# International Section

CHINA

# Optimizing Fodder Grass Production for Fisheries in Hubei

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**Balanced fertilization is a tool readily-available to support rapid improvements in productivity for in-land fishery enterprises in China.**

The Jianghan plain region of Hubei is renowned for its ability to supply superior quality rice and fish staples. Recent adjustments to China's national agricultural development plan have designated this region as one which is particularly favorable to continued development and expansion of in-land fisheries as a means for local economic improvement. For example, 5 years ago, the Datonhu State Farm operated 8,500 hectares (ha) with 7,000 ha of paddy and 1,500 ha dedicated to fish ponds plus fodder grass production. With economic readjustment, lands associated with fisheries now occupy 5,500 ha of this farm's total land base.

**Fish grass** field trial in Honghu County, Hubei Province, shows N fertilizer only (farmer practice) at left, compared to NPK fertilization (BF) at right.

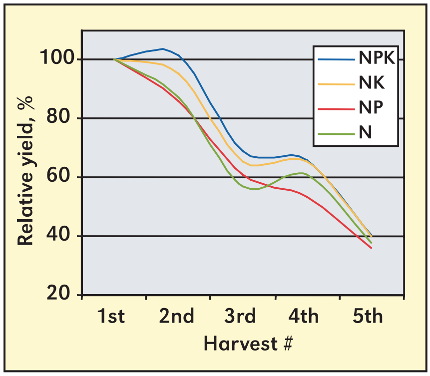
Fresh fodder grass is a crucial feedstock for in-land fisheries. Although other commercial fish fodder sources are relied upon throughout the fish growth cycle, the use of supplemental fresh grass has greatly increased land use efficiency and reduced production costs. Research has highlighted a significant feed supply gap which is hindering fishery productivity and suggests that improvements in grass yield will benefit the industry and its economic opportunity.

Currently, there are more than 130,000 ha growing fodder grass in the Jianghan plain, a portion in year-round production and the remaining area is seasonal. Although the planted area has developed quickly, it has happened despite a lack of knowledge by farmers concerning nutrient management of grass varieties. Most of this area only receives nitrogen (N) fertilizer and suffers from poor establishment and low yields. The species of grass best suited for fish fodder production in this area are Sudan grass (*Sorghum sudanense*) and perennial ryegrass (*Lolium perenne*). Research of fish fodder use efficiency suggests that

**Fish ponds and grass** in Honghu County, Hubei.

| Table 1. Soil characteristics, Datonhu State Farm, Hubei. | |
|---|---|
| Texture | Loam |
| pH | 8.2 |
| O.M. | 1.1 % |
| N | 13.9 mg/l |
| P | 13.0 mg/l |
| K | 161.7 mg/l |
| Ca | 3,745 mg/l |
| Mg | 273 mg/l |
| S | 2.4 mg/l |
| Fe | 19.6 mg/l |
| Mn | 14.8 mg/l |
| Cu | 5.0 mg/l |
| Zn | 1.6 mg/l |
| B | 0.58 mg/l |

**Figure 1.** Relative yield of each treatment as compared to initial harvest, Hubei.




15 to 20 kg fresh grass is required to produce 1 kg of fish.

In 2002, a Sudan grass trial established at the Datonhu State Farm evaluated the following N, phosphorus (P), and potassium (K) fertilizer treatments: (N, NP, NK, and NPK) using 540 kg N/ha, 150 kg $P_2O_5$/ha, and 135 kg $K_2O$/ha applied as urea, single superphosphate, and potassium chloride (KCl). Soil test information is shown in **Table 1**. Fertilization involved an initial broadcast application which supplied one-third of the N, all the P, and two-thirds of the K. The remaining N was divided into four topdressings applied after each harvest. The remaining K was applied after first harvest.

