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Cambodia, Sustainable Agriculture

Sustainable Agriculture Practices for Rice Growing in Cambodia

As stated by the U.S. National Agricultural Research, Extension, Education, and Economics Advisory Board, sustainable agriculture is "an integrated system of plant and animal production practices that will over the long term satisfy human food and fiber needs, enhance environmental quality, make the most efficient use of nonrenewable resources, sustain economic viability of farm operations, and enhance the quality of life for farmers and society as a whole" (U.S. Code). The increasing threats of climate change affect not only the crops themselves, but the manner in which they are grown. Farmers around the world are forced to look for more sustainable practices and methods to lessen the contributions to climate change, which has consequences that affect the whole planet. While efforts for sustainable agricultural practices have been made, most farmers are not able to employ these methods due to expense. In this essay, I will be focusing on Cambodia and its potential increased use of sustainable agriculture practices for growing rice.

Cambodia is located in Southeastern Asia and is bordered by Thailand, Vietnam, and Laos. As of 2022, the approximate population of Cambodia is 17 million people, with around 75% of them rural and 25% of the urban (Lina). Cambodia contains a constitutional monarchy, and is governed by the Prime Minister Hun Sen, who acts as the head of the government, and the King Norodom Sihamoni, who acts as the head of the state (Pariona). "Cambodia's climate is governed by monsoon winds, which defines two major seasons: mid-May to early October, where the southwest monsoon brings heavy rains and high humidity, and early November to mid-March, where the northeast monsoon brings dry winds and lower humidity" (Chandler). This type of climate makes Cambodia suitable for producing a variety of crops. Farming is very common and typical for families living in Cambodia. "The major crop grown in Cambodia is rice but other parts of the land are used to grow cassava, corn, and mung beans. Major exports besides crops include textile goods, which are made in factories" (Chandler). "Cultivated rice areas in Cambodia increased from 2.5 million to 3 million in 2016 according to the Ministry of Agriculture Forestry and Fisheries" (Singh). About 80% of Cambodian families live on agricultural farms, depending on it as their main source of income, so it is important that they are able to have access to resources and can learn new sustainable agriculture practices to ensure the best quality for their farm in the long run (Singh).

In Cambodia, "agriculture, led by rice farming contributes to roughly a third of the country's GDP" (Inserey). This number could increase if Cambodia's "rice sector reached full potential, with exports amounting to $2.1 billion, which would boost not only the country's economy but the income of farmers as well" (Inserey). While this seems like good news to hear that Cambodia could be attaining such promising numbers, it is actually quite difficult to attain 'full potential' of crops, specifically with rice. Many factors contribute to the low productivity of rice cultivation primarily being poor infrastructure and high expenses that farmers are unable to deal with due to the little income they receive (Inserey). There are limited resources available to these farmers, so they are forced to plant and harvest crops at

their own pace, using the more traditional practices of manual labor (Cramb). In Cambodia, rice is grown in paddy fields across the country. “Paddy fields are flooded by rivers, rainfall during monsoon season, and some by irrigation” (Chandler). “While most plants are unable to germinate submerged underwater, rice has unique ways in which it germinates, using ‘strategies’ of fast growing coleoptile elongation to break the water’s surface and make contact with the air” (Ahumada). The country has two major rice crops per year, following the monsoon season and the dry season, incorporating those rains to help flood the fields (Cramb). While paddy fields are especially helpful for flooding rice crops, they generate a lot of plant waste of leaves and such left in the water to decay, which contributes to methane emissions into the atmosphere (Singh). Climate change is one of the biggest threats to the planet and new sustainable agricultural practices are needed to prevent an increase of severity. Another downside to using the paddy fields is that the risk of contamination is very high. The use of pesticides to treat crops can be useful, but it contains many harsh chemicals which can lead to many consequences that come from its use, such as run off pollution that can damage the crops in the paddy fields (Brown). There are issues stemming from inefficient water usages as well when growing rice crops. “Rice consumes 50% of irrigation water that is used for all crops, which poses threats towards cultivation from the water scarcity affecting the world” (Singh). During the dry season of rice growing, irrigation is necessary in flooding the fields, but it needs to be done in a more sustainable way that will help the farmer and the environment.

