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Optimized Use Of Plant Protection Equipment For Sustainable Agriculture

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ABSTRACT: Sustainable agricultural practices are intended to protect the environment, expand the Earth's natural resource base, and maintain and improve soil fertility. Based on a multi-pronged goal, sustainable agriculture seeks to: Increase profitable farm income. Practitioners of sustainable agriculture seek to integrate three main objectives into their work: a healthy environment, economic profitability, and social and economic equity. Every person involved in the food system—growers, food processors, distributors, retailers, consumers, and waste managers—can play a role in ensuring a sustainable agricultural system. There are many practices commonly used by people working in sustainable agriculture and sustainable food systems. Growers may use methods to promote soil health, minimize water use, and lower pollution levels on the farm. Consumers and retailers concerned with sustainability can look for “values-based” foods that are grown using methods promoting farmworker wellbeing, that are environmentally friendly, or that strengthen the local economy. And researchers in sustainable agriculture often cross disciplinary lines with their work: combining biology, economics, engineering, chemistry, community development, and many others. However, sustainable agriculture is more than a collection of practices. It is also process of negotiation: a push and pull between the sometimes competing interests of an individual farmer or of people in a community as they work to solve complex problems about how we grow our food and fiber.

KEYWORDS: sustainable agriculture, plant protection, equipments, soil health, environment friendly

I.INTRODUCTION

The desired effects of a pesticide can be obtained only if it is applied in an appropriate time and in a proper method. The important methods of applying pesticides are dusting and spraying. The appliances that are used for applying dust and spray formulation of pesticides are called dusters and sprayers, respectively.¹

Dusters:

All dusters consist essentially of a hopper which usually contains an agitator, an adjustable orifice and delivery tubes. A rotary fan or a bellows provides the conveying air.

A) Manually Operated Dusters:²

1. Plunger Duster: It is simple in construction and consists of a dust chamber, a cylinder with a piston or plunger, a rod and a handle. It is useful for small scale use in kitchen garden and in household.³

2. Bellows Duster: It has a pair of bellows made of leather, rubber or plastic. The bellows can be worked with a handle just like a Blacksmith does. The dust is placed either in the bellows or in a separate container made of wood, metal or plastic attached to one end of the bellows. The air current that is created runs through the container and drives the dust out through an opening.

3. Hand Rotary Duster: They are also called crank dusters and fan type dusters. They may be shoulder mounted, back or belly mounted. Basically a rotary duster consists of a blower complete with gear box and a hopper with a capacity of about 4-5 kg of dust. The duster is operated by rotating a crank and the motion is transmitted through the gear to the blower. The



air current produced by the blower draws the dust from the hopper and discharges out through the delivery tube which may have one or two nozzles. It is used for dusting field crops, vegetables and small trees and bushes in orchards. The efficiency of these dusters is 1 to 1.5 ha/day.⁴

B) Power Operated Duster:

- 1) Engine operated dusters
- 2) Wet dusters

Sprayers

Sprayer is a machine to apply fluids in the form of droplets. Sprayer is used for the following purpose. * Application of herbicides to remove weeds. * Application of fungicides to minimize fungus diseases. * Application of insecticides to control insect pests. * Application of micro nutrients on the plants. The main function of sprayer are * To break the liquid droplets of effective size. * To distribute them uniformly over the plants. * To regulate the amount of liquid to avoid excessive application.⁵

The major challenges in sustainable and profitable agriculture are developing high-yielding crop varieties and reducing crop losses. Presently, there are significant crop losses due to weed/bird/insect/animal attacks. Among the various renewable energy sources, solar energy is utilized for different agricultural operations, especially in plant protection applications. Solar photovoltaic (PV) devices present a positive approach to sustainable crop production by reducing crop loss in various ways. This might result in the extensive use of PV devices in the near future. PV-based plant protection equipment/devices are primarily utilized in protecting crops from birds, weeds, or insects. Solar-powered plant protection equipment such as light traps, bird scarers, sprayers, weeders, and fencing are gaining interest due to their lower operational costs, simple design, no fuel requirements, and zero carbon emissions. Most of these PV devices require 12 V rechargeable batteries with different currents to meet the load, which varies from 2 to 1500 W. ⁶

