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Risks Related to the use of Chemical Inputs for Crop Production in Nkong-Ni and Penka-Michel, West Cameroon

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Abstract**—** *This study aims at analysing the risks management of chemical inputs' use in crops production in the Nkong-Ni and Penka-Michel subdivisions. It aims at analysing the measures taken by the farmers to prevent possible threats caused by chemical inputs such as fertilisers, weed killers, insecticides, fungicides and nematodes in both subdivisions; precisely in Northern Bafou and Balessing. For this purpose, we identified the different chemical inputs used in market gardening, their impact on farmers' well-being, and their risks. We analysed risks considering actors and policies oriented to limit these risks. Our study sample consists of 239 market gardeners. One hundred and thirty-nine producers received questionnaires: eighty-nine (89) in Ndzieh (Northern Bafou, in the Nkong-Ni subdivision), fifty (50) in Balessing (Penka-Michel), one hundred (100) producers for semi-structured interviews, sixty (60) in Ndzieh and forty (40) in Balessing. The findings show that 67.59% of producers do not comply with inputs prescribed doses. Indeed, they confirm that the use of chemical inputs improves yields, even if it causes some discomfort. Regarding support, relative to chemical inputs use, offered to producers in their agricultural activities, just few of them attended seminars and training, or approach extension agents. As recommended, producers should organize themselves into associations or cooperatives. So, they could benefit from government contributions and actions to raise awareness about environmental safeguarding.*

Keywords**— *agriculture, management, risk, market gardening, exploitation, chemical input, rural areas, harvest.***

I. INTRODUCTION

Since the 1990s, coffee, land, and economic crises caused in West Cameroon Highlands, some upheavals which affect material basis, operating modes, and local societies' values. This large-scale crisis's complexity involves social and agricultural innovations which escape old logic. Therefore farmers exploit lands in mountain areas like Bamboutos Mountains (fertile and very high in organic substances), practising subsistence farming and market gardening (Célestin KAFFO, 2005).

Vegetable crops are exposed to many pests and diseases. Several means against these bio-aggressors are used. Chemical control remains the most used method, given its easy implementation. It involves soil treatment and products with chemicals. If these products are often necessary for producers to achieve their production objectives, it is important to keep in mind that they are toxic. Then, they should only be allowed or encouraged in some conditions: perfectly master usage methods as well as risks for human health and natural environment (DeVillers et al., 2005). The use of chemical inputs is influenced by various contexts. Larousse defines context as a set of circumstances surrounding an event.

Agriculture is the largest sector of economy in the world. Very diverse, it includes cultures such as vegetable crops, food crops and cash crops. Our study is about vegetable crops. It is carried out in Nkong-Ni and Penka-Michel subdivisions, Menoua Division, in West Region of Cameroon, areas where market gardening is a main activity. However, during production, crops are subjected to several treatments by means of chemical inputs such as fertilisers (fertilisers and soil improvers), phytosanitary products. It should be noted that chemical inputs on crops have become indispensable for a profitable and good quality (concerning the size) production. A question to be asked: which measures are taken to reduce the risks of these chemical products?

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Population growth generated food demand increase, which can only be met by intensifying agricultural activity (Milleville and Serpantié, 1994). Population growth does not always mean an increase in arable lands. Consequently, agriculture intensification generates pressure on ecosystems, which in turn decrease soil fertility (Laurence, 1998). Given that soil is not inexhaustible, it's necessary to consider management methods that enable rational and sustainable land exploitation (Manlay, 2000). This sustainable management of soil suggests that extraction should be compensated by inputs, so as to maintain the dynamic balance.

This study intends to contribute to agricultural development, more particularly to the improvement the in the management of agricultural risks. Agriculture, the peasants' main source of incomes, holds an important place in Cameroon (a largely agricultural country) development. The multiplicity of synthetic chemical inputs, aiming at improving agricultural yield, increases number of farmers involved in agricultural production. Therefore, there is an issue of chemical inputs misuse by farmers, which might be harmful for producers, consumers and environment. How do producers manage these risks related to agricultural activity? This opportune survey investigates the strategies that should be adopted by farmers to manage risks related to agricultural activity. Inputs may be very important to boost agricultural production. But they can also be a treath for populations and environment. This study is important to solve food safety, producers and consumers' health, environmental degradation issues, through an integrated management of agricultural risks by farmers. This involves the following objectives: identify chemical inputs used in market gardening, assess inputs' impact on farmers' well-being, examine risks related to these inputs, analyse how actors consider these risks, analyse the policies intended to limit these risks.

