Solutions to topsoil loss in palouse

Topsoil is the upper layer of soil containing water, minerals, high concentrations of organic matter, and microorganisms that promote biological activity. Topsoil is very important. It is the basis of crop growth and can be used for water filtration and carbon absorption. However, the world's topsoil is seriously lost due to agricultural activities. About half of the topsoil can't be used for food production because of degradation (Fiakas, 2019). According to U. S. Department of Agriculture, Palouse which is composed of parts of Washington, Oregon, and Idaho is one of the areas with the most serious topsoil erosion in the United States. Palouse had lost averaged 360 tons per acre on cropland only from 1939 to 1979 (U. S. Department of Agriculture, 1979). This leads to serious consequences, such as the reduction of arable land, river blockage, mass unemployment of farmers and so on. As stated in Garret Hardin's essay *The Tragedy of the Commons* , the problem of topsoil loss can't be fully solved by technical solution likes Divided-slope farming and field strip cropping because it is the product of conflict between individual interests and collective interests. Moreover, it is ineffective to solve the problem of topsoil loss by appealing to conscience such as publicity on Returning Farmland to Forest (RFFP). Fortunately, Hardin also express that the best solution that prevent the tragedy of topsoil loss in Palouse is Mutual Coercion likes improvement of the institution for protecting topsoil supplemented by Enhancing education in agricultural knowledge.

In Hardin's article, the commons are considered a resource or property which has many owners and each of the owners has the right to access it but has no right to prevent others from accessing it. The individual interests refer to tendency to the options that are conducive to individual survival and

development needs when making decisions. On the other hand, the collective interest refers to the interest of a certain group of people. Hardin argues that the causes of the tragedy of the Commons mainly come from the conflict between individual interests and collective interest on the allocation of resources. And the tragedy is inevitable because even though we know it is bad, we can do nothing but watch the tragedy step to the reality. The nature of tragedy means that it cannot be solved by technical solution. To prevent tragedy, Hardin offers three non-technical solution which are appealing to conscience, mutual coercion and education.

In the problem of topsoil Loss in Palouse due to agricultural practices, the commons are considered the topsoil since Topsoil is finite and everyone is free to access it through investment in farm. The individual interests are considered personal economic development. Suppose the economic return on each piece of farmland is the same, then the amount of farmland farmer invests increases, and so does their overall income. Thus, farmers tend to access more topsoil because of profits. Moreover, the size of the farm is in direct proportion to the quantity of crops and the quantity of crops is inversely proportional to the price of crop. Therefore, consumers tend to access more topsoil for saving money. The collective interest in our problem is considered sustainability. According to a senior UN official, the world’s topsoil will be depleted in 60 years at the current rate of topsoil loss (Arsenault). For collective interest, it tends to access less topsoil than present for sustainable development. Because of the conflict between personal economic development which asks for more topsoil access and the sustainable development which requires reduction of utilizing topsoil, people

will eventually act in accordance with personal interests and ignore the collective interest if the access of topsoil is not restricted.

Technical solutions can mitigate the problem of topsoil loss in Palouse. According to the research by United States Department of Agriculture, Topsoil loss is an average of 25 to 30 percent higher on summer fallow farmlands than on normal farmlands due to high rainfall and a lack of mulch. Reducing the fallow area in summer can reduce the rate of topsoil loss by 35 percent. In addition, more than half of the topsoil loss came from the farmland with a slope of more than 25 percent. Divided-slope farming and field strip cropping can reduce the rate of topsoil erosion by 15 to 28 percent. Furthermore, terraces can reduce the rate of topsoil erosion by 8 to 13 percent. Increasing the acreage of small grain crops such as wheat or barley also can significantly reduce topsoil erosion. (U. S. Department of Agriculture, 1979) However, technical solutions cannot fully solve the problem of topsoil loss in Palouse. It takes 500 years to form 2. 5 centimeter of topsoil under ideal conditions, but for every year, 0. 5 centimeter of topsoil is lost due to agricultural practices. Topsoil is losing 100 times as fast as it is forming (Dockrill, 2015). The technical solution slows the rate of topsoil loss and extends the time it takes for topsoil depletion, but it cannot balance rate of topsoil loss and topsoil formation even if the technology is advanced. Topsoil will eventually run out since technical solution makes no change to individual interests and collective interest.

Strengthening publicity on Returning Farmland to Forest (RFFP) is a solution of appealing to conscience. Returning Farmland to Forests (RFFP) is a successful ecosystem restoration program in China, which aims to reduce

soil erosion by allowing rural families to convert marginal farmland back to forest land (Trac, 2013). In Palouse, the root cause of topsoil loss is excessive tillage area. To solve the problem of topsoil loss, the local government can refer to the Returning Farmland to Forests (RFFP) program, actively publicize the importance of topsoil protection, arouse people's conscience, and finally make people consciously reduce the area of agricultural land. For instance, local government can take advantage of major environmental days and broadcasts promotional video in order to highlight the importance of sustainable development of agriculture. However, appealing to conscience cannot prevent the tragedy of topsoil effectively. Just acting on conscience is the elimination of individual appeal (Hardin, 1968). About topsoil loss in Palouse, conscience requires people to reduce the area under cultivation, while individual interests encourage people to invest in more farms. People must suppress their individual interests if they act in good conscience. In addition, People are always different. There are always those who act on conscience and those who act on self-interest. People who follow individual interests will increase the size of the farms they invest in. Their assets increase and their social influence increases relatively. People who follow their conscience will reduce their investment in farms. Their assets will decline, and their social influence will be less relatively. Ultimately, Collective decision is influenced by people who follow their own interests.

