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Tashkent International University of Education
Turin Polytechnic University in Tashkent

PROCEEDINGS

of the MMIT'25 International Conference

TA'LIMNING ZAMONAVIY USULLARI VA
INNOVATSION TEXNOLOGIYALAR

MODERN METHODS AND INNOVATION
TECHNOLOGIES IN EDUCATION

СОВРЕМЕННЫЕ МЕТОДЫ И
ИННОВАЦИОННЫЕ ТЕХНОЛОГИИ
В ОБРАЗОВАНИИ

29 May 2025, Tashkent, Uzbekistan

MAQOLALAR TO'PLAMI
СБОРНИК СТАТЕЙ



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Modern methods and innovation technologies in education

**Современные методы и инновационные технологии в
образовании**

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DOIMIY SUV BERISHDA YER OSTI SUVLARI SATHINING O'ZGARISHINI MODELLASHTIRISH

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Annotatsiya. Ushbu maqolada yer osti suvlari sathining o'zgarishini aniqlash imkonini beruvchi model taqdim etilgan. Ushbu model qishloq xo'jalik yerlarining suv melioratsiya jarayonlari intensivligini ilmiy asoslash, drenaj tizimlari hisob-kitoblarini optimallashtirish va sug'orish rejimlarini boshqarishni takomillashtirish uchun qo'llaniladi. Model yer osti suvlarining tashqi muhit bilan o'zaro ta'siridan hosil bo'lgan ikki asosiy kinetik jarayon – yer osti oqimi va qurigan zona orqali sodir bo'ladigan o'zgarishlarni sxematik tarzda ko'rsatadi. Yer osti suvlari oqimining suv ombori bilan o'zaro ta'sirini sxemalashtirish, suv balansiga erishishni ko'rsatadi. Yer osti suvlari sathining o'zgarishini modellashtirish parametrlarini aniqlash metodikasi va misollari keltirilgan. Hisob-kitob natijalari va tajribalar mos kelishi amaliyotda modeldan foydalanish uchun yetarli asos bo'lib xizmat qiladi.

Kalit so'zlar: yer osti suv sathi, suv o'tkazuvchanlik koeffitsienti, qurigan zona.

MODELING THE CHANGE IN GROUNDWATER LEVEL UNDER CONSTANT WATER SUPPLY

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Abstract. This article presents a model that allows determining changes in the groundwater level. This model is used for the scientific substantiation of the intensity of water-melioration processes of agricultural lands, optimization of drainage system calculations, and improvement of irrigation regime management. The model schematically shows the changes occurring through two main kinetic processes arising from the interaction of groundwater with the external environment - groundwater flow and the dried-up zone. Schematization of the interaction of groundwater flow with the reservoir shows the achievement of water balance. Methods and examples of determining the parameters of modeling changes in the groundwater level are given. The correspondence of the calculation results and experiments serves as a sufficient basis for using the model in practice.

Keywords: groundwater level, permeability coefficient, dried-up zone.

Kirish

Agrosanoat majmuasini barqaror rivojlantirish masalalarida asosiy vazifa me'yoriy hosildorlikka erishish va yuqori sifatli mahsulot ishlab chiqarishni ta'minlash, mehnat, energetik resurslar va Qashqadaryo viloyatidagi atrof-muhitni muhofaza qilish bo'yicha sezilarli darajada tejamkorlikka erishishdir [1-3]. Bunga suv melioratsiyasi zarurati va intensivligini asoslash, qishloq xo'jalik drenaj tizimlarini optimallashtirish va qishloq xo'jalik yerlarida suvni boshqarish rejimini takomillashtirish kabi muammolarni hal qilish orqali erishiladi. Yuqoridagi muammolarni hal qilish uchun yer osti suv sathining o'zgarishini modellashtirish, suv ombori tizimining suv sathi va tashqi muhit bilan murakkab o'zaro ta'sirini hisobga olish orqali amalga oshirilishi mumkin [4].