TYPES OF EQUIPMENT:

- a) Boom-type field sprayers
- b) High-pressure orchard and general purpose sprayers
- c) Air-blast sprayers which utilize an air stream as a carrier for sprays
- d) Air-craft sprayers
- e) Granular applicators
- f) Ground- rig dusters
- g) Air – craft dusters⁷
- h) Aerosol generators, which atomize liquids by thermal or mechanical means and are widely used for control of mosquitoes and other diseases – transmitting vectors and have limited application for agricultural pest control.⁸

II.DISCUSSION



In general terms, Directive (EC) 2009/128/EC of the European Parliament and of the Council of 21 October 2009 establishes various lines of action to be adopted by Member States to ensure compliance with its objectives of promoting and enhancing human health and environmental protection and encouraging the use of alternative techniques and methods, including integrated pest management. This involves training and awareness-raising for users, responsible sale, the safe use of application equipment, aerial applications, reduction of the risks associated with the use of plant protection products, the handling and storage of such products and management of their residues⁹. The cross-cutting nature of training and awareness-raising makes it a particularly important line of action, since it is essentially by promoting the acquisition of skills and expertise concerning the risks and effects of these products that practices associated with their safe use can be improved. In addition to training, reference must also be made to the contribution of research and the practical application of the scientific and technical knowledge acquired, including as concerns complementary or alternative methods to the use of plant protection products. Accordingly, given that they cut across all of the actions continued or started under this revised Plan, the two cross-cutting axes initially established remain in place: Cross-cutting axis 1 – Research, innovation and technology transfer; Cross-cutting axis 2 – Training, awareness-raising and information. The three strategic axes previously established also remain in place: Strategic axis 1 – Protection of human health; Strategic axis 2 – Protection of the environment; Strategic axis 3 – Promotion of sustainable agricultural and forestry production systems. Due to the nature of the themes addressed within each cross-cutting and strategic axis, their organisation varies. The cross-cutting axes will maintain their simplified presentation and organisation according to the objectives identified, while the strategic axes will continue to be organised according to themes or policy areas regarded as priorities, in which lines of action are identified and fleshed out by quantifiable objectives, measures, targets and relevant indicators.¹⁰ The measures set out in this Plan are organised in the form of action records which appear in Annex I to this document and are referred to in relation to each of the objectives established under the PANUSPF 2018-2023. This Action Plan is also based on the results achieved and described in the published report on the implementation of the PANUSPF 2013–2018: any reference to results obtained under the earlier PANUSPF should be verified by consulting that report¹¹

In addition to training and awareness-raising — and to support them — production, updating and dissemination of information for professional and non-professional users is essential. This information covers the various aspects of the sustainable use of plant protection products, focusing in particular on helping professional users to adopt best practices in the storage, handling and transport of plant protection products in sales and distribution channels and on activities related to the application of plant protection products, including guidelines for the correct application of general integrated pest management principles. Although some information dissemination activities have taken place – some leaflets were produced, for instance – the activities not completed under the previous action plan should continue, specifically updates to the Code of Conduct for applying plant protection products.¹³ It is also important to continue to gather information from professional users, particularly by conducting surveys to assess the quality of the services provided as part of the activities carried out under the legal rules in force. The training to be delivered and undertaken in the national territory can be supplemented by awareness-raising activities as an additional means of transferring knowledge and exchanging experience, as they involve users more closely. Such activity must continue to be carried out by the competent authority in cooperation with the DRAPs and other authorities competent for the matters¹⁴ concerning which awareness is being raised. Actions that were not sufficiently developed during the earlier PANUSPF implementation framework — specifically those involving raising awareness among nonprofessional users — should be given particular impetus under this new action plan, given the significance of this sector of the population in general and their right to clear information on matters relating to risks and safety in the handling and application of these products¹⁵