II. METHODOLOGY

To carry out this research we used two (02) data collection methods: the qualitative and the quantitative ones. Indeed, qualitative research places the author both at the origin and at the centre of the research. Therefore, for Muchielli (1996, p.11), a qualitative research gives the greatest place to the researcher. Qualitative approach has enabled a multilevel analysis of agricultural risks management and foundations that structure it.

As for quantitative approaches (like surveys), it stresses on the number of respondents and the possibility of generalising and extending the findings to wider populations. The main quantitative method tool is the questionnaire.

Sampling Method

For this research, the sampling method used is a reasoned sampling for market gardeners. Because the possible respondents are persons known as involved in vegetable production, this was possible thanks to the guides met in our study area.

The Study Sample

Our study sample consists of 239 market gardeners:

- One hundred and thirty-nine (139) of which received questionnaires: they include eighty-nine (89) in Ndzieh (Northern Bafou) in the Nkong-Ni subdivision and fifty (50) in Balessing, in Penka-Michel subdivision).
- One hundred (100) producers in a semi-structured interview [sixty (60) in Ndzieh and forty (40) in Balessing].

Data collection tools

- **Interview guide**
- **Questionnaire**

Data analysis tools

Prior to analysing data, we transcribed data collected in the field during interviews, given that data recording could not be carried out only manually, we used a phone device to vocally record data.

Data Transcription

Transcription is the written format of data vocally recorded. It is preceded by a header with the respondent's name, date and place of the interview. The transcription was entirely done, given that, if summarised, some details might be dropped. At the end of each interview transcription were added any comments written in the notebook, during the interview. That data were manually processed, assigning codes to each category of answers, useful for this research.

Data Analysis

For the analysis of quantitative collected data, we used SPSS (Statistical Package for Social Science, version 20.0) software. This analysis tool helps us to obtain diagrams and tables showing variations observed.

Data collection on the field was followed by a transcription of interviews, observation and other notes, in order to create a database. The interpretation of this data was done through an analysis method, namely the content analysis which can be described as a set of text analysis

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developed to deal with non-quantifiable answers. It is also an analysis of the meaning, a way or a system of perceptions, representations of things and facts.

III. FINDINGS

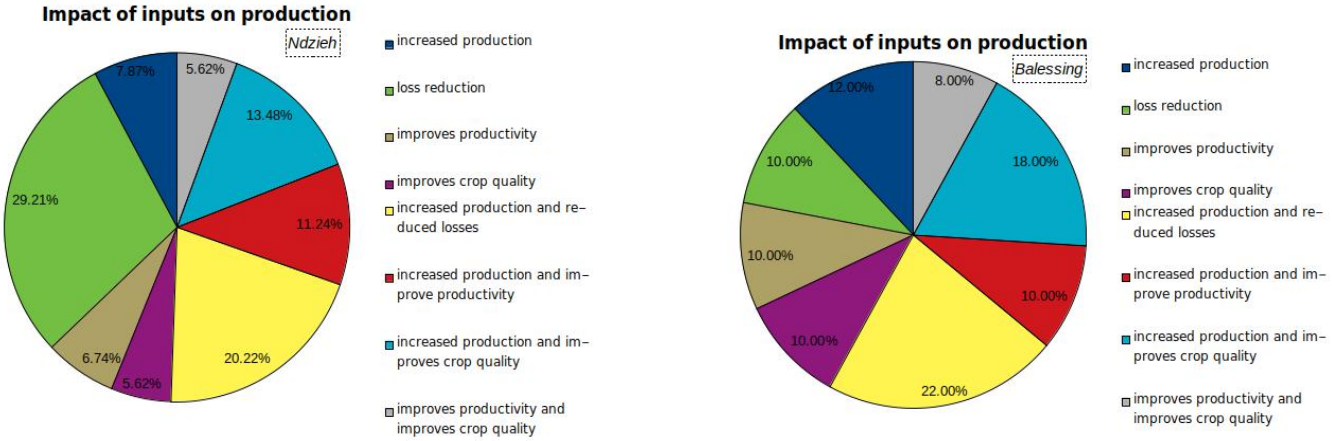

Fig. 1 – a/1-b): Positive effects of chemical inputs on production in Ndzieh/Balessing

The above diagrams show that, for one reason or another, producers use synthetic chemical inputs. In fact, in Northern Bafou area, 29.21% of producers use chemical inputs to reduce losses, 20.22% to increase production and reduce losses. Others use inputs to improve productivity or crops quality. As for Balessing producers, 22% of them use chemical inputs primarily to increase production and reduce losses, then to improve the quality of crops, and finally to improve productivity.

