Comments on the Agricultural Water Management Plan 12/26/14

The drought and the revelation that the exceedance of possible water supply by water rights held in California argue for fundamental revisions to the Agricultural Water Management Plan (AWMP). The revisions proposed in this essay are termed fundamental because they advocate measures which, if adopted, will incorporate agriculture more fully into the social-economic matrix of the state.

Discussion of agricultural water has implicitly contained the assumption of agriculture as one of three major entities with claims on flexibly allocated portions of the water resources of the state. There are well established foundations in law for this this approach, of course, and the approach has worked to alleviate or suppress civil discontent over access to water over the last century. This tripartite division resembles the division of public interest between the estates of nobility, church and town in early modern Europe. Modern Western national governments are no longer partitioned in such a fashion, and the growth of California beyond the abilities of its water supply system also requires the evolution of responsibilities for water supply and use. The requirements of water supply to California's three "estates" are recast when water supply becomes the single overriding priority.

The AWMP will contribute better to solving the state's water allocation problems if it communicates a shift in focus from agriculture as a semi-independent component to agriculture as one cooperating component of the statewide water-dependent social and economic system. As a component of the system, agriculture should recognize its water supply obligations as well as its claims. Irrigated agricultural land comprises a significant fraction of the lands of the state and, thus, a significant fraction of state lands receiving precipitation in winter. Agriculture, however, does not conduct its operations in ways conducive to increasing the state's water supply from intercepted winter rainfall. This note will argue that management of such a large fraction of the state's lands for capture of seasonal rainfall is important to augment state water supplies, and that the AWMP should advance arguments for the application of satellite imagery and modeling to increase supply and reduce the economic impact of agricultural supply reductions resulting from drought.

Agriculture's impact on land's ability to collect and transmit water is severe. A recent call for papers by a section of the European Geosciences Union characterized agriculture's impact as follows:

> SSS2.7
> Agriculture and Land Degradation - Cause and Effect
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> Agricultural practices are notorious for degrading soils through their impact on accelerated water and wind erosion, salinization, compaction, soil organic matter oxidation, and nutrient depletion. In a form of feedback loop many agricultural practices lead to soil degradation which in turn negatively impacts subsequent production potential resulting in even more intense and often aggressive practices to get high yields, which increases soil vulnerability to further degradation. Identifying

approaches to break this cycle and quantifying land degradation impact on crop yields and crop production consistency is critical as strategies to meet the rising global demand evolve.

Soil organic matter oxidation is the most important factor affecting soil's ability to infiltrate precipitation. Oxidation is inherent wherever cultivation takes place. It is therefore widespread. Oxidation also contributes fundamentally to erosion. Compaction is generally compensated for in the course of normal agricultural practice. Salinization (apart from sodicity) and nutrient depletion do not adversely affect infiltration, but do affect the beneficial use of water n aquifers.

Because irrigated agricultural land is, as a class, the least steep and the most intensively managed, it is the appropriate category of land to manage for the purpose of infiltration. The AWMP should incorporate broad measures to encourage irrigation districts to disincentivize tillage and tarping of the soil coupled with measures to incentivize organic matter addition by cover crop cultivation and importation of organic matter from urban areas. Such encouragement would likely be congruent with the goals of recent groundwater management legislation.

The AWMP should recognize that measures to restore soil organic matter are not in growers' short term interests. Financial assistance to effect restoration may be appropriate to the extent it can be estimated that the gradual progress of restoring aquifer water storage and lengthening seasonal stream flows are in the interests of the state. Financial assistance always runs the risk of creating dependency on the part of the agricultural sector, though, and it is necessary to distinguish between programs which benefit only the district or the political unit of which it is a part from programs that benefit the entire state. Smaller political units may still be useful locations for financial assistance if a case can be made that subsidies will garner state revenues that exceed the investment cost.

A rule of thumb for agricultural yields is that they vary over a field such that the best producing subdivision of a field yields about ten times more than the worst. Yet many irrigation technical assistance programs developed in environments where water was not limiting have focused on achieving uniformity in the distribution of irrigation over fields, and have done so despite abundant evidence of spatial variation in fields' hydraulic parameters and yields. When water is a severely limiting factor for agricultural production, technical assistance should incorporate decision support for restricting irrigation to the more productive portions of fields.

Apart from production at the high end of the quality spectrum, yield and revenue are tightly related to crop evapotranspiration (Et). Landsat 8 imagery facilitates the evaluation of crop Et at 15 meter (m) square resolution across fields at a frequency of once per sixteen days. Though some amount of spatial drift in Et will be evident across seasons, due primarily to insect and disease infestation, Landsat 8 imagery adequately supports delineation of portions of fields consistently reflecting higher temperatures resulting from less plant growth due to relatively reduced evapotranspiration. (The importance of Landsat 8 is such that the Western states cooperated to get a thermal sensor added to the satellite. They would doubtless cooperate again to get a replacement should the present satellite fail.) Classification and sophisticated accounting are able to produce rational decisions

about what areas of fields to fallow in water short years.

As the effects of climate change on the state's water resources become more apparent, the analysis can naturally be extended to decisions about what portions of fields could be turned over to management solely for water capture as individual growers contribute to the sustainability of the their irrigation districts. These examples of the use of remote sensing are certainly not exhaustive. The AWMP should encourage adoption of this technology by irrigation districts, perhaps initially by requiring at least supply to DWR by the districts of Et data based on the imagery, and making available a training course for districts' staff.

The AWMP is but a single set of regulations affecting one facet of a highly interconnected system of water use. The extent of interconnectedness has rarely been acknowledged to date. If DWR chooses to adopt some or all of the suggestions above, it would be advantageous to begin discussion about incorporating hydraulic and yield parameters into the taxation of agricultural land, for the tax system contains assumptions of uniform value across fields. The technology mentioned above permits the taxation system also to hew more closely to the realities of periodic water shortages.

Two additional observations:

Sprinklers in hand and wheel move sprinkler systems generally are spaced too far apart to achieve maximal uniformity of application. (This observation does not contradict the suggestion above.) The AWMP may want to suggest tighter spacings and shorter runs to increase application uniformity.

Use of recycled water for agriculture is impractical in several ways. Most recycled waters are injurious to soils because the water's sodium concentration is too high for the total salts the waters contain. Amelioration with gypsum only partially reverses the soil structural damage caused by recycled waters. In some cases, the recycled water will improve some chemical parameters of aquifer water. In other situations that is not the case, and managed degradation of the aquifer will ensue. Lastly, it is much less costly to recycled water for potable consumption than to lay sufficient pipeline to bring recycled water to agriculture.

Bob Siegfried
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