Due to the inherently dangerous nature of plant protection products, their use involves risks for human, animal and environmental health. Risks to human health affect users as follows: a) Professional users are at risk due to constant handling and exposure of plant protection products as a result of their professional activity in their capacity as operators or as professionals involved in the storage, distribution, sale or handling of such products.¹⁶ b) Agricultural workers and bystanders may be exposed to the treatment through e.g spray drift, contact with pesticide residues on crops or in previously treated places or accidentally when plant protection products are handled by persons without proper training or by children. c) Consumers are at risk as they may consume agricultural products containing pesticide residues due to the treatment of crops and/or stored agricultural products.¹⁷ Since agricultural products are tradable goods, a minimum quality standard must be met which guarantees their safety and freedom of movement. Since the safety of consumers of food treated with plant protection products is of fundamental importance, it is necessary to reinforce the system for monitoring

the responsible sale and use of such products as regards both MRL infringements in agricultural products and the conditions under which they are placed on the market. Accordingly, the action lines selected for this policy area are being maintained.¹⁸

- Reduction of risks to consumers associated with the use of plant protection products;
- Reinforcement of best practice in the sale and application of plant protection products.

The sale, distribution and application of plant protection products must be subject to a suitable regulatory process that allows these activities to be performed in accordance with the current legal framework, which represents, in this regard, the principal guarantee of the responsible sale and use of these products.¹⁹ The contract of sale to professional users must provide adequate information on the use of plant protection products, health risks and safety instructions in order to ensure the risks pertaining to the products in question are managed accordingly. Furthermore, in order to protect professional users trading in plant protection products and those who purchase the said products, it is important to reinforce expertise in terms of handling and selling these products and advising other professionals about their use, and to ensure the safety of storage and sales facilities, bearing in mind the dangers posed by the products in question. It is therefore necessary to provide licences to the economic operators involved in the sale and application of plant protection products and ensure that they act in accordance with the provisions of the current legal framework.²⁰

III.RESULTS

Some of the activities that would be conducted to increase awareness and the spread of sustainable agriculture include:

- Create farmer demonstration plots in villages around the districts to demonstrate sustainable techniques in organic farming.
- Provide input support to supply organic seed, fertilizers and pesticide inputs through an input shop.
- Create local market linkages for outputs from farms that practice sustainable agriculture.
- Create strong local awareness of non- pesticide management as well as organic farming through farmer meetings and trainings.
- Create linkages with government schemes (where possible) to increase organic and bio – dynamic farming²¹

There are several key principles associated with sustainability in agriculture:^[17]

1. The incorporation of biological and ecological processes such as nutrient cycling, soil regeneration, and nitrogen fixation into agricultural and food production practices.
2. Using decreased amounts of non-renewable and unsustainable inputs, particularly environmentally harmful ones.
3. Using the expertise of farmers to both productively work the land as well as to promote the self-reliance and self-sufficiency of farmers.
4. Solving agricultural and natural resource problems through the cooperation and collaboration of people with different skills. The problems tackled include pest management and irrigation.²²

It "considers long-term as well as short-term economics because sustainability is readily defined as forever, that is, agricultural environments that are designed to promote endless regeneration".^[18] It balances the need for resource conservation with the needs of farmers pursuing their livelihood.^[19]

It is considered to be reconciliation ecology, accommodating biodiversity within human landscapes.^[20]

Oftentimes the execution of sustainable practices within farming comes through the adoption of technology and environmentally-focused appropriate technology. Practices that can cause long-term damage to soil include excessive tilling of the soil (leading to erosion) and irrigation without adequate drainage (leading to salinization).^{[21][22]} The most important factors for a farming site are climate, soil, nutrients and water resources. Of the four, water and soil conservation are the most amenable to human intervention. When farmers grow and harvest crops, they remove some

nutrients from the soil. Without replenishment, the land suffers from nutrient depletion and becomes either unusable or suffers from reduced yields. Sustainable agriculture depends on replenishing the soil while minimizing the use or need of non-renewable resources, such as natural gas or mineral ores.²³