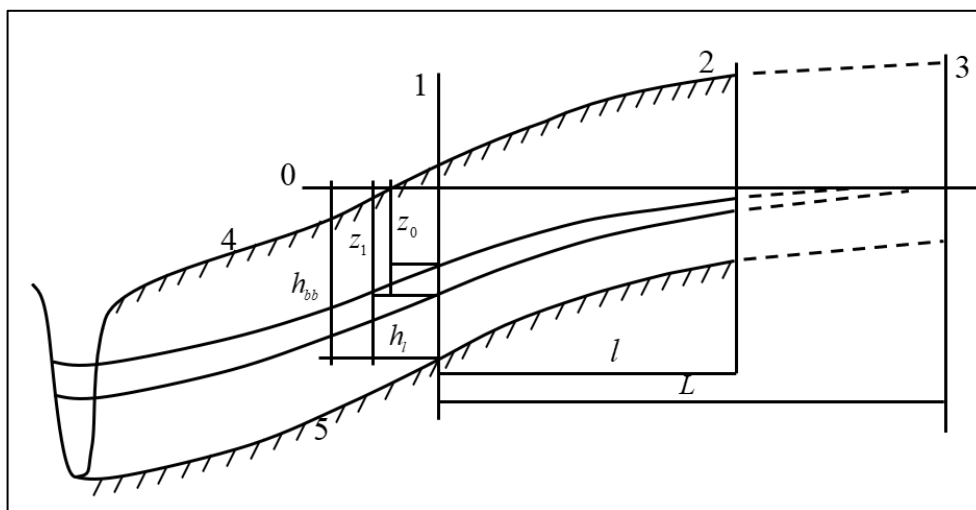
Natijalar va muhokama

Aytish mumkinki, yer osti suvlar tizimidagi barcha o'zgarishlar tashqi muhit bilan faqat ikki umumlashtirilgan kinetik birlik – yer osti oqimi va qurigan zona orqali sodir bo'ladi [5].

$$Z + H \rightarrow Z + Z \quad (1.1)$$

Bu yerda z , h – kuzatuv qudug'i o'qi bo'yicha qurigan zona va yer osti oqimi qalinligi santimetrda ifodalanadi.

Turli vaqt momentlarida suv ombori oqim chizig'i bo'ylab sathlarning egri chiziqlari kesish nuqtasi ("0" nuqta) gacha gipoteza sifatida davom ettiriladi, undan gorizontal chiziq 0-0 o'tkaziladi – qurigan zona quvvatini hisoblash o'qi "z" (1-rasm). Vertikal o'q OZ ning musbat yo'nalishi pastga qaratilgan. Darci qonuni va suv balansi tenglamasidan foydalanib, yer osti suvlari sathining tekis ekanligini faraz qilib, sathlar o'zgarish tezligini (1-rasm) quyidagi tenglama orqali ifodalash mumkin:



1-rasm. Yer osti suvlari oqib chiqishini sxematik tasviri. 1 – kuzatuv qudug'i o'qi; 2 – suv havzasi chegarasi o'qi (suv ajratuvchi).

$$\frac{\partial z}{\partial t} = \frac{k z h_b}{\varphi \delta l L} \quad (1.2)$$

bu yerda: φ - depressiya egri chizig'ining shaklini tavsiflovchi koeffitsiyent, u nisbatdan aniqlanadi; δ - suv chiqarish koeffitsiyenti; l - kuzatuv qudug'i kesimidan suv ajralish chizig'igacha bo'lgan oqim yo'nalishi bo'yicha masofa (1-rasm); L - kuzatuv qudug'i kesimidan depressiya egri chiziqlarining kesishish gipotetik nuqtasigacha bo'lgan masofa (1-rasm); $\frac{z}{L}$ - vaqt davomida o'zgarib turadigan yer osti suv oqimi sirtining nishabligi; k - gruntning filtratsiya koeffitsiyenti; b - oqim kengligi;

$$\mu_1 \text{ ni quyidagicha belgilaymiz: } \mu_1 = \frac{k}{\varphi \delta l L}$$

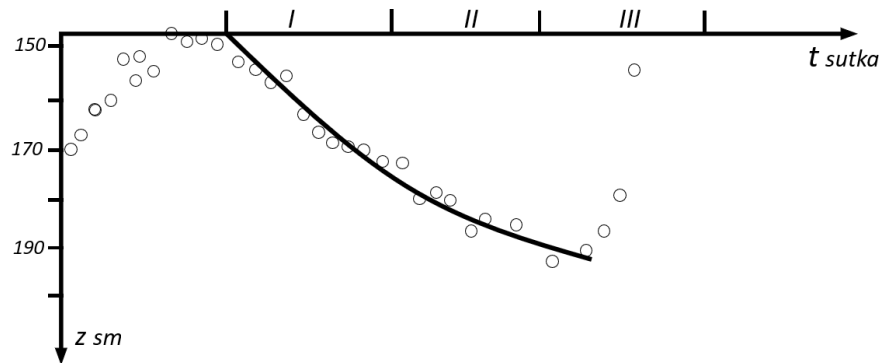
Shunda differensial tenglama quyidagicha yoziladi:

$$\frac{\partial z}{\partial t} = \mu_1 (h_{bb} - z) z \quad (1.3)$$

(1.3) tenglamani boshlang'ich shartlar $t = 0$, $z = z_0$ da integrallash orqali quyidagicha natija hosil qilinadi:

$$z = \frac{h_{bb}}{1 + \frac{h_{bb} - z_0}{z_0} e^{-\mu_1 h_{bb} t}} \quad (1.4)$$

Olingan (1.4) ifoda, yer osti suv sathining vaqt bo'yicha pasayishini ifodalab, S - shaklidagi egri chiziqlarga yaqin bo'lgan kinetik egri chiziqlarni beradi. Matematik modelni eksperimental tekshirish uchun Qashqadaryo viloyatining Kasbi tumanidagi kuzatuv quduqlarida o'lgan ma'lumotlar ishlatilgan.



2-rasm. – Depressiya egri chizig'i.

S - shaklidagi kinetik egri chiziqlarda to'rtta davrni ajratish mumkin: boshlang'ich va inertsia davri, suv sathining muntazam pasayish davri, muvozanat yoki stasionar holat fazasi va suv sathining ko'tarilish davri. Kinetik egri chiziqning bo'linishi suv harakatining har bir davrida qandaydir maxsus qonunlar mavjudligini anglatmaydi. Boshlang'ich davrda tizimda qayta qurilish sodir bo'ladi, bu esa suvning ko'tarilish va pasayish harakatining yo'nalishini o'zgarishi bilan bog'liq. Suv sathining muntazam pasayish davrini, yer osti suvlari kapillyar chegaradan suvga to'yingan tuproqqa va suvga to'yingan tuproqdan kapillyar chegaradan o'tganini tasvirlash mumkin. Suv sathining susayishi doimiy miqdorga yetadi, biroq eksperimental ma'lumotlarni tahlil qilishda yillar davomida suv sathining stasionar holati fazasi paydo bo'lishi aniqlandi, bu hodisa suv qatlamlari o'rtasidagi suv almashinuvi bilan izohlanmaydi. Ko'rinib turibdiki, suv sathining pasayishini cheklovchi boshqa sabablari mavjud.

Eksperimentdan olingan ma'lumotlarga asoslanib model parametrlarini aniqlash uchun (1.4) tenglamani qayta ko'rib, uni chiziqli shaklda qulay ko'rinishga keltirish maqsadga muvofiqdir. Tenglamaning chap va o'ng qismini (1.3) tenglama bo'yicha z ga ajratsak, quyidagiga ega bo'lamiz:

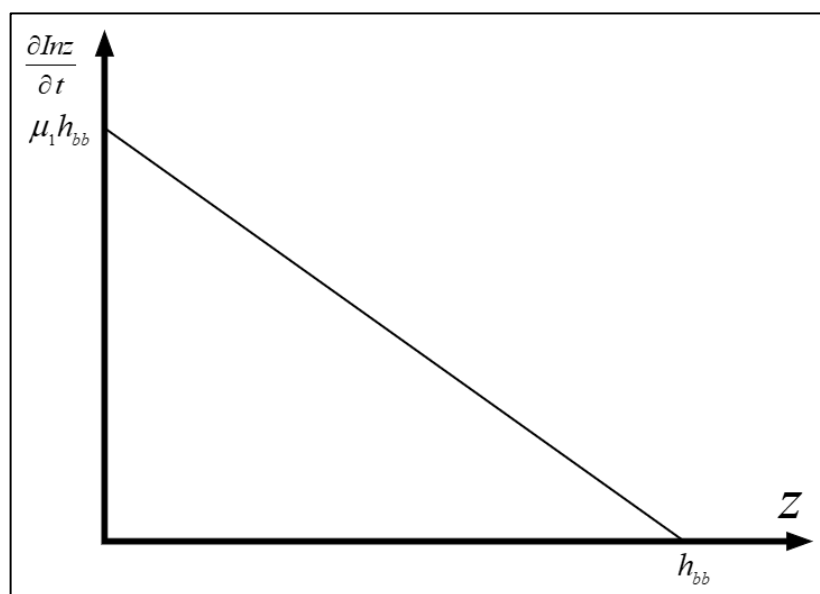
$$\frac{\partial z}{\partial t} \frac{1}{z} = \frac{\partial \ln z}{\partial t} = \mu_1 (h_{bb} - z) \quad (1.5)$$