What are the negative effects of these products on the environment and people's health?

Field surveys show that most of producers in our study areas are aware of the fact that agricultural chemical inputs are great threats for the environment (soil degradation) and human health (respiratory issues, skin itching, itchy eyes…). Another worrying finding: huge number of farmers have no idea about the dangerousness and toxicity of the inputs they use.

The impact of agricultural practices on environment is closely and almost exclusively related to surface water and groundwater; or to water associated with transport and transformation mechanisms, on which the environmental contaminants depend. These practices (including water management) are generally likely to alter the hydrological cycle; then their impact on earth and water resources, absolutely necessary for human survival. However, farmers point out that the qualitative deterioration of these resources – in particular surface and groundwater ones – is often due to other human activities as pollution from urban and industrial sites. Assuming that the impact of those other activities are quite significant and even dominant in some situations, large-scale effects on the soil surface layers and water resources are basically due to agricultural activities in regions with intensive practices, with quality issues related to the use of some substances. The geographic extension of agricultural activities, compared to other human activities, is such that their impact predominates at least in the following phenomena:

—Erosion and degradation of soil properties

—Contamination of water resources of shallow aquifers by nitrates.

–Eutrophication of stagnant aquatic environments.

On this matter, a market gardener from Ndzieh said:

Chemical inputs are very dangerous for environment and for all of us. We know that when we use them, there is a risk of water and environmental pollution because these products are directly discharged into nature. The majority of people is not aware of these risks.

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Efforts made to feed ever-growing population of the planet is still far from fully satisfactory. We can predict with certainty the necessary development of arable agricultural land (increase in arable areas) and associated activities (practice intensification). Therefore, we should expect an extension of the agriculture impact on both geosphere and aquasphere. Human's possibility to master (limit or even reduce) this impact is not very high, given the inadequate attention and resources devoted to environmental protection. This can be understood, given that till now, in most parts of the world, agriculture development only aims at the survival of the whole world population avoiding famine. It is much less acceptable from northern developed countries, where food production already exceeds demand. If, this region strongly expresses its concern for environmental protection (even too much theoretically), resources allocated to research, planning and implementation of strategies are usually insufficient. Despite increased efforts to analyse this issue and find means to solve it, disturbing knowledge gaps remain, in particular regarding cause-effect connexions concerning environmental damages. So:

- An overview of terrestrial and aquatic environment possibly affected by agriculture is insufficient. Except where there is an adequate system of soil, subsoil and water monitoring.
- The diffuse sources of pollutants related to agriculture are poorly assessed when determining their contribution – i.e. their responsibility – in an overall context. The key word here is responsibility: without an indisputable identification, any binding action will be inevitably postponed.
- Processes that may affect pollutants (transport and transformation), from production to their ultimate target in the environment, are difficult to qualify and quantify, following agriculture large spatial and temporal scales.
- The effects of strategy known, which aims to master agriculture impact on environment, cannot be predicted with certainty, especially when it comes to large-scale soil-water systems.
- The legal and administrative apparatus for controlling agricultural sources of non-point pollution is missing or unsuitable. This is due to the inability to identify the responsibilities of the different sources. This inability has to do with failure to understand these pollutants transport and transformation mechanisms.

Finally, it should be noted that water management aims, for agriculture benefit and environmental protection are identical or very similar given that they aim at: preventing land losses, exporting nutrients and chemical substances, maintaining soil wetness suitable for crops.

If adequate information on the state of agricultural environment, on pollution sources and processes, are available, the strategies for controlling environment (first applied to water management practices) may be adapted to meet both food production and environmental safeguarding requirements.

However, there is still a long way to go to reach a stage where a strong scientific information, allocation of resources and appropriate legal and administrative structures authorise an adequate mastery of both agricultural and environmental protections. Two fundamental reasons endorse the urgency of this agreement:

- Damages done to soil and water resources by agriculture is very often irreparable and procedures (such as the loss of fertile soil layers or the pollution of aquifers by nitrates) are irreversible.
- Even if the processes were reversible, the situation would be similar to the financial world situation: the greater our debt to the environment, fewer possibilities we have to pay. If we don't spend a dollar for environment prevention today, we will spend much more solving damage caused, or for deploying alternative resources if this constitutes even a little solution in the future.

The environmental impact of agricultural practices related to water, includes three main categories:

- Soil losses due to water erosion with sediment deposition elsewhere, erosion and sediment transportation are also the main transfer mechanisms of important pollutants, nutrients and pesticides.
- Contamination of water resources by surface runoff, sediments' infiltration and transportation.
- Physical, chemical and biological modification of the soil surface layers properties

Three major matters were chosen for further discussion of this impact:

- Agricultural land erosion
- Groundwater contamination by nitrates
- Eutrophication of stagnant aquatic environments.