A farm that can "produce perpetually", yet has negative effects on environmental quality elsewhere is not sustainable agriculture. An example of a case in which a global view may be warranted is the application of fertilizer or manure, which can improve the productivity of a farm but can pollute nearby rivers and coastal waters (eutrophication).^[23] The other extreme can also be undesirable, as the problem of low crop yields due to exhaustion of nutrients in the soil has been related to rainforest destruction.^[24] In Asia, the specific amount of land needed for sustainable farming is about 12.5 acres which include land for animal fodder, cereal production as a cash crop, and other food crops. In some cases, a small unit of aquaculture is included (AARI-1996).²⁵

Nitrates are used widely in farming as fertilizer. Unfortunately, a major environmental problem associated with agriculture is the leaching of nitrates into the environment.^[25] Possible sources of nitrates that would, in principle, be available indefinitely, include:

1. recycling crop waste and livestock or treated human manure^[26]
2. growing legume crops and forages such as peanuts or alfalfa that form symbioses with nitrogen-fixing bacteria called rhizobia^[27]
3. industrial production of nitrogen by the Haber process uses hydrogen, which is currently derived from natural gas (but this hydrogen could instead be made by electrolysis of water using renewable electricity)
4. genetically engineering (non-legume) crops to form nitrogen-fixing symbioses or fix nitrogen without microbial symbionts.^[28]

The last option was proposed in the 1970s, but is only gradually becoming feasible.^{[29][30]} Sustainable options for replacing other nutrient inputs such as phosphorus and potassium are more limited.

Other options include long-term crop rotations, returning to natural cycles that annually flood cultivated lands (returning lost nutrients) such as the flooding of the Nile, the long-term use of biochar, and use of crop and livestock landraces that are adapted to less than ideal conditions such as pests, drought, or lack of nutrients. Crops that require high levels of soil nutrients can be cultivated in a more sustainable manner with appropriate fertilizer management practices.³¹

Phosphate is a primary component in fertilizer. It is the second most important nutrient for plants after nitrogen,^[31] and is often a limiting factor.^[32] It is important for sustainable agriculture as it can improve soil fertility and crop yields.^[33] Phosphorus is involved in all major metabolic processes including photosynthesis, energy transfer, signal transduction, macromolecular biosynthesis, and respiration. It is needed for root ramification and strength and seed formation, and can increase disease resistance.^[34]

Phosphorus is found in the soil in both inorganic and organic forms^[31] and makes up approximately 0.05% of soil biomass.^[34] Phosphorus fertilizers are the main input of inorganic phosphorus in agricultural soils and approximately 70%–80% of phosphorus in cultivated soils is inorganic.^[35] Long-term use of phosphate-containing chemical fertilizers causes eutrophication and deplete soil microbial life, so people have looked to other sources.^[34]

Phosphorus fertilizers are manufactured from rock phosphate.^[36] However, rock phosphate is a non-renewable resource and it is being depleted by mining for agricultural use:^{[33][35]} peak phosphorus will occur within the next few hundred years,^{[37][38][39]} or perhaps earlier.^{[40][41][42]}

IV. CONCLUSIONS

Sustainable agriculture attempts to solve multiple problems with one broad solution. The goal of sustainable agricultural practices is to decrease environmental degradation due to farming while increasing crop—and thus food—output⁴³. There are many varying strategies attempting to use sustainable farming practices in order to increase rural economic development within small-scale farming communities. Two of the most popular and opposing strategies within the modern discourse are allowing unrestricted markets to determine food production and deeming food a human right. Neither of these approaches have been proven to work without fail. A promising proposal to rural poverty reduction within agricultural communities is

sustainable economic growth; the most important aspect of this policy is to regularly include the poorest farmers in the economy-wide development through the stabilization of small-scale agricultural economies⁴⁴