To help solve these challenges, new irrigation and water management systems are needed to help limit methane emissions and still yield high amounts of rice crop. A solution for this could be the Alternative Wetting Drying (AWD) system. “Many farmers are now incorporating this system to reduce irrigation water consumption in their rice fields by alternately flooding and ‘drying’ their fields” (Lampayan). By doing this, farmers are able to plant more crops without having flooded fields filled with decaying plant matter turning into methane gas. However, not all farmers have access to resources to use this system, and it can be expensive. Organizations like the Global Agriculture and Food Security Program (GAFPS) have contributed funding to Cambodia to help implement the AWD system, but this does not cover all of the farmland in the country. A practical method farmers could use to help practice the AWD system is by constructing a field water tube, also known as the pani pipe, using PVC pipe or bamboo, to monitor the water levels of the field (Lampayan). “The field water tube should have a diameter of 10-15 centimeters and a height of 30 centimeters, with perforations around the bottom 15 centimeters of the tube to allow water to flow through” (Lampayan). This is an easier way for farmers to monitor the water levels of the field, so when the water is below the 15-centimeter mark, they will know to irrigate the field. This pani pipe technology is appropriate to Cambodia because it is something simple and manageable that the farmers could use to help reduce water usage.

Collecting rainwater and using groundwater as well would be useful to store for use of irrigation in the field, when in the dry season with no monsoon rainfall floodings. India, the second largest producer of rice in the world is also facing the same problems with water efficiency, in efforts to prevent any contributions to climate change. “High efficient use of rainwater includes pond reservoirs, crop scheduling, alternate wetting and drying systems, and aerobic growing (Singh). These methods have been useful to rice growers in India, so hopefully more of these practices will be communicated to and adopted by other countries like Cambodia, that also suffer from water shortages and climate change threats. Cambodian farmers can construct pond reservoirs to store water used for the wetting/drying systems. This is an opportunity for local water management projects guided by the Cambodian government that would benefit whole communities: farmers with irrigation and also ordinary citizens with flood control.

The aerobic method in particular has sparked interest as it does not use flooded fields to grow rice. Israel has had great success when growing 'aerobic rice' using aeration, which has now expanded into India as farmers are trying this new method that saves lots of water with partly or complete aerobic rice growing (Singh). While flooding the paddy fields is useful for rice growth and controlling weeds, it is not water efficient, so these sustainable practices used in Israel and India can be applied to rice farmers in Cambodia, who can slowly start reducing flooded water into the fields. By gradually decreasing the amount of water, the crops will be able to adjust to the new growing environment. This could be demonstrated for Cambodian farmers at local agricultural experiment stations by Land Grant University-style Extension and Cambodian Government Agricultural personnel.

Controlling weeds and combatting rice diseases using pesticide type products also causes issues. Pesticides contain harsh chemicals that can contaminate the crops and harm people around it. A potential solution could be the use of biocontrol agents such as endophytic bacteria and fungi. Endophytic bacteria are bacteria that live inside the plant and benefit both themselves and the plant host (Chou). Recently, scientists have been trying to find ways to use endophytic bacteria as biocontrol agents, some examining rice as one of the crops being studied. "One study tested microorganisms and endophytes in the microbiome against rice germination to see its physical effects on the plant, as those endophytes were known to provide protection from abiotic stresses." (Ahumada). "The analysis was performed on the temperate *japonica* rice varieties, and they examined to see if the bacteria could potentially help the germination process, which it did" (Ahumada). The scientists were trying to employ this method of testing to see if the bacteria could stick to the seedlings to promote germination while underwater, and based off the positive results, this could be a new biocontrol method that will not damage the environment and positively benefit the rice crops. Another sustainable practice used is the use of fungi as biocontrol agents as well. "A study tested *Trichoderma harzianum*, a fungus that is commercially available in Cambodia, against rice blast, which is a disease caused by fungi that seriously damages rice" (Chou). "The scientists combined *T. harzianum* with the average farmers' practices when performing the experiments and observed the results from the rice plant leaves. *T. harzianum* did effectively limit the rice blast symptoms on the leaves, however it did not increase the effect in the control of the disease" (Chou). The use of these biocontrol agents is very promising but there is still more to be done, especially in developing it into something like a spray farmers can use and have easy access to for treating their crops. Biocontrol is another opportunity for agricultural education for Cambodian farmers by Extension and Government Personnel.

In conclusion, while Cambodia has had an increase in its rice production, it could still use improvement and these sustainable practices could help with that, which in turn will benefit the farmers. While these are not perfect solutions just yet, they are very promising steps forward in trying to use sustainable practices that will not only help crops for food consumption but also benefit the environment. Hopefully, more countries will join in these efforts following the examples of India and Cambodia in broadening their use of sustainable agriculture. World hunger unfortunately will always be a looming issue, but if people around the world can make more efforts to find sustainable practices and distribution methods then we can lessen it more every day. Groups like the Food and Agriculture Organization of the United Nations and Land Grant University-style Extension Services will be beneficial in these processes following their successes in similar endeavors in other parts of the world. Additional organizations including the international CGIAR agricultural research centers can contribute to these educational and research efforts. Increased awareness about sustainable agriculture is needed to encourage farmers to use these practices when tending their crops, as it will benefit themselves, their country, and the world.

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