Tenglama (1.5) dan shunday xulosa kelib chiqadiki, nisbiy (logarifmik) sathning pasayish tezligi:

$$\frac{\partial z}{\partial t} \frac{1}{z} = \frac{\partial \ln z}{\partial t} \quad (1.6)$$

Absolyut $\frac{\partial z}{\partial t}$ dan farqli o'laroq, $\frac{\partial z}{\partial t}$ nisbiy qiymati tuproq oqimi quvvatining oshib borishi jarayonida chiziqli kamayuvchi funksiya hisoblanadi. Bu shuni anglatadiki, tenglama (1.4) bilan tasvirlangan S - shaklidagi egri chiziqlar $\frac{\partial z}{\partial t} \frac{1}{z} \rightarrow z$ koordinatalarida natijalarni ifodalashda to'g'ri chiziqqa aylantirilishi mumkin.

Bunday to'g'ri chiziq ordinata o'qi bilan kesishish nuqtasiga ekstrapolyatsiya qilinganda, $z = 0$ bo'lgan nuqtada kesilgan segment son jihatidan $\mu_1 h_{bb}$ ga teng bo'ladi; ordinata o'qi bilan kesishish nuqtasiga ekstrapolyatsiya qilinganda, $\frac{\partial z}{\partial t} \frac{1}{z} = 0$ bo'ladi, kesilgan segment h_{bb} ga teng bo'ladi (2-rasm).



3-rasm. Darajalar pasayishining logaritmik tezligi o'zgarishi.

Agar eksperiment natijalari asosida olingan bog'liqlik

$$\frac{\partial \ln z}{\partial t} = f(z)$$

chiziqli bo'lsa, bu shuni anglatadiki, darajalar pasayish jarayoni boshidan oxirigacha haqiqatan ham faqat o'sha xususiyatlarga bog'liq bo'lib, ular modelni qurishda muhim deb hisoblangan va μ_1 , h_{bb} doimiylari bilan tavsiflanadi. Bu, shuningdek, butun oqib ketish davrida kinetika parametrlari qiymatiga ta'sir qiluvchi oqib ketish sharoitlari sezilarli darajada o'zgarmaganligini ham ko'rsatadi.

Parametrlarni aniqlash uchun $\mu_1 h_{bb}$ va h_{bb} bog'liqlik

$$\frac{\partial z}{\partial t} \frac{1}{z} = f(z) \text{ grafik usulda olish mumkin, buning uchun darajalar vaqt bo'yicha}$$

o'zgarishini aks ettiruvchi depressiya egri chizig'ini differensiallash lozim.

Parametrlarni aniqlash uchun $\mu_1 h_{bb}$ va h_{bb} bog'liqlik

$$\frac{\partial z}{\partial t} \frac{1}{z} = f(z)$$

grafik usulda olish mumkin, buning uchun darajalar vaqt bo'yicha o'zgarishini aks ettiruvchi depressiya egri chizig'ini differensiallash lozim. Buning uchun $\frac{\partial z}{\partial t} \frac{1}{z}$ yoki $\frac{\partial \ln z}{\partial t}$ ning joriy qiymatlari o'rniga, vaqtning muayyan yakuniy oralig'i uchun o'rtacha tezlikni hisoblash talab qilinadi:

$$\frac{\partial z}{\partial t} \frac{1}{z} \text{ yoki } \frac{\partial \ln z}{\partial t}$$

