Gender in Aquaculture and Fisheries: Engendering Security in Fisheries and Aquaculture
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Short Communication

The Water-Energy-Food Nexus: Women's Lens for Fisheries Security

MARIETA BAÑEZ SUMAGAYSAY*

University of the Philippines Visayas Tacloban College, Tacloban City, Leyte, Philippines

Abstract

The water-energy-food (WEF) nexus, in an environment of increasing climate variability, is one lens which stakeholders must develop and embrace. Changes in the climate are intensifying the pressures on natural resources on which food production is primarily dependent. An increasing population further impacts on the ecosystem. The challenge is mounting on the fish drying food chain in Brgy Duljugan in Palompon, Leyte, Philippines. Heightening the women fish driers' awareness about the nexus and strengthening their roles within the nexus are crucial towards attaining sustainable and resilient livelihoods. Likewise, policymakers' appreciation of the WEF nexus is necessary as a basis for crafting integrated policies on climate, environment, and socio-economics.

Introduction

Climate variability is a major change driver in the water and energy ecosystems which in turn affect the food production value chain. There is a complex and interrelated structure that runs through the life cycle pathways of the water, energy and food nexus amid climate change in terms of temperature, precipitation changes, and rises in sea level (Liu 2016). Women, who are at the core of fish processing activities particularly in fish drying, are heavily affected. They are highly vulnerable to climate change as they depend on local natural

*Corresponding author. Email address: mayet_uptac@yahoo.com

resources for their livelihood (UN Women Watch 2009). The women fish dryers of Duljugan, a coastal village in the municipality of Palompon in Leyte, Philippines, depend on the sun for drying fish and on water from the wells to clean the fish to be dried.

The criteria used in the choice of Duljugan as the research locale included the presence of a significant number of women fish dryers, the high volume of dried fish production, and the number of coastal villages in the municipality from where research respondents can be randomly chosen.

Materials and Methods

32 women fish dryers were interviewed, and another set of 16 women fish dryers joined a Focus Group Discussion. The women represented various sectors of the fish dryers community such as the women's producers cooperative, village officials, women with long or short stints as fish dryers, women with large or small volumes of production, as well as those from various age groups and educational attainment.

Questions revolved around the women fish dryers' perception of climate change and variability, their utilization levels of resource inputs in fish drying, their knowledge and practices in fish drying, and their understanding of the interrelationships of water, energy and dried fish production.

This paper is based on a study funded by the National Research Council of the Philippines in 2013. It aimed to ascertain the water-food, energy-food, and energy-water nexus in fish drying, as well as to generate insights on ways to heighten the awareness of the small-scale women fish dryers about the importance of the water-energy-food nexus vis-a-vis climate variability as it affects the sustainability of their livelihoods and the supply of dried fish.

Results

The concept of the water-energy-food (WEF) nexus and its understanding by stakeholders is extremely important particularly in a country like the Philippines where the corresponding ecosystems are adversely affected by both slow and sudden-onset disasters. The interrelationships between food,

water and energy are complex. Such complexity is deepened when climate change concerns are added into the discourse, particularly as they impact on the need for sustainable resource use.

An estimated 60 % of the Philippine population is living near a coastline, and they are exposed to frequent climatic variations and extreme climatic hazards (Bohra-Mishra et al. 2016). The country ranks fourth in the Climate Risk Index (CRI) among the top 10 countries with the highest exposure and vulnerability to climate-related risks (Sonke et al. 2015). It is a climate hotspot and is highly vulnerable (Jabines and Inventor 2007). At the local level, the island-province of Biliran which is located around 57.12 kms from the study area of Palompon, is identified by the Manila Observatory as one of four areas that is most at risk to climate and weather related changes. Literature shows that where vulnerability is high, the poverty incidence is high, too. This vulnerability worsens the existing disparity of living standards across socio-economic classes since the relatively poorer are hardest hit by climate change impacts, having less or no access to alternative resources (Jabines and Inventor 2007; Sonke et al. 2015). Hence, they are less resilient.

The coastal village of Duljugan in Palompon belongs to the Eastern Visayas region which had a poverty incidence of 33.3 % in 2006. After typhoon Haiyan in November 2013, its poverty incidence increased to 39.3 % (NAPC 2016). That is, two in every 5 households fall below the poverty threshold. More than the occurrence of Haiyan as a sudden extreme event, women fish dryers continue to experience daily climatic variability which they describe as follows:

"It is not the rainy season, yet it rains a lot."
"The weather is unpredictable. It suddenly rains even in summer."
"The rains and the sun have lost their normal paths."
"The rains and the sun have gone crazy and berserk."