**Phosphorus** deficiency on fish grass.

**Potassium** deficiency on fish grass.

Both P and K, when combined with N, increased fresh grass production compared to the check. However, the highest cumulative yield over five harvests (at approximately 3- to 5-week intervals from mid-June to mid-October) was obtained with the complete NPK combination (**Table 2**). Compared to the N treatment, NP, NK, and NPK raised annual production by 11.1 t/ha (16.6%), 13.5 t/ha (20.3%), and 23.4 t/ha (35.3%), respectively. Each harvest responded to P and K fertilizer. However, the third harvest produced the greatest response as P fertilization increased yield by 28%, K by 29%, and their combined use by 49%.

The influence of each nutrient combination in supporting grass production over the five harvests is represented in **Figure 1**. Although most treatments produced their highest yields during the first cut, the complete treatment supported a marginally higher yield level for the second harvest period. The second cut for the NK treatment was only 4.8% less than the amount harvested during the initial harvest, but treatments without K showed stronger yield declines equal to 13 to 14%. Later in the season, treatment advantages were less apparent, but visual and measured observations suggest residual benefits from applying either NPK or NK. Although it is clear that K fertilization improves fodder production and provides farmers with substantial yield gains, the overriding climatic factors and

**Table 2.** Effect of P and K on fresh grass yield, Hubei

| | Treatment | 1st Harvest | 2nd Harvest | 3rd Harvest | 4th Harvest | 5th Harvest | Total |
|---|---|---|---|---|---|---|---|
| Fresh yield, t/ha | N | 19.4 (100†) | 16.9 (100) | 11.0 (100) | 11.8 (100) | 7.3 (100) | 66.4 (100) |
| | NP | 23.0 (119) | 19.8 (117) | 14.1 (128) | 12.3 (104) | 8.3 (114) | 77.5 (117) |
| | NK | 21.8 (112) | 20.8 (123) | 14.3 (129) | 14.3 (121) | 8.8 (120) | 79.9 (120) |
| | NPK | 23.8 (123) | 24.2 (143) | 16.5 (149) | 15.7 (132) | 9.6 (133) | 89.9 (135) |

†Numbers in parentheses represent percent (%) relative yield.

**Table 3.** Economic evaluation of P and K application on fresh grass yield and its contribution to fishery productivity, Hubei.

| Treatment | Fresh grass yield, t/ha | Yield increase, t/ha | Added income, US$/ha | Added input cost, US$/ha | Added labor cost, US$/ha | Added net profit, US$/ha | VCR[1] |
|---|---|---|---|---|---|---|---|
| N | 66.4 | - | - | - | - | - | - |
| NP | 77.5 | 11.1 | 333 | 60 | 67 | 206 | 2.6 |
| NK | 79.9 | 13.5 | 405 | 38 | 81 | 286 | 3.4 |
| NPK | 89.9 | 23.5 | 705 | 98 | 141 | 466 | 2.9 |

[1]VCR = value-to-cost ratio. Prices: US$0.4/kg $P_2O_5$, US$0.3/kg $K_2O$, $0.03/kg grass fodder.

plant growth potential produced a general and continual decline in productivity as the growing season progressed. The economic benefit from the NPK production system increased net profits to farmers by US$466/ha (**Table 3**).

**Serious K-deficiency** symptoms of fish grass.

## Future Requirements

Managing grass for fish production is a relatively new concept which is developing quickly and causing significant change to the agricultural landscape of the Jianghan plain region. Rapid adoption rates have identified knowledge gaps among farmers who largely apply traditional cereal crop techniques to manage these fodder grasses. Given traditional nutrient management practices, the sustainability of this production system must be questioned as soils endure multiple harvests each year, nutrient recycling is virtually non existent, and thus, nutrient demands are extremely high. Improved nutrient management can reverse the unsustainable conditions. Seasonal fodder grass production is required to augment declining productivity and the production will also require adequate nutrient supply.

**Field trial** shows difference between common practice (left plot) and BF (right plot).

Despite the large improvement in productivity that was achieved in these trials, more study is required to achieve a robust nutrient management strategy. Researchers need a complete understanding of the native fertility of grass-producing soils as the first step in developing suitable fertilization rates, ratios and schedules for selected grass species. An understanding of how balanced fertilization can improve fodder quality through the manipulation of key nutritive characters is also desired. BC

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