies addressing the mismatch in knowledge flows with its bias in uncertainty towards situations in the South were identified. The first is to refrain from action when there is insufficient data, the second to consider the data generated in the North as valid for direct application in the South, and the third to find ways to take the heterogeneity in the natural and social systems of the South into account.

[14] It was his sons who had been able to buy a computer with money from picking coffee, and they were also learning English.

[15] There is very limited research not only on ecotoxicological principles in the tropics, but also on ecological and environmental conditions in general as compared with non-tropical regions. Only 0.09% of the 15 000 ecological publications published between 1979 and 1983 dealt with tropical environmental research (SCOPE, 1989).

No data, no action

One strategy to address the mismatch in knowledge flows is that when there is no data, nothing is done, the issue does not surface on agendas. Many of the potential issues of risks from pesticides use in the South do not turn up in policy. The empirical material indicate that one reason for this situation is the lack of data. IGOs build their legitimacy on hard facts and science and the way uncertainty is handled is by trying to avoid it. They do not make any MRLs, any risk assessments, and do not consider environmental effects in risk assessments if there is not sufficient data. In addition to a bias in uncertainty of the state of the environment and health, developing countries also have a weaker position due to less political and economic influence. The farmers have no, or very limited, knowledge of what effects pesticides may have, neither on their own coffee plants, their own health, their local environment and how much less so on the global environment. The strategy of no data, no action, is existing in a range of decision-making arenas but in view of the whole discussion on the precautionary principle in governance of environmental issues it should have fundamental flaws.

Harmonisation

An alternative strategy to address this mismatch in knowledge flows is to assume that data on e.g. health and environmental toxicity and exposure, which is used to calculate assessments of risk made in OECD countries or evaluated in the IGOs, can be directly applicable for use in countries of the South. This is a dominating approach in IGOs, in their work with making globally valid risk assessments and pesticide residue standards.[16] For example, the calculation of the MRLs have been built upon a standard exposure pattern for all countries, based on standard diets and agricultural practices. At the national level in registration decisions, knowledge from Industry or IGOs were used assuming the data was valid for the risk situation in the country.[17] The pesticide Industry and national agricultural extension systems promoted standardised pest control packages, also at times with the epithet IPM, to farmers with label instructions to be applied equally in every local situation in each country.

This strategy assumes that knowledge generated largely elsewhere, is valid to transfer to the situations in the South. There is a scientific position to claim the scientific way of interpreting an issue as the correct and only interpretation. The claim is that science can present the single definition of for example a global environmental problem (Yearley, 1996). But such universality claims of science are in the pesticide case complicated by the spatial complexity and diversity of local natural and social systems. In three aspects risks in (sub)-tropical areas from pesticides can differ in quantity and quality from the northern latitudes. Firstly, there are unique ecosystems and species of both ecological and economical importance in the South. The natural ecosystems of the (sub)-tropics harbour a vast majority of our planet's diversity in ecosystems like rain forests, freshwater bodies, mangroves, sea grass beds and coral reefs, all systems that are exclusively found in this part of the world. In addition, there is a range of managed systems (agricultural, silvicultural and aquacultural) equally unique for the (sub)-tropics. Secondly, the effects of pesticides can alter with temperature and humidity. Thirdly, the pattern of exposure to pesticides can be quite different due to specific physical-chemical changes of the substances which influences their character and mobility (SCOPE, 1989). But the most important factors that differ from temperate countries that affect how pesticides are handled and applied, in which doses, the timing of spraying under which weather conditions, with which protective garments they are applied, thus affecting exposure, are connected to

[16] International organizations have as a major focus the benefits that will come from global harmonisation of risk assessments so that limited resources could be used to evaluate a larger number of chemicals.

[17] The exception was the transfer or results from the efficacy of pesticides on target pests where both Kenya and Costa Rica demanded local efficacy tests, from one to several growing seasons.

socio-economic and cultural factors, to the extent and enforcement of legislation, to the level of education, etc., see for example (Health Council of the Netherlands, 1992).