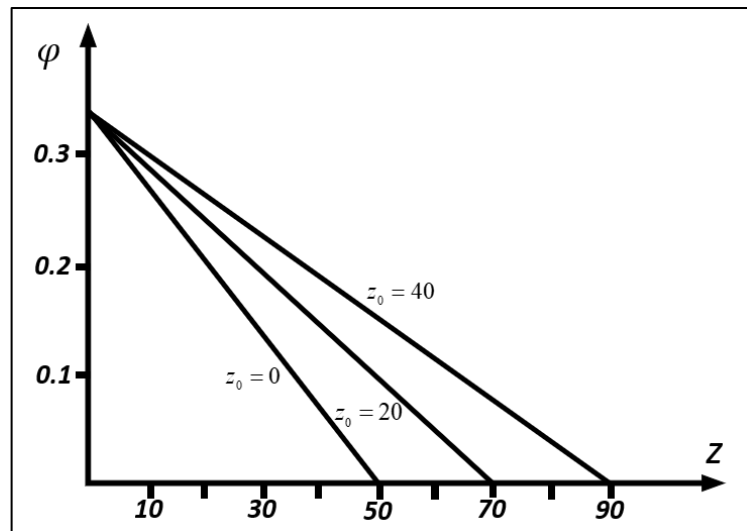
Cheksiz kichik miqdorlardan chekli qiymatlarga o'tish bir qator holatlarda haqiqatan mavjud bo'lgan bog'liqlikni sezilarli darajada buzishga olib keladi. Tadqiq qilinayotgan bog'liqlikning buzilishi vaqt oralig'i daraja holatini aniqlash orasidagi farq qanchalik katta bo'lsa, shunchalik kuchli bo'ladi.

(1.4) ifodasini z_t va $z_{t+\Delta t}$ o'rnini bosish orqali o'zgartirib, quyidagini olamiz:

$$\frac{z_{t+\Delta t}}{z_t} = \frac{1}{e^{-\mu_1 h_{bb} \Delta t} + \frac{z}{h_{bb}} (1 - e^{-\mu_1 h_{bb} \Delta t})} \text{ yoki } \varphi = 1 - \frac{z_t}{z_{t+\Delta t}} = (1 - e^{-\mu_1 h_{bb} \Delta t}) \cdot (1 + \frac{z}{h_{bb}})$$

Shunday qilib, Δt qiymatini bilgan holda, $\mu_1 h_{bb}$ va h_{bb} parametrlarini aniqlash mumkin. $\mu_1 h_{bb}$ va h_{bb} parametrlarini aniqlash usuli o'lchovlar orasidagi vaqt oralig'i qiymatiga hech qanday cheklov qo'ymaydi, faqatgina u butun o'lchov davri davomida bir xil bo'lishi talab etiladi. Agar Δt doimiy bo'lsa, u holda tenglama chiziqli bo'ladi. Shunday qilib, eksperimental ma'lumotlarni φ ning z ga bog'liqligi shaklida tasvirlashda, absissalar o'qida ajratilgan kesma h_{bb} ga teng bo'ladi, ordinatalar o'qida esa kesma $(1 - e^{-\mu_1 h_{bb} \Delta t})$ (3-rasm).

$\mu_1 h_{bb}$, h_{bb} , z_0 parametrlarini eksperimental ma'lumotlar asosida aniqlash misollari 3-rasmda keltirilgan. Bug'lanish va infiltratsion oziqlanish ta'sirini istisno qilish uchun hisob-kitoblar qishning beqaror davrlarida amalga oshirildi.



4 - rasm. $\varphi = \frac{z_t + \Delta t - z_t}{z_t + \Delta t}$ ning z ga bog'liqligi. Depressiya egri chizig'ining chiziqlashtirilishi, $\Delta t = 10$ sutka, $z_0 = 40$ sm bo'lganda, $\varphi = 0.34$.

Xuddi shu h_{bb} qiymatida qurigan qatlamning quvvatini oshirish oqim sharoitlarini optimallashtirish orqali mumkin, chunki ular quritish to'liqlik koeffitsienti qiymatiga ta'sir qiladi. Quritish to'liqlik koeffitsienti qiymati yer osti suvlari oqim sharoitlarining optimal sharoitlardan qanchalik uzoqligini baholash uchun eng to'g'ri mezon hisoblanadi.