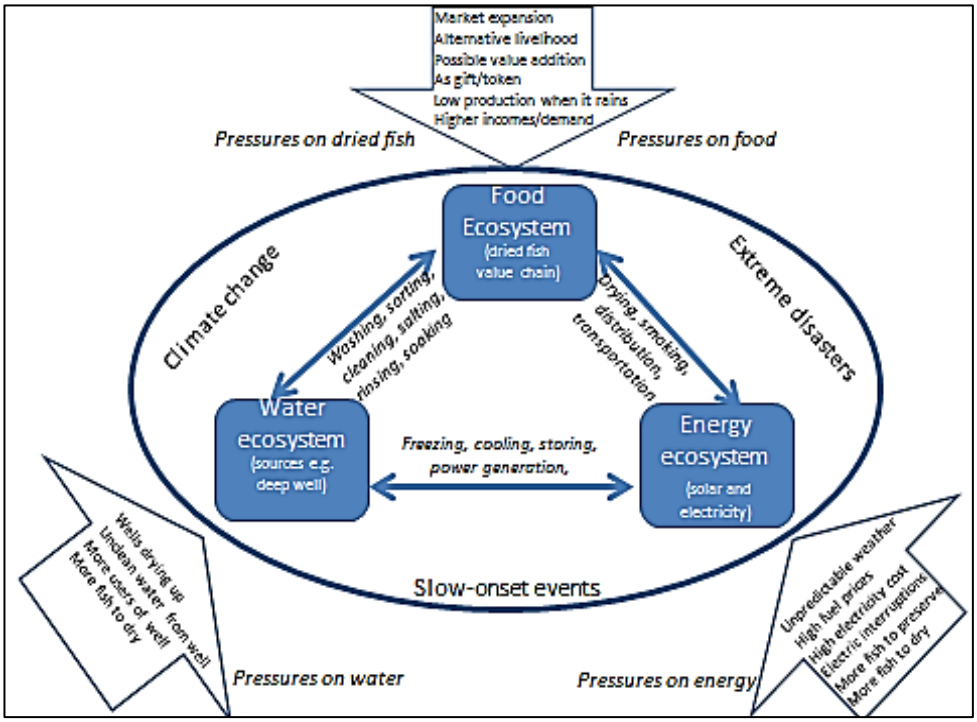
The effects on the volume of dried fish produced and, consequently, on the women's cash incomes and their conribution to the family coffers are adverse. Since fish drying requires water as well as energy (solar and electricity), any pressure on these resources and/or limitations on their access pose challenges to the women who have been assigned, by social norms,

practices and cultural traditions, the task of drying fish. The dried fish food chain is weakened by the impact of climate changes since the water-energy-food ecosystem processes are disrupted.

Fish drying on a raised fine-meshed rack takes 4 hours under the sun. However, when the weather is cloudy, drying takes longer by 2-3 hours. When rain falls suddenly, the women have to gather the fish on the racks. Depending on the degree of dryness or moisture content of the fish as well as the anticipation of good weather later in the day, the women have options to take. When the fishes are almost dry, and the sun is no longer expected to shine during the rest of the day, the fishes are dried either by smoking or by air using an electric fan, both of which will require energy (Table 1).

Table 1. Water-energy-food nexus: Case of fish drying under the sun (Brgy Duljugan, Palompon, Leyte, Philippines)

Eco systems	Fish Drying Activities	Requirements
Water - energy ecosystems	Ice-making (Purpose: used to preserve fish when it cannot be spread to dry due to sudden rains and cloudy skies)	2 l of water to produce 7 ice blocks 5 h of electricity to convert water into ice inside the freezer 7 to 10 pcs of ice 15 kg^{-1} of fish placed in ice box
Water - food ecosystems	Cleaning fish for drying	12 l of water 15 kg^{-1} fresh fish
	Sorting fish for drying	12 l of water 15 kg^{-1} fresh fish
	Salting fish for drying	2 l of water 15 kg^{-1} fresh fish
	Washing fishing paraphernalia and fish drying tools	24 l of water
	Rinsing fish (which has started to dry) for re-salting to preserve it in times that it suddenly rains	12 l of water 15 kg^{-1} fresh fish
	Soaking fish in vinegar to lengthen shelf life and wait for the sun to come out again	2 l of water 15 kg^{-1} fresh fish
Energy - food ecosystem	Sun drying the fish	4 h (longer time to sun-dry on cloudy days: add 2 to 3 h)
	Electricity to fan-dry the fish when it rains	5 h
	Smoking the fish to dry on rainy days	3 to 6 h
	Kerosene lamp at sea	2 l kerosene
	Gasoline for the engine of fishing boats	4 l per short trip
	Operating generator sets when there is a black out	10 l gasoline



Source: Survey and FGD results, Brgy. Duljugan, Palompon, Philippines, 2013

Fig. 1. Water-Energy-Food Nexus in Fish Drying

The water-energy ecosystem processes make freezing, storing, cooling, and power generation possible, while the energy-food ecosystem processes take care of energy for the boat's engines used in fishing trips, the drying, smoking, distribution, and transportation when the fish is taken to the market (Fig. 1). The water-food ecosystem processes, on the other hand, deal with cleaning, washing, sorting, salting, rinsing, and soaking in order to produce dried fish. Frequent and higher intensity climate changes put more stresses on these ecosystems. Consequently, the women fish dryers' livelihoods are compromised.