When for example IGOs apply this strategy in risk assessment for health and environmental effects in the South they tend to take for granted a reality which is not always in correspondence with actual reality. The key link between the ideal world of appropriate use and the actual use, is crystallised in the "pesticide label", the label that should be found at each sold pesticide container and which should outline the dose to be applied, the mode of use, the necessary precautions that needs to be taken etc. The case studies at local level documented that handling and spraying is far from living up to the instructions on the label. Specially protective clothes are rarely used and the local districts, Meru and Naranjo where the study was carried out were yet areas where substantial awareness raising on the safe use of pesticides had been made and where a large percentage of the sprayers were literate. Many other studies confirm that the assumption of correct use by those who apply the pesticides are seldom valid in the South. The exposure models used in e.g. the calculation of the MRLs are based on the assumption that pesticides are used according to instructions that should be found on the label. This is the general case in risk assessments, calculating on what reality ought to be, failing to adequately consider social realities:

> "Whilst science attempts to describe the natural world it must also make social assumptions about our interaction with that world; how will a pesticide actually be put to use?" (Irwin, 1995:59).

A consequence of such a strategy of harmonisation in the application of data in e.g. risk assessments and standard setting is that the specificity of scientific knowledge can be lost for the sake of making issues more 'manageable' for the institutions to handle. All environments are regulated "as if they were similar in structure"(McGinnis and Ostrom, 1996:474). The average country gets an average risk assessment, only that the average is rather northerly biased. The average farmer gets a standardised pest control and safety instructions package, only that the protective clothes are rather inappropriate for the tropics. This may lead to neglecting those potential victims of negative effects of pesticide use who are most vulnerable, both humans and ecosystems.

Taking heterogeneity into account

Another strategy to address the mismatch in knowledge flows is to find ways of taking heterogeneity in both natural and social systems into account. Some of the potential flaws in translating data on toxicity, ecotoxicity and exposure for pesticides from the North to the South were outlined in the previous section. The need for more knowledge on ecotoxicology in non-temperate regions of the world has been stated repeatedly at various international fora (FAO, 1990; OECD, 1993; IFCS, 1995; IPCS/OECD, 1995). An expert consultation that IPCS organised together with OECD in 1995, raised a number of issues for the possibility of harmonisation of risk assessment and choosing priority chemicals:

> "...The consultation recognized that many of the data relating to ecotoxicity have been obtained using species found in the temperate regions of the world, it was noted that the potential risk in other geographic regions may need to be further assessed...risk assessment involves consideration of exposure potential which is usually dependent on local conditions and situations. For this reason, international assessment of the degree of risk posed by a chemical is rarely feasible"(IPCS/OECD, 1995).

Concern has thus been raised as to the appropriateness of these risk assessments for policy-making in developing countries in the (sub)-tropics. To be able to provide global assessments that are relevant for diverse situations in developing countries there has to be an awareness of the limits of harmonisation and tools and capacity to adapt them to national and local climatic, ecological and socio-economic circumstances. This has proved difficult in practice both at global and national level and Young raises this as a general issue for environmental problems:

> "Unitary states have the competence to take decisive action regarding environmental concerns. But they often exhibit little sensitivity to subnational or local variations in environmental conditions, and they have little ability to benefit from experiments relating to human/environment relations initiated by lower levels of government enjoying sufficient autonomy to act on their own in this realm" (Young, 1999:32).

At a global expert consultation on MRLs it was agreed that diets that are used in the calculation of MRLs need to be regionally modified, and that there were factors that may influence variations in risk assessment such as vulnerability due to age, sex, genetic constitution etc. (WHO/FAO, 1997). Global assessments were seen to be useful for those who did not have national ones, but otherwise they were unsuitable for use at national level.

A part of the strategy to take diverse realities into account is to try to learn more about these realities by working for the generation of the data that is lacking.[18] An example of this is the International Programme on Chemical Safety (IPCS) project to get more accurate estimations of pesticide intoxications in countries of the South. And another example is the Global Environment Monitoring System (GEMS) monitoring program of pesticide residues in food. However, the data generation in these cases is dependent upon the national research infrastructures, human resources and will to take part in the generation of monitoring data. Guidelines on national registration of pesticides from the FAO stress the importance of developing countries demanding local tests of efficacy of those pesticides that companies want to market in their country. And in Kenya and Costa Rica the pesticide companies are forced to carry out such tests.