In 2007, the United Nations reported on "Organic Agriculture and Food Security in Africa", stating that using sustainable agriculture could be a tool in reaching global food security without expanding land usage and reducing environmental impacts.^[75] There has been evidence provided by developing nations from the early 2000s stating that when people in their communities are not factored into the agricultural process that serious harm is done. The social scientist Charles Kellogg has stated that, "In a final effort, exploited people pass their suffering to the land."^[46] Sustainable agriculture mean the ability to permanently and continuously "feed its constituent populations".^[45]

There are a lot of opportunities that can increase farmers' profits, improve communities, and continue sustainable practices. For example, in Uganda Genetically Modified Organisms were originally illegal, however, with the stress of banana crisis in Uganda where Banana Bacterial Wilt had the potential to wipe out 90% of yield they decided to explore GMOs as a possible solution.^[76] The government issued the National Biotechnology and Biosafety bill which will allow scientists that are part of the National Banana Research Program to start experimenting with genetically modified organisms.^[77] This effort has the potential to help local communities because a significant portion live off the food they grow themselves and it will be profitable because the yield of their main produce will remain stable.⁴⁷

Not all regions are suitable for agriculture.⁴⁸ The technological advancement of the past few decades has allowed agriculture to develop in some of these regions. For example, Nepal has built greenhouses to deal with its high altitude and mountainous regions.⁴⁹ Greenhouses allow for greater crop production and also use less water since they are closed systems.⁵⁰

Desalination techniques can turn salt water into fresh water which allows greater access to water for areas with a limited supply.⁵¹ This allows the irrigation of crops without decreasing natural fresh water sources.^[52] While desalination can be a tool to provide water to areas that need it to sustain agriculture, it requires money and resources. Regions of China have been considering large scale desalination in order to increase access to water, but the current cost of the desalination process makes it impractical.⁵³

Ecological farming is a concept that focused on the environmental aspects of sustainable agriculture. Ecological farming includes all methods, including organic, which regenerate ecosystem services like: prevention of soil erosion, water infiltration and retention, carbon sequestration in the form of humus, and increased biodiversity.^[54] Many techniques are used including no-till farming, multispecies cover crops, strip cropping, terrace cultivation, shelter belts, pasture cropping etc.⁵⁵

There are a plethora of methods and techniques that are employed when practicing ecological farming, all having their own unique benefits and implementations that lead to more sustainable agriculture. Crop genetic diversity is one method that is used to reduce the risks associated with monoculture crops, which can be susceptible to a changing climate.⁵⁶ This form of biodiversity causes crops to be more resilient, increasing food security and enhancing the productivity of the field on a long-term scale.^[57] The use of biodigestors is another method which converts organic waste into a combustible gas, which can provide several benefits to an ecological farm: it can be used as a fuel source, fertilizer for crops and fish ponds, and serves as a method for removing wastes that are rich in organic matter.^[59] Because biodigestors can be used as fertilizer, it reduces the amount of industrial fertilizers that are needed to sustain the yields of the farm. Another technique used is aquaculture integration, which combines fish farming with agricultural farming, using the wastes from animals and crops and diverting them towards the fish farms to be used up instead of being leeched into the environment.⁶¹ Mud from the fish ponds can also be used to fertilize crops.^[60]

Organic Fertilizers can also be employed in an ecological farm, such as animal and green manure.⁶² This allows soil fertility to be improved and well-maintained, leads to reduced costs and increased yields, reduces the usage of non-renewable resources in industrial fertilizers (Nitrogen and Phosphorus), and reduces the environmental pressures that are posed by intensive agricultural systems.⁶³ Precision Agriculture can also be used, which focuses on efficient removal of pests using non-chemical techniques and minimizes the amount of tilling needed to sustain the farm. An example of a precision machine is the false seedbed tiller, which can remove a great majority of small weeds while only tilling one centimeter deep.^[64] This minimized tilling reduces the amount of new weeds that germinate from soil disturbance.^[65] Other methods that reduce soil erosion include contour farming, strip cropping, and terrace cultivation.^[66]

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