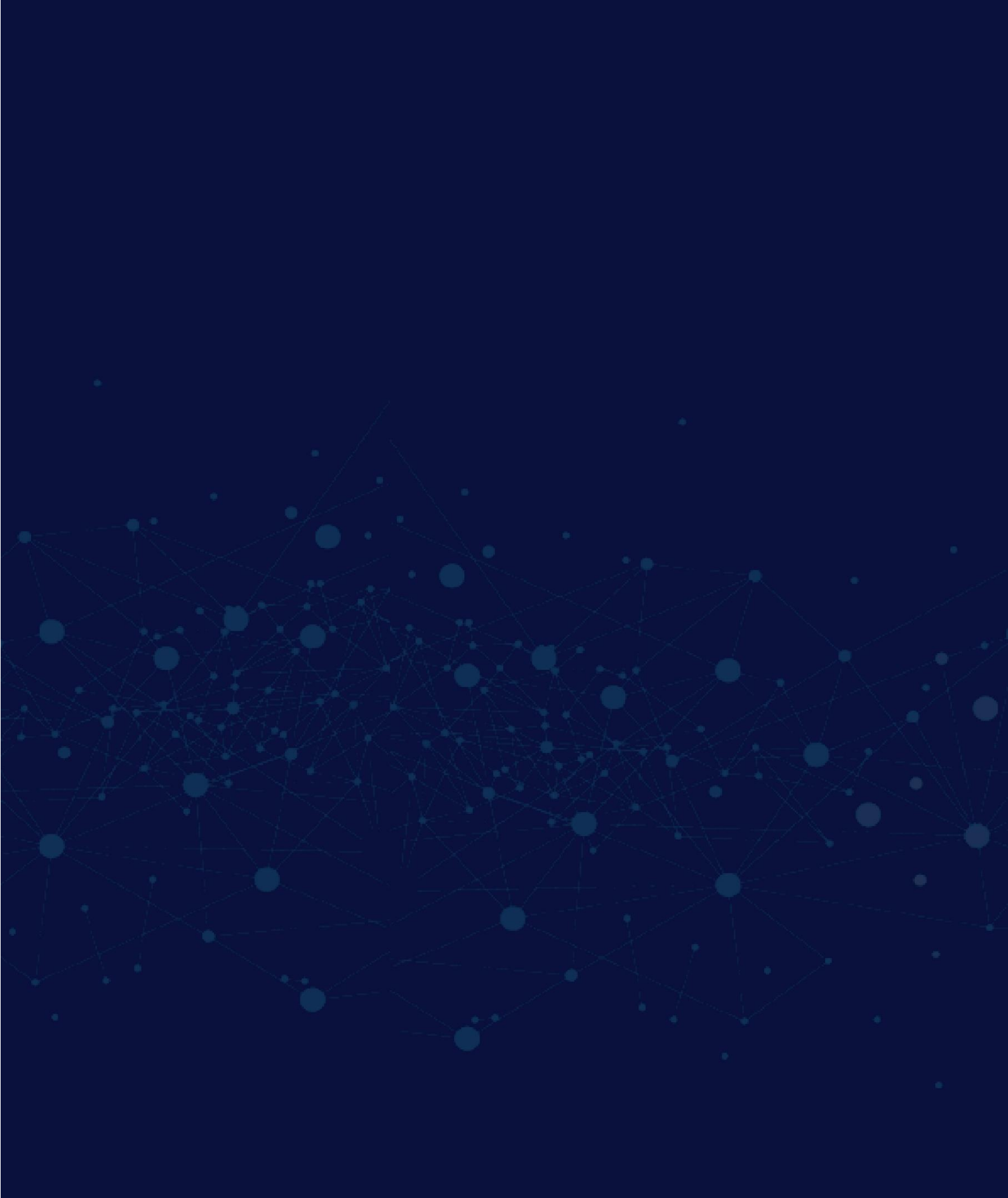
Xulosa

Hisob-kitob va eksperiment natijalarining muvofiqligi ushbu modelni amaliy qo'llash uchun barcha asoslarni beradi. Taklif qilingan model tuproq suvlari darajasining o'zgarishi haqida ishonchli ma'lumot olish, agrolandshaftlarning meliorativ chora-tadbirlar intensivligini rejalashtirish, qishloq xo'jalik drenaj hisob-kitoblarini optimallashtirish hamda qishloq xo'jalik yerlarining suv rejimini boshqarish imkonini beradi.

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An abstract graphic featuring a complex network of interconnected nodes and lines, resembling a molecular structure or a digital network, set against a dark blue background. The nodes are represented by circles of varying sizes, and the lines are thin, light blue, creating a web-like pattern that fills the upper two-thirds of the page.

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