As a significant obstacle for the generation of more locally specific data is the lack of human and financial resources to carry out both the generation and evaluation of such data. Sharing the methods of producing knowledge, the pivot around which science circles, down to the farmer himself could radically improve the situation. This approach is not just about upholding the value of local knowledge, but empowering the farmers to validate this information her/himself with the tools of the scientific method. That it is possible has been shown by the development in Farmer Field School IPM projects in South East Asia, where farmers ask their own questions, make experiments to find the answers and then implement their findings and share them with their community:

> "...the researchers do work that is to be generally applicable. Use this variety with this fertiliser, in all areas. Use this corn all over Africa. It is built to make globally applicable results. Farmers' knowledge is local, is more historical, may be better sensitive to day to day changes. He does not have to have a global applicability. A farmer armed with the concept of trophic levels, etc. can share that with others and will initiate more and more and better and better science." Global IPM Facility official 2.[19]

The approach of encouraging local knowledge production in these projects include producing knowledge both on the reasons for pest attacks, pest control technologies and the type and magnitude of negative side-effects of pesticides use (FAO, 1998). For local CPRs the creation of indigenous capacity to both performing research and designing institutions as those resources exist in particular physical and institutional contexts has been stressed (Feeny, Berkes et al., 1990).

If a strategy of addressing the mismatches in knowledge flows should be addressed by more local knowledge production, the next necessary step is to provide a flow of this local knowledge to reach in decision-making processes at higher governance levels. This would entail making local knowledge scientifically legitimised. In the IPM projects in Asia this has been no easy task. An official of the Global IPM Facility made the following remark:

[18] An alternative or complementing alternative would be to apply the precautionary approach to a larger degree .
[19] Interview 21/7/98.

> "If you talk about science that farmers are doing versus science done in research centres, the farmers have mostly no connection with policy but the scientist has a great role. This is one of the tremendous contradictions in policy. Anyone with a Ph.D. has much more power than farmers in the field. There is a lot of research going on but mostly scientists are so focused on the top... We are often bewildered that science in the CGIAR system have a voice in policy making in developing countries. Their opinion weighs more than their own extension organisation. It seems incredible to me. The approach I think we follow in IPM is based on farmers' ability to interpret science. One of the precepts is the farmers' studies in the field, that taken to policy makers, not by potential results but with concrete research results." Global IPM Facility official 1.[20]

The scientific knowledge produced by researchers, which they are always striving to be as widely applicable as possible, are by policymakers seen as superior to the more locally specific, and historically based knowledge produced by each farmer.

Mismatch in institutions

Usually, when one discusses a mismatch in institutions for environmental issues and specifically CPRs, one refers to the mismatch between geographical scope of the environmental problem and the institutions addressing it, see for example (Oakerson, 1992:55). Mismatches in this dimension exist for pesticide use in the South for example in that the effects of pesticide use that are global (from the persistent pesticides) have still primarily been addressed nationally by banning their use in agriculture years before they entered the global agenda. Local health effects are not addressed much by institutions at local level, but very consciously so by institutions at national and global level.

There can also be another type of mismatch, that between institutions addressing the problem and the driving forces for them. Analysing this mismatch depends on which driving forces are in focus. The multinational companies and their economic interests are by many seen as the major driving force behind the side-effects from pesticide use, their production and marketing strategies, their lack of product stewardship etc. The efforts to restrict their activities by creating institutions at global level are very limited. There is only a voluntary code of conduct for everyone involved with pesticide use and this the Global Crop Protection Federation (GCPF) have accepted to adhere to (FAO, 1990). Farmers and their way of handling and applying pesticides are also seen by many as the essential reason for the negative side-effects. There are institutions created at national and global level to address the behaviour of farmers and workers. The International Code of Conduct on the Distibution and Use of Pesticides assigns responsibility to farmers to follow the instructions on use, the national law in Kenya forbade farmers to use pesticides against label instructions, and there were training programs in place to educate the farmers. Yet, these institutions have little record of success in being implemented and enforced at local level even in Kenya and Costa Rica which are much forward in this respect compared to other developing countries.