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Erosion by water (uprooting and transportation of soil particles and associated substances) may be the most damaging impact of agriculture on continental environment, because it results in:

- loss of soil fertility, due to the fact that water drives out organic matter and nutrients useful for vegetation
- Silt deposits on lands, in the stream bed, flood fields and reservoirs
- Deterioration of water quality.

Even if assessments made on a global scale, by large geographic areas, only provide phenomenon orders of magnitude their comparing is useful, and we noted that:

- The current global soil erosion is 5 times higher than that of the period leading up intensive agriculture development.
- The main reserves of cultivable lands are in the subtropical and tropical areas; place where maybe expect a considerable increase in erosion
- Currently, the greatest increase in erosion is observed in humid regions.

The Agricultural Causes of Erosion by Water

Erosion or the sediment production by agricultural practices is frequently referred to as the 'sheet erosion'. This does not mean that erosion necessarily results from sheet-runoff: it occurs rather in small channels or gully erosion. Its obvious cause is exposure of bare soil to water action under favourable conditions such as:

- long sloped land exploitation without creating terraces or head race tunnels;
- the rows of crops following the greatest and steepest slopes;
- contours ploughing if carried out without precautions can also accelerate erosion phenomenon as a result of water storage breaks in furrows;
- bare soil state after sowing;
- bare soil state between the harvest and setting of a new ground cover;
- intensive runoff from upstream which gullies rows of sloping crops;
- intensive crops near watercourses;
- poor condition of standing crops;
- faulty location of access roads which lead to agricultural plots: dirt roads along the steepest lines will be deeply gulled while at the bottom of the valley, deposits of mud turn them impassable.

In summary, agricultural land erosion mainly results from exposure of bare soils to raindrops energy and runoff in aquifers or micro-channels. The steeper the slope is, the finer and less cohesive soil particles are, and the more vulnerable to erosion is exposed bare soils. In this respect, a market gardener from Balessing affirms:

You just have to see soils situation. They are all degraded. This is due to erosion caused by the constant use of chemical inputs. But, how are we to deal without? We need it to boost our production and thus increase our profits.

Table. 1 Check of support provided to stakeholders in terms of input advice

Access to advice/Ndzieh	Workforce	Percentage	Cumulative percentage
Actors who receive advice	45	50.6	50.6
Actors who do not receive advice	44	49.4	100.0
Total	89	100.0	

Access to advice/Balessing	Workforce	Percentage	Cumulative percentage
Actors who receive advice	18	36.0	36.0
Actors who do not receive advice	32	64.0	100.0
Total	50	100.0	

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We note that: more than 50 (of producers do not receive advice in their farming activities and practices, some receive advice from family members, friends or neighbours. The producers do not comply with prescribed doses of chemical input. They claim that the use of chemical inputs on vegetable crops allows them to improve yields, even if they experience various discomforts due to use of these products. Most producers do not use protection during supply, conservation and application of these agricultural chemical inputs. An informant from Balessing said:

The *Government doesn't give us advice to produce. We just follow advice received from our fathers. So, with chemicals we use today to produce, we face some difficulties that we don't control. It even makes us sick. But, most of the time, the yields are good.*

IV. DISCUSSION

The prodigious rise of chemical industry in the 20th century profoundly and irreversibly changed production and consumption patterns, in technologically and economically advanced regions, as well as in the less affluent regions of the planet. More particularly, the massive production and widespread use of chemicals in agriculture, in particular mineral fertilisers and phytosanitary products, made possible agriculture intensification with a spectacular increase in crop yields (Gbénonchi M, 2008).

By definition, risk is the probability of damage or nuisance after an entity (population, ecosystem) exposure to a hazard which may be a physical, biological agent or a toxic substance (Schiffers, 2011). So, pesticides capable of killing or repelling living organisms are a danger. They must be used with particular attention. The most used chemicals' families are organochlorines, organophosphates and pyrethrynoids (Congo, 2013; Naré et al., 2015; Son et al., 2018). Several studies show that more than 80% of crop producers do not observe any protective measures during phytosanitary treatments (Toé, 2010; Tarnagda et al., 2017; Son et al., 2018) and do not comply with recommended doses (Naré et al., 2015; Son et al., 2018). This is because more than 50 (of producers are uneducated. So, they neglect dangers related to pesticides. Therefore, they are highly exposed to an immediate health risk (Toé, 2010; Lawson et al., 2017; Son et al., 2018). The lack of rigour in chemical pesticides used for crop production is a threat to biodiversity and the natural ecosystem productivity (Bon et al., 2014; Naré et al., 2015; Tarnagda et al., 2017). Therefore, vegetable and water consumers are highly exposed to sooner or later contamination (Lehmann, 2017). Similarly, a study carried out in Senegal showed that phytosanitary products used in Dakar agricultural regions have enormous impacts on farmers and surrounding populations' health (Diop, 2013). This could upset the existing spatial synergies in urban production systems (Ba et al., 2016).