Discussion and Conclusions

The Rio + 20 declaration, "The Future We Want," focuses on the need to address the core issues of food, water and energy security in ways that are least destructive to nature and biodiversity (Rasul 2014). With an increasing demand for food coupled with the adverse impact of climate change on limited resources, the critical role of water security and energy sufficiency in ensuring food supplies in the future cannot be undermined. The challenges that women

fish dryers face in food production revolve around the pressures on water and energy that arise from: (1) the impact of climate change, (2) the increasing demand for dried fish due to a bigger population and a higher capacity to buy and (3) the volume/proportion of the fish catch that fishers allocate for drying among other uses.

Firstly, because of climate change, the wells from where water is sourced to clean, rinse, wash and soak fish for drying are drying up due to increased usage for preparation of dried fish and also due to drought. Heavy rains, on the other hand, have made water from the wells unclean and murky. They have also caused production costs to increase since women fish dryers resort to alternative drying methods which require electricity, fuel, and gasoline. Interruptions in electricity supplies and the high cost of these energy supplies limit women's productivity. Dried fish production is low.

Secondly, the demand for dried fish has increased. The reasons include: a larger population with higher incomes, a preference for dried fish including the use of dried fish bought as a "pasalubong" (token/gift) item for guests. There has been market expansion outside the municipality of Palompon and value added to dried fish, for example through better packaging, which has enabled penetration into another sector of the market, so that fish drying has become an alternative source of income. This increase in demand has put pressure on scarce water resources. There are more users of wells, who compete with domestic users, for example mothers who must ensure adequate and regular water supplies for family consumption.

Finally, a larger fish catch means more fish to dry and more fish to preserve. This requires more water and more energy resources. This makes it imperative for women fish dryers to spend more time at work. After spreading the fish to dry on raised fine-meshed racks which have been improvised by the household, the woman does not have the option of engaging in other income-generating activities other than drying fish. Drying of fish is a demanding activity which warrants utmost attention and care from the woman fish dryer who has to be a keen observer of changes in the climate, for example a sudden spurt of unprecedented weather events such as rainfall or sunshine.

Women fish dryers need to close the knowledge gaps in the WEF nexus. Fish drying is an energy-intensive production activity, yet the women whose lives revolve around fish drying are in energy-deficient coastal communities. Today, the method of dried fish production is highly dependent on the sun. Clean water supplies are inadequate. Incomes are not maximized due to the impact of climate variability on water and energy. It is imperative, therefore, to seriously consider wastewater management before wells dry up. Moreover, spoilage of fish that cannot be dried due to the unpredictable rains must be reduced by providing alternative gender-responsive technologies and/or common service facilities that will enable women fish dryers to benefit.

At the core of the matter is the need to make stakeholders recognize the nexus and take proactive steps to make fish drying resilient to water and energy shortages that may be brought about by climate variability. However, there is a seeming lack of awareness and understanding on the importance of these interrelated and interweaving connections between the supply of water, the availability of energy (solar or electricity or fuel), and the capacity to sustain fish drying as a basic food source and as a primary source of women's incomes in coastal communities. With an integrated approach, some trade-offs may be possible. Sectoral issues must not be treated in isolation from the others. The issues are highly interlinked and the solution of one may even worsen the situation of the other (World Economic Forum 2011).

Women fish dryers will have to be engaged in the WEF nexus discourse and decision making. Developing a nexus lens will provide a framework for assessing the use of the limited resources, managing the interconnections and interdependence of these resources, and maximizing synergies in order to address the challenges facing sustainable livelihoods for women in the dried fish industry, as well as to contribute to the food security of the wider community. Awareness-raising activities for women fish dryers and their households are urgently needed. These could be spearheaded by the stakeholders involved, including academic researchers, the private sector, and development agencies.

On the policy side, a continuous effort is needed to make policy makers and planners appreciate the inclusion of the WEF nexus in governance. That is, to recognize that water, energy, and food (in this case, dried fish) are resources

that are essential to life, yet are finite, are not accessible to some people, and are getting scarce due to pressures from climate change and population increases.

A major step would be creating policies and draft plans that integrate climate, environment, socio-economics, and infrastructures (Wicaksono et al. 2017). This will require bio-physical perspectives together with economic modeling and simulations in order to more accurately determine the resource levels and interlinks vis-à-vis resource utilization rates under different climate variability conditions. In addition, a social network analysis and a gender-responsive set of WEF interventions are advocated to bring to the surface and address the gender differentials in parts of the fish drying value chain, i.e., roles, responsibilities, relationships, opportunities, constraints, and the impact of climate variability on women and men.

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