Governance strategies for institutions

In cases of mismatches between effects and institutions, it is usual to call for more appropriate governance-environment matches, for example to call for more global governance of global environmental problems, or for catchment based management for regional water issues. The underlying rational is that institutions' effectiveness:

> "is a function of the match between the characteristics of the biogeophysical systems with which they interact"(Young, 1999:45).

For mismatches between driving forces and institutions similar calls for stronger governance at the level where driving forces originate could be made. Irrespective of which mismatches

[20] Interview 22/7/98.

are in focus, that of effects or of driving forces, since both of these exist at multiple levels the need for multilayered governance is obvious:

> "it is apparent that institutional innovations must address behaviour at a number of distinct levels to succeed in solving environmental problems"(Young, 1999:34).

The question is then, in order to address these mismatches, by which principle/s could institutions be assigned to a particular level of governance, global, national or local?

Matching effects and institutions

One guiding principle for creating institutions for governance at a specific level is the extent of the effects, or suffering. This is the usual rationale for talking about fit between environmental problems and governing institutions in the case of natural resource management between the physical, biological and technical attributes of a resource and institutional rules (McGinnis and Ostrom, 1996:465). Those who suffer should have the strongest incentives to address the situation and be motivated to initiate mitigating policies. The globsl extent of the effects is given as the reason for making the use of certain persistent pesticides subject to negotiations for a global Convention. However, in the case of pesticides the potential worst scenario victims of acute health effects may be largely ignorant about the effects on their own bodies and their surrounding environment. This puts them in a position where they have no, or very little, knowledge of such risks for themselves or others, for their own environment or for the environment of others to take into account in their decision-making. Decision-makers at the level of suffering must know of the effects to be able to see it as their priority to address them. If they do not, governance is needed at other levels where such knowledge exist, and one type of action taken at those levels could be the dissemination of knowledge of the effects to the other levels. But even if the stakeholders at the local or global level would be aware of the extent of health and environmental risks, there may be constraining factors that prevent them from initiating risk reduction. They could face institutions created at the same or other levels that constrain their freedom of choice in decision-making, such as the obligation put on farmers in Meru to spray their coffee or be barred from delivering their coffee harvest to the co-operative. Other priorities could be stronger than consideration of long term health effects, such as the income security for the farmer.

Matching driving forces and institutions

If institutions or actions at one level are the driving forces for effects at other levels it would be less productive to create institutions at levels where driving forces do not originate. The second criteria for assigning governance to a particular level would then be culpability. Those behind the problem should be governed:

> “A governance system that channels behaviour in such a way as to eliminate or substantially to ameliorate the problem that led to its creation is an effective system”(Young, 1992:256).

Those who see farmers’ lack of proper application methods as the driving force would direct risk reduction efforts at changing their behaviour. Those who see companies’ aggressive marketing of pesticides as a driving force would envision stronger governance at national or global level. But as it was discussed in the section on a common understanding of the problem *who* or *what* is seen as the driving force for the problem reflect varying value judgements of who should be responsible. Driving forces exist in layers with indirect and more direct driving forces interlocked, from the R&D efforts of multinational companies on pesticides to farmers’ neglect of adhering to label instructions for spraying. Whatever governance is made at higher levels that does not influence the farmers’ decisions on reducing the risks from their pest management strategies, is of no avail to either the health of the farmers and workers themselves, consumers in national and international markets or the local and global environment. For a range of issue areas effective policies necessitate “that local management

regimes be embedded in larger supportive regimes" (Princen, 1998:410). For the global level specifically Princen argues that increasingly:

> "...actors associated with international regimes have recognized that if the regime cannot reach down to the local level, to the level of primary resource extraction, it can not effectively pursue long-term goals"(Princen, 1998:410).

Whatever indirect driving forces are behind, it is the farmers' use of pesticides that directly influence the type and magnitude of side-effects. But even if there is a clear need for proper institutions at local level to address the risks to create effective governance, it does not automatically follow that such institutions fulfil the criteria of equity and sustainability (Young, 1992:257).

Matching capacity and institutions

A third criteria for establishing institutions at a particular level would be that individuals or organisations at a particular level have capacity and resources to create and enforce institutions when it is realised that this capacity is more limited at other levels. If there is no capacity to act, there is not much that can be done in governance:

> "Socially, one cannot be responsible for something if one cannot respond to the relevant problems"(Princen, 1998:401).