Agriculture is characterised by the significant contribution of inputs which are beneficial to plants but which might be dangerous for humans and environment. It can locally contaminate water sources if important quantities of chemical fertilisers and pesticides are used. According to Kiba (2012), solid and liquid waste inputs improve soils' nutrient contents and crop yields, but increase risks of pollution by heavy metals and excess of nutrients. Besides, in the long run, the use of chemical pesticides can cause presence of harmful residues in food and in environment.

Chemical inputs, which destroying pests, also impact on the whole soil organisms. They directly kill (broad spectrum biocide products) or decrease communities' longevity or even their fertility (FREYSSINEL, 2007). The prevention of phytosanitary risks lays on adequate knowledge of products, their impact on health, constraints during its use and farmers' working conditions (AGUT & VERDIÉ, 2008).

Inappropriate dosed fertilisers can kill the soil and leave plants without food. They can affect health of plants and harvested products. The risks related to improper use of fertilisers make natural fertilisers often preferable to artificial ones. Natural fertilisers are more balanced and their supply in mineral salts is more diversified (DUPRIEZ & LEENER, 1987). Plants easily assimilate chemical fertilisers. More or less soluble in water, they are also able to easily pollute surface water and groundwater.

Fertilisers' effect varies according to their nature, use conditions and soil chemical characteristics. They cause a rapid mineralisation of organic matter and are immediately available to plants (PIERI, 1989). As a result, in long run, they cause a decrease of soil biological activity (OUEDRAOGO, 1998).

When a pesticide is applied to a plant, a part reaches the plant but another infiltrates soil to end up in groundwater or rivers. Most of it (from half to 3 quarters of the product) evaporates and falls back to the soil through rain and wind. When temperature rises, they evaporate again and move, traveling hundreds or thousands kilometres. Pesticides impoverish soil by increasing its toxicity, further destroying soil microorganisms; quite apart from causing pollution. This gradually leads to organic matter loss and soil erosion. Species at the top of the food

chain (mammals, birds, etc.) are particularly affected by problems caused by pesticides. But insects (especially browsers such as bees and butterflies) and cold-blooded animals (such as reptiles and amphibians) are the most affected. Thus, all species are current or future victims of millions of tons of pesticides dumped on the planet (AKADEM, 2000).

V. CONCLUSION

At the end, our research is about environmental and human risks of production factors selected in the context of this survey. Focused on the risks related to the use of chemical inputs for crops production in Nkong-Ni and Penka Michel (in Western Cameroon), this survey examines producers' behaviour when using agricultural chemical inputs. These inputs can damage human beings, their environment, their activities development and sustainability. It also analyses the misuse of agricultural chemical inputs by producers in order to understand the reasons and consequences of this misuse. Furthermore, the increasing number of crop producers shows the increasingly importance of this activity as the sources of income activities for people of our study area. So, we note that chemical inputs are important for plant growth and treatment. However, they remains dangerous for environment and human health. So precautions must be taken when using them.

VI. RECOMMENDATIONS

Considering the relevant results of our study, some recommendations in order to improve the use of chemical inputs, in agricultural activities, in Nkong-Ni and Penka-Michel, are formulated. These recommendations are intended for crop producers and the Cameroonian state. This is to preserve our environment and people's health.

Recommendations for market gardeners

Vegetable producers should comply with prescribed doses of chemical inputs they use in their farm plots, relying on recommendations mentioned on these inputs packaging.

They shall protect themselves by following the given prescriptions when applying chemical inputs in order to avoid discomfort or even illness in the long run.

Recommendations to the Cameroonian State

The Cameroonian state, through MINADER (Ministry of Agriculture and Rural Development), should organise training seminars not only on agricultural techniques, but also on supply, storage, and use of agricultural chemical inputs. It should call producers, members of organisations or not, to attend seminars and training. It should also ensure that each representative of producers' group and some producers who evolve alone, attending training seminars, effectively transmit lessons received to members group and other producers.

The government should work to raise awareness among producers about the benefits of environmental protection, in order to promote environmental consciousness in the areas of study.

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