Enhancing education on topsoil protection is another non-technical solution for topsoil loss in Palouse. According to researches by Department of planning, Education can improve farmers' ability to understand, use, and

manage, thereby increasing productivity and protecting topsoil (Eric, 2014). The depletion of topsoil is caused by the conflict between individual interests and collective interest. Through education, farmers will not focus only on the immediate interests and ignore the long-term interests. It helps farmers balance individual and collective interests to prevent tragedy of topsoil. For instance, Schools can incorporate agriculture into the basic curriculum so that students can systematically learn more about agriculture. For students who want to go into agriculture, they can apply what they have learned to practice in the future. However, education can help solve the problem of topsoil loss, but it cannot be decisive. First of all, it is very difficult to make education work. Education needs to be repeated over time to influence farmer's behavior. Moreover, perceptions of protected farmland are changing. For example, hundreds of years ago, the loss of topsoil is not even a problem since the area of agricultural practice is small and the frequency of farming is low.

Improvement of the institution for protecting topsoil is the last non-technical solution to the problem of topsoil loss in Palouse. When the individual interests and collective interests are not consistent, in order to prevent the tragedy of the Commons, the government should change the individual interests through mandatory regulations and make the individual interests close to the collective interests. Thorough system is the key to ensure the good running of all social and economic activities. So is protecting topsoil. For instance, adjusting the tax on agriculture. Subsidies will be given to owners of farmland under the conservation scheme. On the other hand, taxes will be raised to owners if their arable land exceeds a certain amount.

Furthermore, the federal government works with local governments to determine the appropriate amount of farmland to be used and to prevent unrestricted occupation. Moreover, economic preferential policies should be established to make up for the losses suffered due to the protection of topsoil. In addition, the sentencing standards should be determined as soon as possible, and the punishment of the behaviors of destroying farmland should be introduced into the judicial procedure. The parties who caused the loss of farmland must bear the administrative responsibility, criminal responsibility and necessary economic punishment. In fact, individual economic development and collective topsoil sustainable development are not completely in conflict. Think about it. When topsoil runs out, what else can farmers rely on to farm. And perfect legislation can restrain farmer integrated individual interest and collective interest

In conclusion, Because of the conflict between economic development and the sustainability of topsoil, topsoil depletion due to agricultural practices is inevitable without changes to the current situation. Technical improvement such as reducing the summer fallow area, Divided-slope farming, field strip cropping and increasing the acreage of small grain crops can alleviate the problem of topsoil loss, but it cannot change the fact that topsoil loss continues and will runs out eventually. Thus, more attention should be paid to non-technical methods. One of the non-technical solution is strengthening publicity on Returning Farmland to Forest (RFFP) which depends on human conscience, but it is an ineffective method since human conscience and individual interests often conflict. Enhancing education on topsoil protection is another non-technical method. Nevertheless, it is difficult because

education needs to be universal and sustained to change everyone’s values such that change individual interests. Ultimately, mutual coercion mutually agreed upon such as adjusting the taxon agricultureaccording to the area of farmland is the best solution for the problem of topsoil loss because it can restrain people from increasing the size of farms for economic development and make the access of topsoil sustainable.

Referenced Works

- Arsenault, Chris. “ Only 60 Years of Farming Left If Soil Degradation Continues.” *Scientific American* , www. scientificamerican. com/article/only-60-years-of-farming-left-if-soil-degradation-continues/.
- Dockrill, Peter. “ The World Has Lost a Third of Its Farmable Land in The Last 40 Years.” *ScienceAlert* , www. sciencealert. com/the-world-has-lost-a-third-of-its-farmable-land-in-the-last-40-years.
- Fiakas, Debra. “ Vagrants on the Earth: Implications of Topsoil Loss.” *Alternative Energy Stocks* , 21 Mar. 2019, www. altenergystocks. com/archives/2019/03/vagrants-on-the-earth-implications-of-topsoil-loss/.
- Hardin, Garrett. “ The Tragedy of the Commons.” *Science* , v. 162, no. 3859, pp. 1243-8.
- Trac, Christine Jane, et al. “ Is the Returning Farmland to Forest Program a Success? Three Case Studies from Sichuan.” *Environmental Practice : Journal of the National Association of Environmental Professionals* , U. S. National Library of Medicine, Sept. 2013, www. ncbi. nlm. nih. gov/pmc/articles/PMC4511398/#.

- United States Department of Agriculture. “ Erosion in the Palouse: A Summary of the Palouse River Basin Study.” Feb. 1979, http://pnwsteep. wsu. edu/resourcelinks/eip. pdf.