Developing countries had generally very limited capacity to address the risks from pesticide use themselves, they depend on information and resources from other sources, whether multilateral aid, bilateral aid or civil society. Farmers had limited capacity to address risks, for lack of awareness and constraining institutions. The governance level that has the capacity to act may not necessarily be responsible for the problems, may not have contributed to them, but would according to this criteria have to take on responsibility because are morally obliged. Such considerations will be more explored in the sections on values below.

Mismatching values

The mismatching values are reflected in the varying problem structuring, strategies for risk reduction and criteria in decision-making on pesticides. At global level the multinational companies have their economic interests and multilateral negotiations have an agenda which is much influenced by northern countries with the examples of the POPs Convention, while aid activities of IGOs include efforts to address acute health risks in the South. Short term health risks for farmers and workers in the South were present on agendas at national and local levels. Long term health effects appear primarily in the trade context with concern for the consumers of importing countries. The environment in countries of the South was largely absent except on the agendas of a few international and national NGOs and individual organic farmers in Costa Rica. Farmers' economic priorities of securing his crop from pest attacks has largely disappeared from the agenda of IGOs. Pesticides are seldom part of aid packages to developing countries from IGOs any longer, due to the pressure of international NGOs based on their health and environmental concerns. However, the IPM projects have this as a major element, that the farmer should chose the most profitable method of pest control, which does not necessarily mean pesticide applications. Farmers and agricultural workers on their hand were driven by short term economic priorities and the family's survival, rarely raising any issues of side-effects from pesticide use for people or environments in other countries.

There was an absence of consideration for others as reflected in that for example a farmer hired a worker to spray because it made him/her feel uncomfortable or sick, and he/she did not consider providing protection for that worker. A similar absence of consideration was shown by companies exporting chemicals that were banned in the country of origin, or selling pesticides without supplying protective equipment, and while knowing they would cause problems under the conditions they would be used in the South. There was an absence of

consideration of interests of stakeholders at other levels. There was an absence of consideration for the local and global environment among most stakeholders.

The reasons for these mismatches in goals and priorities between levels may include other factors than just varying value bases, differing interests. It may reflect absence of knowledge of the negative effects suffered at other levels and among other stakeholder groups. In risk reduction activities organisations and individuals may be limited by institutional structures to initiate policies aiming at reducing risks for other groups. This situation in itself, as outlined above in mismatches in knowledge flows and institutions across levels, should therefore also fall back on priorities of those who set the agenda for knowledge production and institution creation.

Values for governance

The dominating values surrounding pesticide use in the South were based on particular or limited interest rather than common, collective interests. Based on the previous two sections on knowledge and institutions, it can be assumed that there are clear needs for more collective governance efforts across levels to address mismatches in knowledge and institutions including the global, national and local level. With no world government to enforce such co-operation from above, the remaining option for achieving more co-operative and collective, what I call multilayered governance is to approach the issue as being of common interest, a global common issue.

Enlightened self-interest

The first strategy to make pesticide use in the South a common issue for all states and all human beings is to give everyone a personal interest in the issue. If the assumption that everyone needs a private interest for contributing to collective success (Wade, 1992) is accepted, and thus self-interest is a predominant factor guiding peoples' decision-making, to create collective action on a global common issue, it would be necessary to make each person (and organisation) at every level see his or her interest in the endeavour. This is not easy to do for the issue of pesticide use in the South. Even if the consequences of one category of pesticides, those called POPs, have been called global due to their transportation across the oceans and atmosphere, it does not make every farmer, consumer or citizen in every country, suffer the negative effects equally. And neither do the more acute health effects of many of the remaining categories of pesticides equally afflict farmers and workers. They clearly experience different types and degrees of health effects from pesticides. Implicit in the notion of a 'global' environmental problem lies the assumption that everyone needs to worry about it, since everyone can suffer from the environmental change etc. (Saurin, 1996:96). But it is not a clear cut case as Yearley stresses, suffering is never equally distributed:

> "However, the status of 'global' problems is far from straight-forward. Being global, one might suspect that everyone should worry about them equally. But, in fact, global problems turn out to have different impacts and implications, depending on geographical and socioeconomic factors. Even the most inherently global hazards such as 'global warming' turn out to have differential impacts. Because of climate, altitude and other geographical factors, their impacts will be greater in some areas than in others" (Yearley, 1996:86).

If suffering as it is perceived today is not equally distributed another possibility, while still depending on the need for each actor to be motivated by self-interest to initiate risk reduction, is to raise the level of knowledge of the complexities around the negative effects of pesticide use and unveil possible interdependencies and reciprocities within both natural and social systems. This would imply that the coffee farmer recognised that his spraying and handling of pesticides may influence the health of himself and his family. It could also involve that the consumer buying coffee in the northern coffee market recognises that he/she influence his/her own exposure to pesticides in the food bought and possibly even the general environment by his/her purchasing choices. It could also be related to more subtle interdependencies,

connecting a precautionary approach to the linkages between effects from pesticide use on organisms and ecosystems and effects on your own, your region or your country's environment and the health of its citizens. This would imply realising that the question "whose problem is pesticide use in the South" should be answered by "my problem", and action would be based on enlightened self-interest:

> "Just as planetary interdependence at the political and economic level establishes a moral foundation for our duty to help those in underdeveloped nations, so also our ecological interdependence establishes a prudential basis for our obligation to help ourselves by helping them "(Shrader-Frechette, 1991:184).

> "...individuals, private organizations and individual nation-state governments find themselves increasingly in the position where the actions from which they themselves benefit are also those which serve the greater global good " (Brenton, 1994:269).

As Brown asserts, the traditional view that one nation's interest is always in conflict with other nations, is loosing relevancy and she concludes that "environmental protection is not a zero-sum game"(Brown Weiss, 1992:14). There is no way that such disparate effects on individuals and environments scattered around the globe that pesticide use in the South cause, could be seen as threatening a 'commons' if one does not apply a systems view of both the environmental and social systems as posing organic wholes. Victims are scattered, may not be aware of the risks they are exposed to and even if so, the risks may subside as insignificant either in relation to the benefits gained from pesticide use or the severity of other problems that individuals and countries face for their very survival and development.[21]

Expanding loyalty

The second strategy to make it the interest of all states, and all human beings, to be concerned with the both the health of the environment and people in other countries who are afflicted from the effects of pesticide use, or other activities that pose risks to them, would be to extend the borders of our loyalty to encompass humanity at large. This would mean to open up for other motivations for human action than pure self-interest, see e.g (Mansbridge, 1990). It would mean to internalise the consideration for the plight of others whether they are workers and consumers in your community or in the other end of the world, whatever their citizenship. And this would specially be applicable when your own action, whether referring to an individual or an organisation, negatively affects others. The old general principle of law "use your own property so as not to injure the property of another" is manifested in the responsibility for international environmental damage (Orrego Vicuña, 1992:132). Actors who do not free-ride in CPR regimes do it not only from self-interest but also "because they feel morally committed"(McCay and Jentoft, 1998:23).

The largest leap in such expansion of loyalty in today's world seems to be to extend it to citizens of other countries. This would imply to show them the same considerations we would show for citizens of our own country:

> "Admittedly, fellow countrymen have prior claim to our loyalties, in large part because of an explicit social contract we share with them, But just because they have prior claims, they do not necessarily have exclusive claims to our loyalties. " (Shrader-Frechette, 1991:160).

Yet this is the leap which is becoming essential as the global level depends more on informal governance and voluntary action than hard law in the case of pesticide use in the South and many other global environmental issues. At national level the state may, at least in theory, be able to enforce action to secure the interests of a variety of groups with conflicting interests,

[21] No discussion is made here on the benefits of pesticide use for each of the categories of stakeholders. Those who stand to loose the most in terms of exposure etc. also believe they gain a lot from using them, it is seen as a necessity in their farming system.

but in the South the states are very weak and can seldom live up to this on pesticides, even if they have a legislation in place.

A parallel discussion on the expansion of loyalty to extend citizens of all countries is the one on human rights. In both the area of human rights protection and environmental protection there is "the gradual erosion of so-called domestic jurisdiction"(Trindade, 1992:245). Human rights are usually not expressed in the terms of self-interest. It has been discussed on the basis of a concern that encompasses the plight of others, also those living in other states, demands for human rights have been taking precedence over claims to national sovereignty(UNRISD, 1995:169). A way to express such an expanding loyalty is to talk in terms of citizenship at the global level. This concept of global citizenship was for example elaborated by the United Nations Research Institute for Social Development in its report to the World Conference on Social Development in 1995 (UNRISD, 1995). To establish the notion of global citizenship with its connotations of some degree of both rights and responsibilities would be an approach to establish that sense of community that at local level is considered essential for the management of common resources:

> "...argue that a group's capacity to solve collective-action problems endogenously or, in other words, in the absence of an external public authority able and willing to impose rules on group members, is a function of the presence of community. But what exactly is a community in this sense, and can this argument about the importance of community at the micro-level be generalized to apply to meso-scale and macro-scale settings?" (Young, 1999:58).

In discussions of CPR management the issue of trust and loyalty to jointly agreed upon rules are prevalent (Ostrom, 1992; McCay and Jentoft, 1998), and McCay argues that "the tragedies of misuse and abuse of common resources might well be the result of 'community failure'"(McCay and Jentoft, 1998:24). If the UN bureaucrat recognised that he is part of the same community as the local farmer in the Kenyan or Costa Rican highlands then "whose problem is pesticide use in the South" is turned into "our problem" irrespective of who we are. This change in perspective may be one approach to address this issue. It would mean to internalise the concern for others, making their health and environmental problems from pesticide use your own problem. Thus, the European and American consumers extend their concern to the health of those farmers, and their families, who produces the food products they buy. Governments of the North extend their concern from their own farmlands, farmers and consumers to those of the South by for example banning the export of those pesticides that are known to produce severe effects under conditions of use in southern countries. And it would mean that farmers in the South avoid to use certain types of persistent pesticides just because they are harmful to people and organisms in the other end of the world.

Those based in the tradition of realism in international relations where the principle of national sovereignty is still seen as the only fundamental one for the interaction among states, will shatter both these strategies of supporting multilayered governance based on enlightened self-interest expanding loyalty as will those that agree with Hardin (1968), who in his classical article discarded it as a completely mistaken approach to appeal to people's conscience for action towards the collective good. And yet, in international instruments on environmental protection there:

> "seems to be occurring lately an evolution from the notion of common heritage of mankind (as emerged in the contexts of the law of the sea and space law) to that of common concern of mankind."(Trindade, 1992)

Strategies for multilayered governance

The multilevel nature of driving forces for the problems from the use of pesticides in the South and thus the inability to assign culpability to any one actor at one level, the range of possible victims to the negative side-effects, and the disparate response efforts to reduce risks,

clearly establish the need for creating institutions for governance at several levels. The complexity of the issue requires complexity in governance:

> "...if the complexity is the nature of the systems we have an interest in governing (regulating), it is essential to think seriously about the complexity in the governance systems proposed" (Ostrom, 1995:34).

Such complexity in governance needs to be co-ordinated across governance levels into a system of nested institutions, creating a system of multilayered governance. In discussing economic issues Hirst and Thompson raises the need for a similar system in that issue area:

> "A world composed of diverse political forces, governing agencies, and organizations at both international and national levels will need an interlocking network of public powers that regulate and guide action in a relatively consistent way, providing minimum standards of conduct and relief from harms..." (Hirst and Thompson, 1996:198).

When striving towards such multilayered governance there are choices to be made whether one should strive towards harmonisation or heterogeneity along the dimensions discussed in this paper; knowledge, institutions and values.

Based on the results of the study on pesticide use in the South I argue that there is a value in harmonisation of knowledge in certain aspects. But even more there is a value in the level specific adaptation and local knowledge production to make decision-makers able to adjust their response strategies. There need not be anything negative or unproductive in the striving towards global knowledge, in the role of IGOs to assemble the edge of the research frontiers and make their most in spreading this knowledge. It is the fundamental inequalities in the capacity of countries to contribute to this global knowledge, from the diverse situations they experience, that pose as a problem. An approach to address this situation is the involvement of the grassroots in the production of knowledge which is relevant for their decision-making, and that could be relevant for decision-making at higher governance levels. This method also relates to the participatory approach of development. Although knowledge needs to better reflect the heterogeneous natural and social world, stakeholders on all levels require a more harmonised and common understanding of the broad dimensions of the problems from pesticide use for various stakeholder groups.

I argue that it is essential that institutions for risk reduction are assigned those levels where decisive decisions are made on driving forces. In view of this there is a need for heterogeneity in institutions adapted to the particular level and context:

> "devising uniform rules to cover the globe may have exactly the opposite effect than intended. Following such a rule in some locations may produce harmful rather than beneficial effects"(McGinnis and Ostrom, 1996:474).

But there is also need for more harmonisation in what driving forces they are addressing, whether it is the use, the type or the mode risk factor. There is the need for more institutions for governance of the negative effects of pesticide use in place at both global, national and local levels, but with emphasis on the global and local levels where the decisive governance decisions on driving forces and risk reduction *de facto* are taken:

> "Sustainable global regimes must make sense at all levels of aggregation: local, regional, national, transnational and global"(McGinnis and Ostrom, 1996:476).

The major challenge of harmonisation is, however, in objectives of policies across levels, the value base for action on pesticides. The debate on pesticides in the North started in the 1960s framed in primarily environmental terms and this is still high on the agenda. In the South the environment has been largely invisible in pesticide policies. Instead the health concerns, for sprayers and consumers, take precedence. When attempting to solve environmental problems they are often not solved but displaced to other areas or other time scales (Wapner, 1997). When the long term risks on health and environment from the use of persistent pesticides was

addressed in developing countries by banning these substances, as had northern countries before them, the problem of acute intoxications among the agricultural population increased due to the switching to other types of pesticides. This should underline the difficulty in disentangling health and environmental effects from each other:

> "Environmental degradation is not simply about how people treat nature but includes, in almost every instance, how they treat each other" (Wapner, 1997:213).

Harmonisation in objectives would entail that stakeholders across levels either realise that actions for the common good will be most beneficial for themselves in the long run, or that all would consider the common good the end in itself. If stakeholders across levels can not add this wider context of their actions, the 'tyranny of small decisions' pose a significant obstacle for governance as Hägerstrand points out:

> "Values must be put into local action, in agreement with the greater reality which has to be affected. In this context, 'the tyranny of small decisions' poses a fundamental problem. Every individual who acts, only immediately sees and feels the dynamic local situation in which he or she is acting. All the rest – the regional, national and global situations – remains abstract. The larger perspective is contingent on knowledge collected and organized by others. And the bodies which promulgate rules and norms are also dependent on this knowledge." (Hägerstrand, 1992:20).

It may seem utopian to analyse the possibilities for multilayered governance from the global to the local level, specially for an issue such as this which in comparison to the major global commons and global environmental change issues shrink in perceived urgency. As the degree of common understanding on both the problems, its causes and solutions was limited across stakeholder groups and governance levels, this will be the first issue to address. A process to reach more common understanding and developing strategies of co-ordination is significantly more difficult and costly for large-scale common pool problems than for local CPRs (Ostrom, 1992). Pesticide use as a global common issue definitely belong to the large-scale category. Nevertheless, the issue is likely to be more representative of a series of issues increasingly interlocked in local-global linkages that affect not only the environment but the lives and health of many people. Problems of global change may press on for new levels of multilayered governance but problems that are less conspicuous, and often those affecting to a larger extent the South, loom in the background and could equally well favour the discussion on global and local governance as well as multilayered governance:

> "...it seems that global change encourages the present trend of the international system to behave like a real system, i.e., a more and more intricate web of dynamic relations. As a consequence, the approach must also be a global one, envisaging the international community as a whole and considering the different functions inside it according to its needs and aims – and no longer according to the interests of individual states"(Kiss, 1992:239).

In conclusion, I argue that there is a need for a more unified understanding of *who* is suffering, *who* is behind the driving forces and *who* in the institutional complex at various levels has the power, capacity and responsibility, to initiate risk reduction. There is a need for the local actor to be aware and consider the global context, as well as for the global actors to be aware of and consider the multiple local contexts in their decision-making. This last point as well as the whole theoretical approach has as its underlying assumption that the issue is framed as a global one, ethically and practically.

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